

ABSTRACTS

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0003

Reconstructive Approaches with Alloplastic-Autogenous Tissues in the Frontal Bone Defects in patients with brain trauma

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Objectives: The search for the ideal bone-graft or alloplastic material substitutes of the frontal bone defects have been the focus of many research and clinical studies. Autografts and alloplastics are various material that combines osseointegration with maintenance of implant volume and excellent durability.

Method: The author presented his experience in 7 patients ranging in age from 21 to 51 years (mean age 35.4 years) who underwent secondary frontal and frontoorbital cranial reconstruction of large to medium contour defects utilizing various (autogenous and alloplastic) materials. Follow-up ranges from 12 to 48 months (mean 30 months). Indications for secondary surgery included residual bony contour defects of the frontal bone, fronto-orbital areas, and fronto-temporal area.

Results: There was not seen the infection, seroma, bulging and extrusions in used materials. And, also no required revision for underfilling and another for overfilling. Permanent contour improvement was obtained with a smooth skin surface in patients.

Conclusions: Currently, surgeons have still many options in frontal bone defects reconstruction. Many autogenous and alloplastic materials have been found and used in reconstructions of these defects. Most important factor is to understand and decide to which one is the most suitable in which patient. Perfect technological devices (Three Dimension Computed Tomography assisted with computers), and measurement of sizes of implant of graft could be very helpful to surgeon in pre-operation. Side effects, advantages, and disadvantages of each material have been also extensively discussed within text.

0004

Surviving the Future: Enhance Communication and Cognitive Outcomes with Affordable Software Treasures

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Objectives: This seminar presents a model of intervention which is based on solid research principles that uses affordable software programs and online resources to enhance the effectiveness of treatment of children and adults with cognitive-communication disorders. Interactive multi-sensory software treasures will be shown that can be used to improve communication, cognition and literacy. The objective is to speed up the learning curve to help practitioners by demonstrating software and presenting a strategy for integrating technology into daily routines to improve outcomes, enhance revenue, and make work more enjoyable. This presentation is ideal for seasoned professionals as well as students.

Method: This presentation, will:

- Review the many benefits of the use of technology and the types of students, patients and clients who can be helped.
- Present a variety of affordable and effective software tools and online sites which can be used to improve reading and writing.
- Review the use of a few interactive multi-sensory software programs to improve talking and auditory comprehension.
- Show several very affordable online programs and other resources to stimulate cognition.
- Suggest a framework for getting started or expanding your programs using technology in the schools, in hospitals, in private practice and when developing home practice programs.

Results: Many physicians, SLPs, special educators, graduate professors and families are now convinced

that the use of technology to enhance treatment is the way to go, but do not have the time, energy or resources to begin. This presentation will streamline the learning process and provide resources so that you can focus your time on the software, websites and other tools which are most appropriate for your situation.

Conclusions: Recent research and outcome studies are becoming more prevalent and continue to document the impact of mainstream and specialized assistive technology both to compensate for and to improve communication and cognitive skills in the fields of education and rehabilitation. With the use of the strategies and affordable software treasures presented in this seminar, clinicians become empowered to revolutionize treatment delivery to people of all ages with a wide range of communication and cognitive challenges.

0005

Prehospital endotracheal intubation in patients with severe traumatic brain injury: guidelines versus reality

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Objectives: Prehospital respiratory management of patients with traumatic brain injury (TBI) is well defined in national and international trauma guidelines, but paramedics and Emergency Medical Service (EMS) teams seem to differently adhere to these recommendations. In the present study we investigated the degree of adherence to intubation guidelines in severe TBI patients and hypothesized that guideline adherence varies when medical skills are involved that rely on training and expertise, such as endotracheal intubation.

Method: The medical records of patients who were referred to the emergency room of a level 1 trauma centre in Amsterdam, with a Glasgow Coma Scale (GCS) ≤ 8 with CT-confirmed TBI and aged 16 years and older were retrospectively evaluated (n = 127). Records were analyzed for demographic parameters, prehospital treatment modalities, the involvement of an EMS and respiratory and metabolic parameters upon arrival at the emergency department. Data were analyzed by parametric and

non-parametric testing, and $P < 0.05$ was considered as statistically significant.

Results: Patients with severe TBI were mostly male and aged 45 ± 21 years with a median ISS of 26 (66). Intubation guidelines recommended intubation of all patients with a GCS ≤ 8 , but adherence to guidelines only occurred in 56% of all severe TBI cases. A subgroup analysis in patients with complete pre-hospital records showed that in 21 out of 106 cases an EMS was not called for while the GCS estimated eight or lower. Especially those TBI patients treated by paramedics tended to receive suboptimal ventilation and showed significant higher levels of stress markers like glucose and lactate. Observed mortality rates were however comparable with estimated outcome predictors like TARN and CRASH.

Conclusions: International guidelines for prehospital treatment of patients with severe TBI recommend immediate intubation, thereby improving patient outcome. Here we show low adherence to intubation guidelines in severely injured TBI patients located in an urban area of the Netherlands. Although low compliance was sometimes caused by the unavailability of specialized care, an Emergency Medical Service (EMS) team was not always called for in cases where intubation was recommended, thereby leading to suboptimal prehospital care. The discrepancy between guidelines and reality warrants for re-evaluation of intubation guidelines for severe TBI patients in the prehospital phase.

0006

Prehospital endotracheal intubation does not associate with outcome in patients with severe traumatic brain injury

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Objectives: The prognosis of patients with severe traumatic brain injury (TBI) who have the lowest Glasgow Coma Scores (GCS) relies on suitable support of respiratory function. Adequate prehospital

respiratory management includes e.g. endotracheal intubation and normoventilation, and is strongly associated with improved outcome in these patients. We recently found that not all patients with a $GCS \leq 8$ are intubated, despite the recommendations of international guidelines. Here we investigated whether endotracheal intubation is an independent predictor of outcome in TBI patients in addition to classical prognostic parameters like age, pupil reflex, GCS value, CT scan score at admission and the incidence of hypotension in the prehospital period.

Method: The medical files of 340 TBI patients with a $GCS \leq 8$ who were admitted to the emergency room of two level 1 trauma centers (Amsterdam and Nijmegen, the Netherlands) were analyzed in a retrospective fashion. Patients aged 44 ± 21 years and were typically male (70%). The median Injury Severity Score estimated 29 and 70% of all patients were intubated in the prehospital phase. Actual and predicted (CRASH score) mortality approximated 43% and 50%, respectively. Of all survivors with a reported Extended Glasgow Outcome Score (GOSE; $n=149$), only 38 patients made a good recovery after trauma.

Results: Regression analysis revealed that mortality was strongly associated with increased age, the prehospital incidence of hypotension and a disturbed pupil reflex (all $P < 0.001$), but not with hypoxia, the GCS value, the CT score or the presence of a tube. Moreover, post-traumatic development of disabilities in survivors was significantly associated with age, a disturbed pupil reflex at the trauma scene and the severity of brain lesions as detected by CT analysis in the first hour after hospital admission.

Conclusions: Neither intubation nor hypoxia is an independent outcome predictor in our severe brain injury population. Our data show that pupil reflex, age and the incidence of hypotension are predictors of mortality in TBI patients with the lowest GCS values, whereas worse CT classification is associated with an unfavorable outcome in TBI survivors. These results should be placed into the light of the Netherlands, which is a wealthy nation and comprises a high density of population with a secure infrastructure for prehospital care of TBI victims. Our results warrant for a prospective investigation of the role of intubation in the outcome of TBI patients.

0007

Effect of Frequency of Multimodal Coma Stimulation on the Consciousness Levels of Traumatic Brain Injury Comatose Patients

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Objectives: Traumatic Brain Injury which is the leading cause of Morbidity, Mortality and Socio-economic losses results in altered states of consciousness which creates a condition of Sensory deprivation. Multimodal Coma Stimulation can be used to offset such deprivation and to support spontaneous recovery, prevent complications and to improve awareness.

Objective is to evaluate the effectiveness of Multimodal Coma Stimulation on the Consciousness levels of TBI Comatose patients and to evaluate the effect of its relative frequency i.e. administering twice a day (50 min each session) or five times a day (20 min each session).

Method: Hemodynamically stable TBI patients ($GCS < 8$) with duration of coma between 4–12 days and were randomly divided into 3 groups.

Group A- Multimodal Coma Stimulation-5 times/day, 20 mins each session

Group B- Stimulation- 2 times/ day, 50 mins each session

Group C- Conventional Physiotherapy

Coma stimulation was given using Coma kit made from locally available materials (vision, auditory, olfactory, gustatory, proprioceptive) with personal salience to each subject.

Pre-test measures were done using GCS & Western Neuro Sensory Stimulation Profile(WNSSP) and then again measures were taken after 2 weeks of therapy.

Results: Significant difference ($P < 0.01$) for GCS and WNSSP between Group A & C, Group B & C i.e. Multimodal Coma Stimulation is better than Control group.

Significant difference ($P < 0.01$) for WNSSP between Group A & B and a non-significant difference ($P < 0.01$) for GCS between Group A & B.

Conclusions: Multimodal Coma Stimulation is effective in improving the Consciousness levels of TBI Comatose patients as compared to control group.

Short duration sessions with high frequency are better than long duration, low frequency sessions.

0008

ICF Core Sets Development for TBI: The Results From “Italian Network”

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Objectives: The ICF classification contains more than 1400 categories that can serve as a reference but is not applicable in clinical practice and tools such as ICF Core Sets are needed to make ICF useful for clinical medicine.

To date, ICF Core Sets have been developed for the acute hospital and early post acute rehabilitation setting. However ICF Core Sets for TBI are not available.

The “Italian Network” contributed to the International project “Development of the ICF Core Sets for TBI.

The objective of the project is to describe functioning and health of patients with TBI using standardized questionnaires to assess the subjective appraisal of health and well being.

Method: The study network involved 23 main Italian Neurorehabilitation Hospitals coordinated by Fondazione Maugeri Pavia. This International research is a collaboration among Guttmann Institute, ICF Research Branch of the WHO Collaboration Centre of the family of the International Classification (DIMDI) Germany at Ludwig Maximilian University of Munich (Germany), the World Federation of Neurorehabilitation (WFNR), the International Society of Physical Medicine and Rehabilitation (ISPRM), the European Society of Physical Medicine and Rehabilitation (ESPRM) The International Brain Injury Association (IBIA) and the CAS (Classification, Assessment and Surveys). The study is conducted as a cross-sectional empirical study that involves data collection at only one time period.

In Italy we collect data from TBI patients with following inclusion criteria:

- TBI diagnosis according to the criteria of TBI Model system
- Age at least 18 years old

The protocol contains two main parts: the so called “Extended ICF check list for TBI”. to classify the most important ICF categories in clinical practise and The WHO QoL questionnaire, the CHART, and the SCQ. to asses the patients point of view.

The second part of the Protocol studies the caregivers’ point of view through standardized focus groups where defined questions and issues are considered.

Results: The patients will be distributed in subgroups according to the classification of severity of illness following the criteria of LCF and the time

from injury. We will present the main sociodemographic data and the most representative ICF categories in the Italian sample of 161 TBI patients. The preliminary sociodemographic results of the caregivers’ focus groups will be presented.

Conclusions: The Italian network can contribute to define prevalence of problem in functioning in TBI patients and to assess the caregivers’ issues according to ICF Classification.

With our data unified with other international data all the categories that explain most of the variance of external standards can be identified.

0009

Attention Deficit Hyperactivity Disorder, Driving Automobiles, and Traumatic Brain Injuries: Etiology and Treatment of Neurocognitive Deficits Following TBI

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Objectives: To examine the connection between pre-existing ADHD, impairments in driving, secondary to ADHD, and subsequent risk of TBI. Following TBI individuals are at risk for worsening of ADHD or developing secondary ADHD (S-ADHD). A review of treatment of S-ADHD and other neurocognitive deficits will be presented.

Method: Extensive handout of referenced slides will be given.

Results: This is not a research study. It is hoped that clinicians will learn more about diagnosing and treating ADHD and S-ADHD. Clinicians should also advise ADHD patients about the risks of driving motor vehicles and how to mitigate these risks.

Conclusions: Patients with ADHD, especially without treatment are at very increased risk for motor vehicle accidents and TBIs. S-ADHD from TBI can be effectively treated.

0010

A Reappraisal of the Kernohan and Woltman’s Article on Ipsilateral Pyramidal Signs: New Insight Denies Role of Herniation in Favor of Deafferentation of the Minor Hemisphere

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Objectives: To avoid “shadows of a baneful experience,” i.e. the “erroneous lateralization of a tumor,” Kernohan and Woltman investigated the role of a notch seen in the right cerebral peduncle of a patient with spasticity and Babinski sign on the left (the same side as the tumor found post mortem). To find whether “this occurred with sufficient frequency to be worthy of note,” the authors undertook a two track retrospective analysis of such cases found in The Mayo Clinic.

Method: The distribution of ipsilateral findings among Kernohan and Woltman’s 35 supratentorial cases reveal that the midbrain notching was asymptomatic in 18 and was associated with pyramidal signs in 17 cases. I present the clinical, electrophysiological and MRI findings of 3 cases of traumatic brain damage, with paralysis ipsilateral to the major hemisphere and no evidence of Kernohan notch in the midbrain. As in symptomatic cases described by Kernohan and Woltman, the occurrences of pyramidal signs ipsilateral to an expanding lesion in my cases were related to the laterality of the lesions they suffered (depending on their handedness).

Results: This binomial distribution of Kernohan’s cases clearly shows that occurrence of pyramidal signs ipsilateral to the lesion was related to a physiological event (interhemispheric diaschisis) rather than the presence of a notch resulting from herniation of the brain. According to insights from one-way callosal traffic circuitry underpinning the lateralities of sensory and motor control, the mechanism behind the malfunctioning of the right (minor) hemisphere in cases with pyramidal signs ipsilateral to the major is the disconnection (deafferentation) of the latter from the excitatory commands arising from the command center on the opposite side; i.e. von Monakow’s diaschisis. Conversely, the 18 asymptomatic cases of Kernohan and Woltman were those in whom it was the minor hemisphere that harbored the lesion. Thus, lesions in the major hemisphere are associated with hyper-reflexia and Babinski sign ipsilateral to the hemisphere housing the lesion due to transcallosal diaschisis disabling the minor hemisphere (which works at the behest of the major hemisphere). Clinical, transcranial magnetic stimulation and other time resolved data from my patients will be reviewed indicating that the minor hemisphere implements the commands arising from the major hemisphere for movements planned for the non-dominant side of the body.

Conclusions: These observations points to the facilitatory nature of the commands issued by the major hemisphere where movements of both sides are planned and executed. The commands for movements occurring on the nondominant side are then

transferred transcallosally to the minor hemisphere for implementation. It is the withdrawal of these excitatory commands which results in the temporary paralysis of the minor hemisphere and appearance of signs ipsilateral to the major hemisphere housing the lesion.

0011

Neuro-Integrative Functional Rehabilitation and Habilitation (neuro-ifrah®) Approach in the Treatment and Management of Adults with Hemiplegia from a Stroke or Brain Injury.

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Objectives: This article documents the history of the Neuro-Integrative Functional Rehabilitation and Habilitation (Neuro-IFRAH®) Approach in the United States and Internationally. The author used a historical methodology to collect primary and secondary sources of historical data; critically analyze them for genuiness, and present historical information in the most accurate and fairest possible treatment. This article highlights the Neuro-IFRAH® Approach’s formation and development to its present state in the United States and Internationally. Exploration of the various currently available literatures on Neuro-IFRAH® is also presented to show how this treatment approach is known in the rehabilitation community. It discusses the how the Neuro-IFRAH® Approach impacts the current and future practice of occupational therapy and other rehabilitation sciences.

Method: The author used a historical methodology to collect primary and secondary sources of historical data; critically analyze them for genuiness, and present historical information in the most accurate and fairest possible treatment.

Results: Discussion

The Neuro-IFRAH® Approach to adults with hemiplegia from a stroke or brain injury is currently used in rehabilitation in the United States and Internationally. However, due to its recent entry in the rehabilitation field, such as occupational therapy, many therapists are only beginning to be informed about it. Neuro-IFRAH®’s evolution toward the mainstream rehabilitation arena is already realized in many cities and facilities as evidenced by including

the Neuro-IFRAH[®] name to market their products or services as seen in their brochures or marketing tools. Now is the time for occupational therapists to consider the Neuro-IFRAH[®] Approach as a treatment option when handling adult Hemiplegia from a stroke or brain injury - as this approach is already in use and continuing to become a popular therapists' treatment for this population group. Despite the limited literature about this approach because of its recent conception, Neuro-IFRAH[®] is no longer an approach that can be ignored by occupational therapists and other rehabilitation professionals as it is currently being used in the rehabilitation arena and continues to have a growing number of practitioners that is following this approach.

Conclusions: Conclusion

Occupational therapy, as a holistic approach, often strives to be inclusive in treating an individual by preparing them to be as independent as possible to face the reality of everyday living. Neuro-IFRAH[®] complements this holistic view by going a step further when considering the various contexts of an activity that the individual engages in. This preparation ensures that the individual will succeed by giving them as much options in handling different life situations that will face them when they engage in the actual event in whatever condition of observation presents to them. The self-evident outcomes for this treatment is readily observed by the practitioners and their patients in real life situations when then the patient is able to make the necessary choices from the preparation in various contexts that they have done using the Neuro-IFRAH[®] Approach. The ability of people treated using the Neuro-IFRAH[®] Approach to take the needed immediate actions to actual real life scenarios - in different contexts, is what appeals to the therapists and patients using this approach. This self-evident appeal of the Neuro-IFRAH[®] Approach elevates what we do in occupational therapy to have adults with hemiplegia engage in occupational choices of activities in all contexts of life and in different conditions of observation possible for their occupations - without the narrow conditions seen in some evidenced based practice studies.

0012

Positive Outcome of a Simultaneous Subdural Hematoma & Subarachnoid Hemorrhage Resulting from a Headfirst Fall from a Height of 30 Feet.

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Objectives: Case Report: A 67 year old male was witnessed falling from a height of approximately 30 feet while he was on a tree. The patient's right side of the head took the brunt of the impact upon the dirt ground. There was a 10 minute period of loss of consciousness. A CT scan of the head confirmed an acute right hemispheric subdural hemorrhage with an adjacent subarachnoid hemorrhage involving the right frontal, temporal, and parietal lobes with a mild right-to-left midline shift.

Method: He underwent acute inpatient rehabilitation improving his strength, gait, transfers, balance, endurance, range of motion, and activities of daily living (ADL). Initially he was unable to ambulate secondary to profound generalized weakness. Initial pertinent physical exam findings included motor strength graded 3 out of 5 in all four extremities. He was fluent in speech and alert and orientated to time, person, and place. There was right sided ptosis.

Results: After this patient completed a two week rehabilitation regimen, he achieved ambulatory distances greater than 150 feet with supervision utilizing a rolling walker and achieved all of his prior ADLs independently.

Conclusions: Given the magnitude of the fall height and the fact that it was his head that had careened to the ground, this case represents a very fortunate traumatic brain injury outcome. Rehabilitation produced a very positive outcome for a patient who fell headfirst from such great a height whilst sustaining a simultaneous acute subdural hematoma and subarachnoid hemorrhage.

0013

Burden of the vegetative state in Italy

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Objectives: Vegetative state is characterized by chronic unconsciousness and severe disability.

The prevalence of the disease in Italy has not yet been evaluated and its burden for the public health is unknown.

Method: We identified patients who were discharged from all the Italian hospitals from year 2002 through 2006 by their anonymized SDO (Scheda di Dimissione Ospedaliera) reporting persistent vegetative state (code 780.03) as the primary or secondary discharge diagnosis, according to the 1997 and 2002 Italian versions of the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) Sixth Edition.

Results: During the 5-year observation period we identified a total of 7,438 SDO referring to patients who were discharged with persistent vegetative state, including 587 day-hospital discharges for a total of 5,344 patients. Most of the patients (88.3%) were hospitalized in the region where they were resident. Hospital discharges increased by 61% from 2002 (n=1,138) up to 2006 (n=1,836). Among the 5,344 patients, 1,480 (27.7%) died, 2,152 (40.3%) were discharged home, 369 (6.9%) to a nursing home, 1,173 (21.9%) to other hospital departments, and 170 (3.2%) had an unknown destination. Considering the most recent data referring to the 1,445 patients who were hospitalized in the year 2006, 1.5% were aged 0–4 years, 2.4% were aged 5–14 years, 23.6% were aged 15–44 years, 26.5% were aged 45–64 years, and 46.0% were aged > 65 years. In the 15–44 years age group there were more men (72.1%) than women as in the 65–74 age group (57.6%), while among subjects aged > 75 years there were more women (56.5%). The category of hospitalization was long-term care (code 60) in 14% of patients, neurorehabilitation (code 75) in 16%, general rehabilitation in 21% (code 56), and others in 49% of patients referring to the whole Italian population while the corresponding percentages for Lombardia region were 4%, 28%, 34%, and 34%. The estimate of the crude incidence rate, referring to the Lombardia region, was 5.3/100,000 and the crude prevalence was 6.1/100,000 (ISTAT, 2007). Data referring to the Italian population showed lower estimates.

Conclusions: The number of patients hospitalized in Italy with a diagnosis of vegetative state is increasing over time suggesting a possible real increase of incident cases as an improved clinical and coding accuracy. A study aimed to estimate the exact incidence and prevalence of the disease is warranted to evaluate the burden of vegetative state as a consequence of severe brain injuries and to plan an appropriate system and timing of medical care and more adequate health services.

0014

Reverse Culture - How Intensive Care Coordination Eases Military Transitions for Returning Soldiers with Traumatic Brain Injuries

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Objectives: Returning military with traumatic brain injury (TBI) often feel misunderstood, isolated, overwhelmed, confused and generally struggle with career and personal relationships. These symptoms are often associated with Reverse Culture Shock, the unanticipated adjustment difficulties experienced when returning to civilian life that can result in depression, suicidal ideation, substance abuse and marital issues. Intensive Care Coordination (case management) combined in partnership with the Department of Defense (DOD), Veterans Administration (VA), and Veterans Service Organizations supports the transition back to the civilian community for soldiers with TBI and decreases the likelihood of depression, financial problems and loss of connection to family and friends.

Method: Intensive Care Coordination for up to two years to help active duty soldiers and veterans achieve their optimum independence, productivity and successful re-integration into civilian life. Care Coordination includes intake assessment, development of care plan goals, and annual care plan review. The program supports the entire family unit and focuses on three transitional phases: Crisis Stabilization, Rehabilitation and Transition. Care Coordination components include: Analysis of DOD/VA/Civilian Benefits, legal assistance and emergency funding for basic needs, Education on TBI and PTSD. Emphasis on: access to community resources, therapies, recreational therapy, social skills classes and family education to satisfy individual needs.

Services are provided by AACBIS Certified Care Coordinators with military and case management backgrounds are overseen by a 13 person advisory board consisting of medical and military professionals. Minimum monthly phone contact/quarterly face to face meetings.

Results:

- Served 231 Active Duty Soldiers and Veterans (73% Active Duty vs 27% Veterans)
- Assisted clients and families obtain over \$1,250,000.00 in financial resources from community partners

- Provided over \$60,000.00 in financial assistance through the use of our Emergency Fund to prevent foreclosures, access therapies and obtain assistive technology devices
- Expanded Referral base of 90 community partners
- Created strong partnership with DOD, VA, and Community Service Organization including monthly DOD/VA briefings
- Development of Social Skills classes, spouses educational support group based upon customer feedback

(Since program inception 4/08)

Conclusions: Intensive Care Coordination reduces the negative effects of Reverse Culture Shock by linking returning military to community resources that enhance a positive transition back to civilian living. Care Coordination decreases suicidal ideation, homelessness, substance abuse, social isolation and dependence upon State/Federal Funding by getting soldiers and their families the resources specific to their needs in a timely manner. We have developed effective partnerships with military, veteran and community organizations that have eased hardships on military organizations/communities while increasing a sense of autonomy for soldiers and families. The intervention of Care Coordination has resulted in soldiers returning to their communities feeling stable, connected to family and friends and able to face the future with a sense of purpose, personal value and a hopeful future.

0015

Use of a Structured Training Protocol for Increasing Interrater Reliability of Occupational Therapists in the use of the [identity masked for review] Cognitive Screening Measure

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Objectives: The aim of this study was to assess the impact of a structured training protocol on the interrater reliability (IR) of occupational therapists (OTs) when administering the [identity masked for review] (M-CSM). The M-CSM is an observation/functional task based screening measure that assesses cognitive processes in individuals with acquired brain injury (ABI). There is a critical need for reliable, valid, and functional task based cognitive assessments. Currently, typical cognitive assessments used by OTs focus on contrived or unfamiliar tasks and do not assess for cognitive

processes manifested during functional task based performance. The development and testing of the M-CSM contributes to the need for cost-effective, efficient, and rigorous screening methods. Literature Review: Screens providing observational data may be subjective and unreliable. Rater training is a critical factor for ensuring adequate IR, especially with performance based cognitive screens. The following guidelines on rater training were used for the structured training protocol for the M-CSM a) provide strategies to promote accurate ratings, b) calibrate participants' point of reference, c) provide practice and feedback to increase rater accuracy, d) provide strategies to improve observational skills. Objectives: This presentation will aid the participant to identify a) necessary steps for the implementation of a structured training protocol for proper administration and scoring of the M-CSM, b) effects of a structured training protocol for OTs on their subsequent IR when administering the M-CSM, c) the need for instrument development and testing germane to cognitive rehabilitation, and d) the need for functional, efficient and cost-effective cognitive assessment.

Method: Study Question: Will a structured training protocol for the M-CSM improve the IR of OTs in administration of the M-CSM? An applied one-group pretest posttest was used with participants serving as their own control. Method: Participants were a convenience sample of 11 OTs. Training occurred over four one day per week one hour sessions. Training videotapes depicting a mock OT and mock patient were used. In Session 1 (pre-test session), demographic data were collected via a Pre-test Questionnaire. An overview of the M-CSM was provided and participants viewed videotape one (pretest score) using the M-CSM Observation Schedule. Sessions 2 and 3 (training sessions) provided a) an in-depth orientation to the M-CSM theoretical bases, b) specific strategies for calibrating the observation of cognitive behaviors, c) written practice and return demonstration of scoring, and d) group discussion. Videotape one was viewed again to obtain a pre-test adjusted score. Participant comments were recorded on a Written Recording Form to capture pertinent discussion not captured on the Post-test Questionnaire. In Session 4 (post-test session), participants viewed videotape two (post-test score) and completed the Post-test Questionnaire. Data were collected on a) Pre-test Questionnaire on demographics; M-CSM Observation Schedule for videotape one (pre-test score), b) M-CSM Observation Schedule for videotape one (pre-test adjusted scores), and c) M-CSM Observation Schedule of videotape two (post-test score); Post-test Questionnaire, and training session Written Recording Forms. Data were analyzed with

a) the intraclass correlation coefficient (ICC) 2-way mixed ANOVA to determine IR and b) frequency distribution of demographic data.

Results: Participants demonstrated an increase in interrater reliability (ICC) as follows: a) Pre-test ICC of Videotape One = .928, b) Pre-test Adjusted ICC of Videotape One = .950, and c) Post-test ICC of Videotape Two = .933.

Conclusions: Discussion: Although the results demonstrated a trend showing high ICCs and an increase in the ICC between the pre-test and post-test scores, the results may not be conclusive due to a small sample size of convenience. The literature on rater training discussed the following as critical to increasing interrater reliability: a) provide explicit instructions for coding procedures, b) provide strategies for learning conceptual definitions, c) provide increasing complexity of observation skills, d) provide practice and feedback, and e) test for return demonstration. These criteria were reflected in the participants' qualitative feedback on the Post-test Questionnaire, specifically a) rater subjectivity, b) administration and scoring criteria, and c) types of cues determining scoring levels. The intent of this research study was to achieve a) provision and implementation of a structured training protocol for clinicians in ABI rehabilitation, b) the identification of critical information addressing bias in test administration and scoring, c) a mechanism for standard administration of the M-CSM, and d) knowledge critical to engaging in research that may provide evidence for practice. Future Research: Future recommendations include a) use of a larger sample size to assess interrater reliability, b) training in a one-day workshop model, c) videotapes depicting actual individuals with ABI, and d) suggested improvements for future use of the structured training protocol such as clarification of scoring criteria/use of cueing and continued use of discussion.

0016

Neurofeedback Training to Ameliorate Deficits of Executive Functions and Quality of Life in Patients with Traumatic Brain Injury – An Indian Perspective:

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Objectives

Traumatic Brain Injury (TBI) constitutes a significant burden on health care resources. A vehicular

accident is reported every 3 minutes on Indian roads. Nearly 1.6 million people in India sustain head injuries annually. It is estimated that India would occupy third position for TBI by 2020. The most vulnerable group of population is the young adult. Attention, memory and executive functions deficits are the most frequent chronic cognitive disturbance in TBI. The recovery of TBI would be maximized by appropriate rehabilitation, which occurs within months of the damage.

Objective: The aim of the study was to examine Neurofeedback Training in executive functions and quality of life in patient with traumatic brain injury.

Method

Research design: Pre-Post Interventional study design was adopted.

Method: Forty patients, 20 in intervention and 20 in wait list control group, with the diagnosis of mild to moderate head injury in the age range of 18–50 years were assessed. After obtaining the informed consent neuropsychological assessment was carried out. The tools used were Rivermead Post Concussion Symptoms Questionnaire, Rivermead Head Injury Follow up Questionnaire, WHO - Quality of life Scale, and NIMHANS Neuropsychological Battery. Patients in the intervention groups were given 20 sessions of neurofeedback training, 5 sessions per week, 40 minutes. The training incorporated video feedback to enhance the frequency of alpha waves (8–12 Hz): and to decrease theta waves (4–7 Hz).

Results: Pre post comparison data was analyzed to evaluate the deficits and changes in the performance of the training using the standardized manual procedure. Patients with TBI in the intervention group showed significant improvements on the neuropsychological profile and quality of life as compared to wait list control group. The frequency of alpha was increased and theta was decreased.

Conclusions: The neurofeedback was found to be useful to integrate patients with TBI into the society at the highest level of functioning possible. The details of the findings will be presented with review and critical evaluation.

0017

Modifying postural adaptation following a CVA through prismatic shift of visuo-spatial egocenter

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Objectives: To demonstrate that Visual Midline Shift Syndrome (VMSS) following a cerebrovascular accident (CVA) can be corrected with yoked prisms.

Method: This randomized study describes how the use of yoked prisms affects visual midline and documents the influence of yoked prisms on improving postural orientation. Evaluation of VMSS and its correlation with postural lean during ambulation were studied in 30 post-CVA subjects and 30 controls. Yoked prisms were used to treat VMSS by correcting posture and balance.

Results: Over 50% of post-CVA subjects showed positive visual midline shift ($p < 0.001$; 95% confidence interval [CI], 0.66–0.93 for right CVAs and $p = 0.001$; 95% CI, 0.61–0.93 for left CVAs). A statistically significant proportion of those with a positive shift showed a decrease in shift utilizing yoked prisms ($p < 0.001$; 95% CI, 0.73–0.97 for right CVAs and $p = 0.001$; 95% CI, 0.07–0.39 for left CVAs). Additionally, over 50% of CVA subjects developed lean or drift away from hemiparesis and many subjects showed increased weight-bearing on the hemiparetic side with yoked prisms.

Conclusions: Yoked prisms are an effective means of treating VMSS in this population and may be useful in other neurological syndromes with visuo-spatial involvement.

0021

Advancing Patient Centered Care through a Model of Care Transformation

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Objectives: Over the past five months at Ontario Shores Centre for Mental Health Sciences, within the Neuropsychiatry Rehabilitation Program (NRS), a new 'Model of Care' has emerged in response to patients' self identified needs.

Method: The new 'Model of Care' focuses on the strengths of each individual on the interprofessional team so that an optimal level of care and programming is provided for each patient based on each patient's strengths and values. We have added

significant environmental enhancements that provide additional recovery based programming including a sensory room. Both dimensions (staffing mix, environmental enhancements) of the model of care add to the quality of the program by increasing options for patients undergoing treatment and for their families. The model also ensures that the right discipline provides the right service at the right time. **Results:** The measurable outcome of this transformation to the new model of care is a decrease in patient and staff incidents on the unit with respect to physical aggression and staff injury.

Conclusions: Enhancements have created a welcoming environment for patients and families that encourage partnership for care planning. Patients and their families are encouraged to collaborate with the NRS team to establish goals and participate in activities that best suit their recovery plan.

0022

Developing a community-based rehabilitation approach for Indigenous People with acquired brain injury living in remote Australia.

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Objectives: The health status of Indigenous Peoples around the world is invariably lower than that of the overall population. In Australia, poor health and disability indicators in Indigenous populations are well documented, including a reported higher rate of brain injury than in the non-indigenous population. However little is known about the experience of brain injury for these people, their families and communities. The 'Brain Injury Project' developed from a recorded underutilisation of formal services provided by the Acquired Brain Injury Outreach Service (ABIOS), a community-based rehabilitation service for adults who have an Acquired Brain Injury (ABI), and is an attempt to address this inequity.

Method: A three year study conducted in collaboration with two self-selected remote Aboriginal communities in Cape York, Queensland, Australia, explored issues and interventions around brain injury through Participatory Action Research (PAR). This chosen methodology was used to determine how brain injury and the resultant disability are perceived by Aboriginal people in the two communities. Consultation with community members, including people with ABI, their families and service providers occurred to determine how

each community wanted to address the issue of brain injury.

Results: The need for education to raise awareness about brain injury, both prevention of injuries and supporting people with brain injury, was highlighted in both communities, and addressed through a variety of means. Community engagement and capacity building activities, including employment of a local Indigenous worker in each community, were critical in developing a working partnership between the two communities and ABIOS rehabilitation co-ordinators.

This paper will examine the critical elements of the PAR process that contributed to community engagement, from the initial self selection process to the ongoing consultation with the community, which have led to the development of a community-based rehabilitation model. The role of the local worker, the challenges of this role, and the importance of this position in terms of successful community engagement will be examined. Through ongoing consultation, the need emerged for a sustainable model that increases community knowledge and capacity about brain injury. This model would improve outcomes for people with ABI and their families, and increase accessibility to resources within and outside of the community. The needs, strengths and resources of each community need to inform this model.

Conclusions: A model for ongoing community-based rehabilitation for people with brain injury and their families and communities has been developed as an outcome of the 'Brain Injury Project', and a partnership developed with the Apunipima Cape York Health Council, the lead agency in community controlled health in this area. This model, which will have applicability in other countries, focuses on developing strengths within each community, building capacity, and drawing on the abilities and expertise of stakeholders within a community.

0023

Blast Brain Injury: a combat zone-like mouse model

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Objectives: Improvised explosive devices (IEDs) are one of the main causes for casualties among civilians and military personnel in the present war against terror. Very few studies are describing the neurological and cognitive consequences of blast injury. Most of these studies either describe humans studied in non-controlled conditions, or elegant animal models that do not resemble real-life situations, and, although some of them perform some behavioral tests, they do not extensively assess the neurocognitive outcome of blast injury and correlate it with molecular and cellular deficits. Primary blast injuries are caused by barotraumas (either over pressurization or under pressurization relative to atmospheric pressure). Body armor does not protect against these barotraumas, and from both clinical and research points of view, it is clear that once the survivor overcomes the physical consequences (to chest/abdomen/limbs/ears) of the blast injury, one of the major problems that emerges, is the cognitive, affective and behavioral changes induced by the blast exposure.

Method: We recently developed a blast injury model for mice that resembles, as much as possible, a realistic combat blast exposure, where the outcome may vary from severe to mild brain injury, but doing it in a controlled manner, in order to avoid confounders such as physical injury and its consequences.

Results: Although no neurological or structural (as seen on MRI) deficits were found following the blast exposure, mice tested 30 or 60 days post blast exposure for the performance in object recognition test, y-maze, elevate plus maze and dry maze, exhibited long-term cognitive and behavioral deficits.

Conclusions: Cellular and biochemical studies are underway in order to further correlate the findings of the blast injury induced cognitive and behavioral changes with possible underlying mechanisms.

0024

Challenges to the field of neurolaw in the 21st century

Michael Kaplen

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Objectives: Current legal controversies in the area of neurolaw

PET scans and other imaging technology, challenges to its admission and its validity as evidence

New studies on the post concussion syndrome and the controversy as to whether mild TBI can have permanent consequences

The importance on differences between vegetative state and minimally conscious state for attorneys in proving pain and suffering

The use of fMRI as a lie detector test

Health insurance issues.

Recent developments in sports litigation for allowing student athletes to prematurely return to play.

Method: Power point presentation including references to court cases in both federal and state courts throughout the United States along with medical references.

Results: not applicable.

Conclusions: Current law and future course of legal developments.

0026

Traumatic Brain Injury Patterns Induced by Control Cortical Impact Are Impactor Shape and Craniotomy Configuration Dependent: A Computational Study

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Objectives: Controlled cortical impact (CCI) rodent model has been well established in the study of traumatic brain injury (TBI)-related vascular, cellular and molecular responses and the evaluation of potential therapies. The experimental parameters, such as the impact depth, velocity, impactor diameter, impactor shape, and craniotomy pattern, used in different laboratories varied significantly. It has been shown that the impact depth and impactor diameter significantly correlated with injury severity while the effect of impact velocity remains controversial. However, the effects of the impactor shape and craniotomy pattern have not been systematically investigated. The objective of this study is to numerically analyze these effects using a previously validated finite element (FE) rat brain model as a first step towards better understanding of TBI injury mechanism.

Method: A detailed three-dimensional computational rat brain FE model was used to simulate four CCI scenarios (two impactor tips and two craniotomy patterns). All simulations involved a 6 mm diameter craniotomy centered at 3.5 mm posterior to Bregma

and 4.5 mm lateral to midline and an impact depth of 2 mm at a velocity of 4 m/s. For the flat impactor simulation, a beveled 5 mm diameter impactor tip was used to impact the dura mater while a 5 mm diameter semi-spherical impactor was used to simulate a spherical impact. Additionally, a second 6 mm diameter craniotomy on the contralateral side was simulated to represent a bilateral craniotomy. The corresponding maximum principal strains (MPS), previously reported to be correlated with TBI, was used as the response variable to analyze FE model predicted TBI.

Results: High MPS under the impact site were observed for all simulated scenarios. The two simulated bilateral craniotomy cases directed high MPS to the contralateral site, but in a level that was less than those occurred ipsilaterally. This biomechanical finding matched well with experimentally observed contusion pattern. In the bilateral craniotomy definition, the flat shaped impactor induced more contralateral tissue stretch than that induced by the spherical shaped impactor. Additionally, a flat shaped impactor generated high MPS regions along the edge of the impactor into cortical tissues while tissues under the center portion of the flat impactor experienced lower level strains. On the other hand, the semi-spherical shaped impactor did not generate such edge effect.

Conclusions: Focally concentrated high intracranial tissue strains were found under the impact site in simulated unilateral craniotomy CCI while a bilateral craniotomy directed some high strain regions to the contralateral hemisphere as well. The spherical shaped impactor generated more focal tissue strain concentrations while high strain areas were found to be along the edge of the flat shaped impactor. Current analyses provide biomechanical perspectives and guidance for researchers using CCI TBI experiments to study neuropathology and therapeutic interventions.

0027

Educating Student Nurses to Brain Injury: Lessons Learned

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Objectives: Educating student nurses to the specialty of rehabilitation and brain injury in particular is becoming increasingly difficult as nursing programs change to meet the demands of the national nursing shortage, and at the same time acknowledge the

dearth of nursing instructors. Student nurses, as educational consumers, have high expectations of what their clinical rotations teach them and what patients will teach them. The following poster will identify goals of a nursing program, challenges of the nursing instructor in a brain injury environment, students' impressions about brain injury nursing and suggested strategies to improve the clinical nursing experience while caring for brain injured patients and families.

Method: Surveys/student feedback.

Results: Misperceptions changed throughout the clinical rotation.

Conclusions: Brain injury nursing environment can provide a positive clinical experience for students.

0029

Alcohol Related Brain Injury - An appropriate model of residential care. The Wicking Project.

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Objectives: For years, community service providers have been frustrated with the lack in availability of long-term specialised supported accommodation for older people with acquired brain injury (ABI), particularly older homeless people with alcohol-related brain injury (ARBI). Although the incidence of ARBI is far wider than being confined to the homeless population, the condition is frequently misdiagnosed and very often misunderstood by health professionals, service providers and care givers. Frequently these people present with an overlay of challenging behaviours that alienate them from most community-based residential care options. Very often they exhibit dementia-like symptoms and a complexity of care needs that require a high level of residential care and support. This paper will report on the outcomes of a research trial that investigated the effectiveness of a specialised model of residential care in improving the life quality and wellbeing of individuals with extremely challenging behaviours resulting from ARBI.

Method: The 18-month Wicking Trial commenced in March 2008 with 16 participants having been recruited and allocated by means of an expert advisory panel into two groups; Household Participant Group and Waitlist/control Participant Group. All participants underwent comprehensive qualitative and quantitative assessments (outcome measurement tools) pre- and post-trial and at 3 monthly intervals throughout the trial.

All participants had a history of severely affected behaviours associated with moderate to severe levels of ARBI and were selectively recruited for a history of unsuccessful tenancies arising from these behaviours. Four household participants received individualised specialised care support, recreation and behaviour management plan implementation. These initiatives were supported by a team of highly trained and skilled personnel including Specialist neuropsychological case management. The Waitlist/Control Participants continued to live their usual lifestyles without intervention beyond their participation in trial assessments.

Results: Pre-trial participant demographic data show the prevalence of co-existing mental illnesses 78%, aggression 100%, severe impairment of executive functions 93%, ongoing excessive drinking 100% of which 29% considered themselves as having a drinking problem.

Preliminary outcome data conservatively estimates a greater than 50% success in transitioning participants into mainstream specialist services and approximately 70% increase in the health and wellbeing of household participants in the trial. Alcohol consumption reduced by approximately 70%.

Conclusions: Essentially this successful outcome has led to greater understanding of what is achievable through a highly supportive model of residential care. It has also led to a shift in emphasis and direction from traditional models that aim to provide long-term residential care to a small number of individuals to a more innovative intensive transitional model that could potentially support many individuals for as long as is needed to make a successful step-down transition to mainstream specialist care.

0030

Decompressive Surgery For Acute Subdural Hematoma ; The Critical Craniotomy Size

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Objectives: Acute subdural hematoma continues to carry high mortality and poor surgical outcome. Decompressive surgery remains the surgical procedure of choice at most of the neuro-trauma centers.

The exact definition and description of decompressive surgery remains poorly defined.

Method: In the present study, the results of fronto-temporo-parietal craniotomy and hemicraniotomy were compared. Over a span of one year, 140 patients were included in the study and the surgical outcome was comparable.

Results: The post-operative CT scans were evaluated for the amount of bony removal and the extent of hematoma evacuation. Among FTP group, the bony removal ranged from 70 sq cm to 105 sq cm (mean of 86 sq cm), while hemicraniotomy group had bony removal up to 2 cm short of both transverse and superior sagittal sinus. The bony removal for hemicraniotomy ranged from 100 sq. cm. to 130 sq. cm.

Conclusions: We conclude that bony removal encompassing frontal, parietal and temporal bones making area of 86 sq. cm. is sufficient so as to gain maximal surgical benefits. The removal of temporal bony ridges is essential to provide adequate decompression for making the cisterns lax.

0031

On lay dural graft without suturing and creation of CSF fistula to prevention of CSF leak following decompressive craniectomy for penetrating brain injury in a war setting.

Prasanna Gunasena, Chaminda Jayaratne, Lasantha Bandara & Mahasen Thilakarantne

Faculty of Medicine University of Rajarata, North central province, Sri Lanka

Objectives: CSF leak through the surgical incision or through air sinuses is a significant problem association with penetrating brain injuries where arachnoid and pia mater is injured. It has been reported as high as 28% in the Korean War.

Method: A prospective study has been conducted during the recently ended civil war in Sri Lanka to evaluate the incidence of CSF leaks following decompressive craniectomies for penetrating brain injury. Patients arrived at a single station for a period of one and half years from January 2008 have been evaluated. Out of 995 patients 650 patients underwent decompressive craniectomies. All patients having had the definitive procedure underwent dural plasty using facia lata as an on lay graft between the brain and the dura without suturing to the dura. A CSF fistula has been created using a suction drain. The drain was removed around the 14th post operative day.

Results: Only 12 patients had CSF leak through the surgical wound no patients had CSF otorrhoea

or rhinorrhoea. All 12 patients required reoperation and managed successfully. 8 patients had confirmed intracranial sepsis. The incidence of CSF leak with our technique was 1.8%.

Conclusions: Creation of CSF fistula and on lay dural graft without suturing is a successful way of preventing CSF leak following decompressive craniectomies for penetrating brain injuries done in a war situation where the time and the resources are limited factors.

0032

Hypernatremia following a subarachnoid hemorrhage with clipping of the anterior communicating artery

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Objectives: Serum sodium concentration alterations are common following subarachnoid hemorrhage. Blood brain barrier disruption can cause increased sodium permeability. The anterior nuclei of hypothalamus receive its blood supply from the anterior cerebral artery and the anterior communicating artery. Damage to the anterior nuclei of the hypothalamus can result in diabetes insipidus or hypodipsic hypernatremia from decreased thirst. Finally, following subarachnoid hemorrhage, patients may exhibit cognitive dysfunction such as amnesia and increased somnolence resulting in a decreased fluid intake causing hypernatremia.

Method: This is a case study about a 59-year-old male admitted to our rehab facility that developed hypernatremia following a subarachnoid hemorrhage with clipping of the anterior communicating artery.

Results: Clinically, this patient had a flattened affect, anterograde amnesia, and intermittent periods of increased somnolence. He also exhibited dry mucous membranes, and dry skin. He was found to have a normal urine osmolality, normal urine sodium, normal cortisol level, normal T4, and normal TSH.

Conclusions: Initial treatment consisted of encouraging fluid intake, however he required increased encouragement to drink. The differential diagnosis included diabetes insipidus, dehydration, and hypodipsic hypernatremia secondary to defective hypothalamic osmoreceptors. Given his urine osmolality, urine sodium, cortisol level, and thyroid function tests were all normal, it was concluded that his hypernatremia was secondary to dehydration.

0033

Evaluation of risk of developing EDH associated with large craniectomy closure without hitching the dura.

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Teaching Hospital Anuradhapura, North Central Province, Sri Lanka

Objectives: Since Walter Dandy described tenting suture to the dura before craniotomy closure to prevent post operative development of EDH has been practiced over many decades. Many authors in the past have described the incidence of developing EDH has not been higher though the dura has not been hitched.

Method: A prospective study has been conducted during the recently concluded civil war in Sri Lanka to evaluate the incidence of developing EDH following decompressive craniectomy for Acute SDH and intracerebral hematomas due to penetrating brain injuries. 300 patients brought to a single unit over a period of two years have been evaluated. Patients who had craniectomies more than 8cm in its largest diameter were included in the study. All these patients had bulging brain at the time of closure. No patients had tenting suture to the dura to prevent post op extradural hematomas. All the patients had post operative CT scanning from 24 hours to 72 hours post operatively.

Results: Not a single patient developed an extradural hematoma. Two patients out of 300 developed intracerebral hematomas and underwent reoperation.

Conclusions: Closure of large craniectomy in the presence of brain bulging does not require Dural tenting sutures to prevent post operative Extradural hematomas.

0034

Use of 3Generation technology- A successful way to transfer CT images for interpretation to improve the efficiency of disaster management during war situation.

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Objectives: The image transfer systems in the hospital setting have gain world wide popularity since its introduction in 1994. In Sri Lanka image transfer system has not yet been introduced but 3G technology is widely used to transfer audiovisual data between mobile phones.

A study was conducted to assess the success of using the 3G technology to transfer CT images for interpretation and decision making during disaster.

Method: 9000 war casualties brought to teaching hospital Anuradhapura from 2008 to May 2009 have been included in the study. A disaster has been defined when more than 30 casualties were brought together to the hospital. 350 head injury patients assessed during disaster in the emergency department by the senior house officers had their CT images transferred to the consultant neurosurgeon using 3G mobile phones. The management was based on the transferred images. All the CTs were later reported by the consultant radiologist.

Two sets of data were compared to evaluate any deficiencies in data transferred using 3G technology.

Results: Transferring data of all 350 patients have been done successfully. In no occasion hard copy of CT had to be referred to change the decision taken using 3G images. There was no significant deference between two systems of CT evaluation to diagnose the lesion and to assess raised ICP. 3G system had the added advantage of communicating with the doctor and seeing the patient simultaneously. In 50% of the instances the consultant surgeon was outside the hospital premises and in 30% of instances he was in the theatre. Only 3 cents had to be paid in average for one video call.

Conclusions: Using 3G technology to transfer CT images is cheap and reliable method in neurodiagnosis during a disaster in a resource limited setting.

0035

Parents' Experiences Following Children's Moderate to Severe Traumatic Brain Injury

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Objectives: Moderate to severe TBI is the leading cause of a heterogeneous range of impairments in children. Changes in the child's functioning can strain their entire family's emotional, physical, social, and economic well-being. Little is

understood, however, about the common social factors that influence this progression because few qualitative investigations of the impact of children's TBI on family functioning have been conducted. The purpose of this descriptive phenomenological investigation was to depict the common experiences of a group of parents whose children were diagnosed with moderate to severe traumatic brain injury (TBI) within the prior five years.

Method: IRB approval was obtained and maintained. Maximum variation purposeful sampling techniques were used to select children with moderate to severe TBI. At least one of each child's parents was interviewed to learn about their experiences parenting a child post-TBI. Participants included 42 parents of 39 children from 13 of the 50 United States. They participated in two semi-structured interviews within the first five years after their child's injuries. First interviews were always in person and occurred within 4 to 36 months after injury ($M = 15.5$ months, $SD = 9.8$ months). Second interviews ($N = 33$ parents of 39 children) occurred from 12 to 15 months following their first interviews and were done in person or by phone. Second interviews allowed for validation of the proposed descriptive model and updating of parents' experiences. The parent model was revised based on participant feedback.

Results: Parents' experiences initially involved adjusting to their child's tenuous health condition and grieving the loss of the child they once knew. Parents with severely injured children were emotionally overwhelmed by their child's injuries and the unsupportive encounters they sometimes experienced following their children's injuries. They felt ill prepared to grasp the amount and type of information they were expected to understand and overwhelmed as they struggled to manage the functional changes in their children. The essence of parents' experiences were described as: 1) grateful to still have my child; 2) grieving for the child I knew; 3) running on nerves; and 4) grappling to get what your child and family need. Parents reported many social barriers as a consequence of others' insensitivities to their children's and families' plight.

Conclusions: More qualitative inquiry is needed to understand how the knowledge and attitudes of others, regarding TBI, influences social interactions with traumatically brain injured children and their parents, and ultimately how these interactions affect the family's health and well-being. Education is needed to help others understand and support families of children following TBI, in a caring and unbiased manner.

0036

The effective assessment of high level cognition based communication disorders in traumatic brain injury (TBI)

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Objectives: Traumatic brain injury (TBI) is a leading cause of death and disability with adolescents and young adults. Individuals who sustain mild-moderate TBI frequently encounter cognition based communication disorders. Deficits are often subtle and therefore difficult to detect, however these can seriously influence an individual's ability to achieve occupational, personal, and interpersonal goals. Feedback from rehabilitation facilities has indicated that high level cognition based communication disorders were not identified at The Alfred, an acute tertiary hospital.

Objectives: 1. To improve the identification of high level cognition-based communication deficits in patients in the acute setting who have a TBI.

2. To relate the findings of the cognition based communication deficits to the patients' brain injury and recovery patterns.

3. To provide evidence for the effective assessment of TBI in the acute setting, facilitating timely and appropriate referrals for further therapy and management, maximising function of patients post TBI.

Method: 101 adults aged 16–81 years (74% males, mean age 36.8) were recruited from the Trauma and Neurosurgery Units at The Alfred. Two tests to assess for cognitive dysfunction post TBI were administered; Cognistat by an Occupational Therapist (as per current practice) and the Cognitive Linguistic Quick Test (CLQT) by a Speech Pathologist. The two tests were completed within 48 hours of one another. The results for the domains of language, memory, executive functions, attention and visuospatial skills were then compared. A Wilcoxon's analysis was used to determine the significance of predictive variables.

Results: Agreement exists between the tests in the domains of executive functions ($p = 0.000$) and attention ($p = 0.0037$) (Weighted kappa). The CLQT was the more effective assessment at identifying language ($p = 0.0002$) and memory ($p = 0.07$) (McNemar Chi²) impairments. Difficulties emerged in the administration of visuospatial skills subtests to this clinical population. No clinical variables relating to patients brain injury or recovery pattern showed a

significant correlation in predicting language impairment (Wilcoxon's analysis).

Conclusions: The results of this research provide evidence for supporting the need for changes in the way patients with TBI are assessed. In view of the absence of predicting factors to identify high level cognitive based communication impairments, all patients admitted with TBI should be screened for language impairments by a Speech Pathologist. This would improve the detection of high level communication based cognitive deficits in the acute setting. Furthermore, the assessment of memory and visuospatial skills require further investigation to ensure adequate identification of impairments.

0037

A RCT With Multisensory Environmental Therapy After Pediatric Brain Injury

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Objectives: There are very few RCTs reporting the effectiveness of therapeutic interventions in children recovering from brain injury. Many investigators across the world have reported beneficial recreational and leisure use of a controlled multisensory environment (MSE) or Snoezelen but there have been little reported about the therapeutic effects.

Method: Over the last few years the number of MSE rooms has been increasing worldwide in many different facilities. Animal research has given us the basis of good evidence that the brain has the capacity for plasticity through physiological stimulation. Exposure to frequent and varied sensory stimulation will facilitate both dendritic growth and improve synaptic connectivity in those with damaged nervous systems. These studies indicate that animals reared in enriched environments demonstrate significantly greater learning skills than those reared in less stimulating or impoverished environments.

Results: This presentation will discuss some of the preliminary findings of a study funded by NIDRR to investigate the effects of MSE therapy on physiological, cognitive and behavioral changes in children recovering from severe brain injury. Subjects from 2–18 years of age recovering from severe brain injury will be studied in a prospective randomized controlled trial. The treatment group that receives up to twenty MSE treatment sessions will be compared to a control group that receives up to twenty playroom

sessions with both groups receiving a standard comprehensive neurorehabilitation program (OT, PT, Speech, Psychology) in an inpatient Pediatric Rehab Unit. The group of children randomized to the MSE room will be compared to the group of children receiving a playroom activity at baseline, pre and post treatment sessions. Data will be presented to report the physiological, cognitive and behavioral differences between the groups.

Conclusions: The MSE protocol administered will be discussed and cases presented. If shown to be effective MSE therapy may be an adjunct therapy to the traditional therapy programs and may be able to be also beneficial for other patient populations.

0038

Social inclusion of persons with moderate head injury: The points of view of adolescents with brain injury, their parents and professionals

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Objectives: This descriptive qualitative study explores the perceptions of adolescents, their parents and professionals as to the social inclusion of adolescents who have suffered a moderate traumatic brain injury (TBI).

Method: Semi-structured interviews were conducted with three adolescents who had suffered a moderate TBI and with their parents. In addition, a focus group was conducted with four professionals.

Results: The results show that the perceptions of adolescents, as well as their parents', affect different aspects of their life, such as the adolescent as a person, the family, friends, the environment, school and leisure activities. We indeed noted a great number of repercussions, which facilitate and sometimes limit the social inclusion of these adolescents. In general, the professionals shared the same perceptions, but added some ideas that did not come up in interviews with the adolescents and their parents.

Conclusions: The results of this study should enable health professionals to better understand the social inclusion experienced by these people. They should also provide professionals with guidelines on how to better support the social inclusion of adolescents with TBI and help families get through this difficult situation.

0040

Neurobehavioral Predictors of Aggression after Traumatic Brain Injury

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Objectives: Aggression, including physical violence, may be the most dangerous behavioral complication of traumatic brain injury. Remarkably little is known about clinical or neurobiological factors that predict this problem. Our goal was to test the hypothesis that specific pre-injury and injury-associated neuro-behavioral variables will predict the emergence of persistent post-TBI aggression.

Method: We reviewed three years of consecutive admissions to the inpatient adult brain injury service at Rancho Los Amigos National Rehabilitation Center, comprising psychosocial, clinical, and neuroimaging data on 138 patients.

Results: Persistent aggression was identified in 26% of patients who had at least six months of post-TBI follow-up. In a univariate analysis, post-TBI aggression was significantly correlated with younger age at TBI ($r = -.158$, $p = 0.64$) and premorbid alcohol abuse ($r = .316$; $p < .001$). Post-TBI aggression was also significantly associated with premorbid substance abuse ($\chi^2 = 19/94$; $p < .001$), premorbid depression ($\chi^2 = 5.69$; $p = .017$), premorbid aggression, ($\chi^2 = 24.97$; $p < .001$) and with seizures after TBI ($\chi^2 = 4.47$; $p = .035$). Hierarchical logistic regression revealed that seizures were the only significant predictor ($p = .044$). Adding the primary locus of cerebral injury to the model, left sided lesions ($p = 0.073$) and frontal lesions ($p = 0.104$) contributed to the prediction of post-TBI aggression.

Conclusions: Pre-morbid behavioral traits, lesion focus, and especially seizures appear to play a role in the likelihood of persistent post-TBI aggression. These results provide a new perspective with potential predictive power for understanding this important complication of TBI.

0041

Prediction of Later Emergence from Vegetative State Using the Behavioural Observation Component of the SMART Assessment

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Objectives: The management of disorders of consciousness such as vegetative state (VS) is a major clinical challenge. At the present there are no validated prognostic markers apart from age, aetiology and time spent in VS. It is hence, difficult to predict which of these patients will progress to greater degrees of consciousness. This study explores whether the behavioural component of the Sensory Modality Assessment and Rehabilitation Technique (SMART) can predict emergence from VS. It also tries to establish if there is a difference in the movement patterns of the patients that emerge from VS and those who do not emerge.

Method: In this quantitative, case-matched retrospective study, 14 participants were divided into two different groups (group 1: emerged from VS; group 2: remained VS). Four categories of behaviour (no movement, reflexive, spontaneous and purposeful movements) were compared using one-tail independent group t-tests.

Results: Results are currently being analysed but initial evaluation suggests that the patients that emerged from VS demonstrate a larger behaviour repertoire and more spontaneous behaviours than the participants that remained in VS.

Conclusions: Finding an accurate prognosis predictor is of major importance in the neurorehabilitation field as it will contribute to improve our understanding of this disorder of consciousness. Furthermore, it would help in the treatment and management of this patient population. Most importantly, would help in any major decisions about withdrawing or withholding treatment of these patients.

This research was conducted with the support from Brunel University and Neuro-disability Research Trust.

0042

Expanding Certification and Brain Injury Training Globally

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Objectives: The Academy for the Certification of Brain Injury Specialists (ACBIS) has been offering brain injury education and certification across the United States since 1996. Over the past two years, ACBIS has begun to develop relationships with organizations from other countries. A pilot program to promote education, training, and certification for healthcare providers who serve individuals with brain injury in Ireland was initiated. Two ACBIS board members Certified as Brain Injury Specialists Trainers (CBIST's) were invited by the Acquired Brain Injury Organization of Ireland to host an educational workshop for thirteen individuals who work in the field of acquired brain injury. Additional objectives of this pilot project included: the assessment of cultural differences that may impact the curriculum, text and testing; identification of content that may require adjustment because of the unique healthcare settings, laws and epidemiology of Ireland; Ongoing collaboration with an representative from the organization to develop and update unique data; finally, evaluate the ultimate value and interest for this certification abroad, specifically Ireland.

Method: This project required all participants to complete application requirements, as is currently required by American applicants. The Essential Brain Injury Guide was purchased as the reference text for each participant by their place of employment. The CBIST's traveled with all training curriculum needed for the course. Participant manuals and slide handouts were sent via a downloadable web link to the coordinator at the Acquired Brain Injury Organization-Ireland. A training room was secured along with computer and projector equipment needed for training. Tests were sent by ACBIS, administered approximately one week after the course was completed and returned to ACBIS upon completion. A proctor was agreed upon between ACBIS and the coordinator to assure the integrity of the testing.

Results: Upon completion of this training the CBIST's met with the group to review the curriculum and learn more about what would be needed to tailor it curriculum to be more culturally sensitive. As well changes specific to epidemiology, systems of care, and legal issues that are specific to Ireland would have to be made. Among the 13 who tested five individuals did not pass. Analysis was completed by ACBIS to ensure that failure of the exam was not a result of incorrect answers on questions related to US specific information. It was found that the removal of US specific questions did not result in increasing the passing rate. ACBIS policy does allow the test retake free of cost. Although the scores improved three individuals did not successfully pass the retake.

Conclusions: This experience suggests that ACBIS continue to develop international partners, develop culturally sensitive curriculums, and work toward promoting certification among all brain injury organizations.

0043

Predicting Long Term Care Needs for Insurance Management

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Objectives: For 35 years New Zealand has had a national no-fault injury compensation scheme which, in the case of brain and like injuries, provides ongoing, individualised, needs-based lifetime care and support funding. In this non-rationed system, scheme lifetime care liabilities for these clients now exceed \$8b with attendant care services accounting for 85% of the liabilities. Therefore understanding attendant care drivers is critical to actuarial modelling and scheme and case management.

The objective of this study was to examine the relationship between FIM, presence of challenging behaviours, demographic factors, brain and other injury factors and hours of attendant care to determine the potential for FIM based predictive modelling of care hours.

Method: Of the 2,066 clients age 16+ in receipt of attendant care (all AC clients), FIM scores, Overt Behaviour Scale (OBS) and various demographic factors (e.g., gender, age) were collected for 336 community living clients (FIM subgroup) for review against the average weekly hours of attendant care over a 12 month period.

Results: The FIM subgroup was comparable with all AC clients on key variables of injury profile, age, gender etc. FIM scores were negatively correlated with average hours of attendant care (-0.56), demonstrating a relationship whereby a higher FIM score was associated with fewer hours of attendant care.

To test the relative predictive power of injury type, socio demographic variables and FIM, three multiple regressions were performed. The level of significance was set at < .001. Without FIM score, the adjusted R² attained by all of the other predictors entered into a standard multiple regression was only 0.138; a significant but inadequate model. Injury type did attain significance (T = -3.438, p = .001). The FIM was added to a second standard multiple regression. Adjusted R² rose to 0.339; a useful level

of prediction. Only FIM attained significance ($T = -10.241$, $p < .001$).

To determine the power of other predictors, in the absence of FIM, variables were entered into a sequential multiple regression in two blocks, with FIM entered in the first block, followed by all the other predictors in the second. In this model, FIM alone attained adjusted R^2 of 0.315 and the remaining eight predictors only added another 0.043; a non-significant change. In the sequential multiple regression, no other predictor attained significance and all were automatically excluded because of co linearity with FIM.

Conclusions: This study suggests that FIM may be used in the statistical modelling of hours of attendant care, affording potential to better model long term care costs. It is proposed to develop and confirm the model with all adult attendant care users.

0045

Cytokine Expression In Post-Mortem Human Brain Tissue Following Acute Traumatic Brain Injury

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Objectives: Little is known about the molecular events following severe traumatic brain injury (TBI) in humans and to date there are no efficient therapies. The availability of human brain tissue from the Australian Neurotrauma Tissue and Fluid Bank is a unique opportunity to analyse the early inflammation following TBI.

Method: In this study, a total of 21 trauma brain samples were analysed. Age and sex matched samples were used as controls. To explore the cerebral inflammation within the brain tissue, we measured the level of expression of 9 major inflammatory cytokines at mRNA and protein levels by enzyme-linked immunosorbent assay, bioplex cytokine assay and real-time quantitative PCR. Axonal pathology was studied using immunohistochemistry against APP and Neurofilament-200kD proteins.

Results: All the pro-inflammatory mediators analysed (IL-6, IL-8, IFN- γ , TNF- α , IL-1b, GM-CSF, IL-2) showed a strong and significant ($p < 0.001$) increase in the brain samples of individuals who died more

than 6 hours following injury. In the brain samples of individuals who died within 17 minutes of injury, IL-6 ($p < 0.027$), IFN- γ ($p < 0.018$), TNF- α ($p < 0.03$) and GM-CSF ($p < 0.022$) concentrations were already found increased. However, the anti-inflammatory cytokines IL-4 and IL-10 levels remained unchanged. Similarly, quantitative-PCR showed that IL-6, IL-1b, IL-8 and TNF- α mRNA levels were increased ($p < 0.001$) more than 6 hours after injury, with TNF- α showing an increase within 17 minutes of the injury ($p < 0.014$). No statistical difference was observed between the damaged and the contralateral cortex. Finally, in all the cases with a survival time of 8 hours or longer, numerous damaged axons were detected, indicating that diffuse brain injury was present.

Conclusions: This study shows clearly for the first time in human brain tissue that i) the inflammatory response begins immediately after the traumatic impact; ii) diffuse secondary axonal injury may contribute to the extent of cellular and humoral neuroinflammation; and iii) cytokines/chemokines detected in the brain tissue are produced locally by intraparenchymal cells in the early stages of the inflammatory cascade and do not diffuse from the systemic circulation.

0046

The Twittered Brain: How Survivors are Using Social Networking as a Support System

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Objectives: Friends vanish, coworkers no longer call, and socializing grinds to a halt. The dissipation of one's social circle following a brain injury has been well documented through research. But now a new online phenomenon is helping the injured reclaim their relationships. The objective of this presentation is to illustrate the importance of social networking as a component of the rehabilitative process.

Method: By presenting findings from an extensive online survey, I will demonstrate the different methods survivors are using to re-establish and build social networks.

Results: Most survivors who utilize social networking claim extremely high rates of satisfaction in areas involving social role return and quality of relationships, as compared to those who do not social network.

Conclusions: Survivors are social networking sites like Facebook, Twitter, and MySpace to maintain and

build both social circles and support systems. However, due to the technical complexity of social networking, social networking is less likely to occur the greater the severity of injury.

0047

Yes, Wii can!

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Objectives: In Dutch Rehabilitation for children and youth with ABI October 2009 a project started: we want to discover and describe the possibilities of the Wii as a supplement on therapy. We will fit 17 games in a matrix linked to therapygoals in gross and fine motor functioning, cognition, perception, selfesteem and social participation. First half of 2010 an effectstudy will be performed.

Method: Inventory study during 10 months in 2 rehabcenters and 4 special schools. All therapists and teachers will be involved, as well as ABI-patients of all ages.

Effectstudy during 5 months, N = 50, age 12–25 years old.

Results: Aimed results: Instructionprogram for therapists in rehab for ABI gaming (f.e. Wii) implemented in rehab inventory of necessary adaption of controllers and software collaboration with international groups design for a larger study.

Conclusions: Gaming is gaining popularity in all ages, the rapidly ongoing development could offer a challenging enrichment for application in therapy, stimulating active leisure and social participation of children, youth (and adults) with ABI. This study wants to challenge, convince and support rehabtherapists to start gaming during work.

0048

The role of EphA4 during development and following injury in primate brain

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Objectives: Upregulation of developmental axon guidance molecules, such as the Eph receptor

tyrosine kinase family, have been shown to play a role in the inhibition of axonal regeneration following CNS injury. We have previously shown a role for EphA4 in mediating glial scar formation after spinal cord injury. EphA4 null mice showed substantially decreased astrocytic gliosis, concomitant with extensive axonal regeneration and recovery of function. Following this study, we have examined the EphA4 expression profile in a non-human primate visual cortex (the marmoset monkeys *Callithrix jacchus*) during development and after injury.

Method: In order to study EphA4 expression during brain development marmoset monkeys aged PD0, PD14, PD30 and adult were used. We also performed a unilateral focal lesions of V1 on neonatal (PD 14) and adult (>12 months) marmosets. Transcardially perfused with 0.1 M heparinized PBS, followed by 4% PFA after been overdosed with sufentanil citrate (0.05 mg/kg). To examine the change in EphA4 expression after injury, animals were anaesthetised and placed in a stereotaxic frame. A craniotomy was performed to expose the lateral occipital cortex back and the dura resected and a unilateral lesion of V1 on the left side was performed by microcautery. These animals were perfused 3 weeks or 9 months after lesion. with no lesions. Sagittal/coronal serial sections (40mm thick) obtain on cryostat. Adjacent sections were processed by standard immunohistochemical techniques. In long term lesions, retrograde tracing (Fast blue) was injected into the borders of the remaining V1.

Results: In PD0 brain, EphA4 is expressed on radial glia processes in V2 area, however, in this stage, it switches to neuronal expression in V1. At PD14 EphA4 is mainly express on neuronal cells and their dendrites and it is downregulated at PD30 and adult brains. Examination of EphA4 after cortical lesion showed that 3 weeks after injury in the visual cortex, it is strongly upregulated on reactive astrocytes around the lesioned area. Long term lesion to both, neonatal and adult marmoset, led to degeneration of the lateral geniculate nucleus (LGN) projecting neuronal cells to V1 and neuronal death around the lesion site together with creation of glial scar at the lesion site. In vitro experiments in cultured primate astrocytes show that activation of EphA receptors, in particular EphA4, mediate primate astrocyte proliferation and activation through Rho and MAPK pathways.

Conclusions: During these stages of development of the visual cortex, EphA4 switches expression from glia to neurons, suggesting a role in guidance of neurones to their target layers and later on for neuroconnection establishment. EphA4 become downregulated in the adult brain. After injury, EphA4 is upregulated on reactive astrocytes, which may

suggest that EphA4 may contribute to the glial scar formation after brain injury in the primate brain.

0049

Families caring for patients in a vegetative state

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Objectives: Vegetative state is a medical condition with a strong impact on psychological wellness of family involved in caring. This research investigates relationships, conflicts and family functioning during patient's vegetative state, care process at home and in clinic, symbolic role of patient, economic impact of the event on family, wellness caregivers.

Method: The sample was made up of 118 caregivers of patients in vegetative state cured in Regione Lombardia (North Italy). The study centred a semi-structured interview analysed using the software 'T-Lab' and 2 tests: Family Life Space and SF36 Questionnaire on State of health. The interview focused on areas such as: the extension and working of the family before the event, the caring process, economic and organizational help involved in the care, support received from the health service and the symbolic place the patient occupies in his/her vegetative state.

Results: Results show as family functioning and caregiver's wellness depends on patient's role, caregiver's gender, time passed by the event and place of care. Data show different psychological characteristics of caring vegetative state for mothers, wives, sons, fathers and husbands. Research noticed an extreme poverty and closure of family relations: the tragic situation of the patient takes place within a context of new and old family bonds and of different individual ways of dealing with this new reality. Moreover the research seems to show a strong isolation of some members of family from social activity and weak relations with extended family: the family is destined to close in on itself more and more and the boundaries between family and the outside world become stronger and more rigid. Few conflicts which are related with care themes and there is a strong desire of support, concerning information, organizational and social level. Research shows a strong impact on work activity on at least one of family members.

Conclusions: In the light of this evidence it seems of utmost importance to undertake a rapid evaluation

and psychological support for families of patients in VS, especially during the stages in which the patient is moved from rehabilitation to long-term care, whether this be in a hospital or at home. It is also of prime importance to obtain a greater understanding of the characteristics of the type of care based on the carer's gender and role in the family in order to adequately help these caregivers and prevent burn-out.

0050

A Shrinking Social Network: The Social Consequences of Aging with a Brain Injury

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Objectives: Aging with a brain injury impacts on the complexity and size of the individual's social network and further enhances the effects of their disability. The objectives of this presentation:

To identify the changes which occur to the social network of the person with brain injury as they age
To understand the importance of social network participation on an individual's social role
To examine the consequences of diminished involvement on the life of a person aging with a brain injury

Method: This presentation is drawn from a long term outcome study at the Neurologic Rehabilitation Institute of Ontario (NRIO) conducted by the author. Now in its thirteenth year of operation, the study collects data from 100% of the individuals discharged from the program. The NRIO Outcome Validation Study includes components which address: social role return; care needs; place of residence; activity return and the durability of outcomes attained by program participants. The Power Point presentation will include animated sociograms to illustrate the social network changes over time.

Results: Over the course of the study, 37.3% of the participants returned to their pre-injury social roles and 43.1% experience a change in role function and status which require support from family members and/or paid staff. Those individuals who return to their pre-injury social role maintain that involvement as indicated by the durability component of the study. Of the cohort requiring moderate and higher support levels, the family members reported: decreased activity outside of the home; the isolation of the person; altered family functioning; feeling stress and

“burnout” due to increased care burdens and experiencing an increased frequency of crisis events. *Conclusions:* As people age with a brain injury their social network can diminish in size and complexity due to factors of the disability and the impact on the person and others. The consequences of aging with a brain injury is associated with an increased likelihood of a move into a healthcare oriented residence and increased reliance upon paid caregivers at a much earlier point in life than their non-brain injured peers. The change in participation level, social role return and community involvement furthers isolation and social withdrawal for many individuals and reduces their involvement in productive social network experiences. The lifelong issues faced by individuals aging with a brain injury requires that we rethink long term options.

0051

Visual Sequelae of Traumatic Brain Injury: A Systematic Review of the Literature

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Objectives: Military personnel who sustain blast-related traumatic brain injury (TBI) are susceptible to diffuse damage that may interfere with visual processing deficits ranging from mild to severe depending on the location and severity of the injury. Unmanaged sensory input to an injured visual system may result in physical, cognitive or behavioral symptoms that interfere with quality of life and recovery.

A multidisciplinary consensus group of VA and military experts in TBI, vision care and rehabilitation was assembled in 2007 to clarify the state of the art/science and best practices in the area of TBI-related vision rehabilitation. The first objective was to clarify the type and frequency of visual sequelae seen with diffuse brain injury.

Method: A qualitative systematic review was conducted for systematic reviews, meta-analyses and primary studies published in English primarily from 1990 to January 2009. Clearly described case series ≥ 10 Veterans or controlled studies ≥ 10 adult subjects with diffuse closed head injury and with oculo-motor or visual perceptual problems were included. Scientific rules of evidence were applied.

Results: Twenty-four studies met inclusion criteria: 13 of mild TBI and 11 of moderate to severe TBI. Evidence of mild TBI-related visual dysfunction comprised one case series, eight case-control studies,

two prospective cohort studies and two meta-analyses. Evidence of moderate-severe TBI-related visual dysfunction comprised one case series, nine case-control studies, and one meta-analysis.

Conclusions: The evidence is based on those who sought medical care in a hospital emergency room, trauma clinic or university health clinic setting. It does not reflect the unknown numbers of cases seen outside those settings with undiagnosed, misdiagnosed or untreated TBI or its consequences. The evidence is hampered by the conduct and reporting of key study elements, specifically, small sample sizes, selection process of cases and controls, and variation in injury severity criteria and testing measures. In mild TBI photosensitivity and saccadic deficits were common, as were blurred vision and double vision. However, these symptoms are not representative of the range of possible oculo-motor symptoms and impairments found in these individuals, nor are they specific to an underlying mechanism of TBI. Moderate-severe TBI is associated with widespread deficits in information processing speed and executive control of task switching in focused/selective and divided attention. Results from cases series of Veterans suggest significant visual perceptual problems even among Veterans with known TBI who have normal or near normal corrected visual acuity and visual fields. Confirmation of their results in well designed prospective, controlled studies would improve understanding of the magnitude of the problem among Veterans and the general population.

0052

An exploratory study on the needs, in regards of life habits, of teenagers and young adults with moderate or severe traumatic brain injury

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Objectives: The needs of individuals who have experienced traumatic brain injuries (TBI) vary for different age groups and levels of severity. In this aspect, the needs of teenagers and young adults differ from those of children and adults even though their concerns are very similar (occupational choice, social and residential independence, leisure activities, love life). Some studies documented the needs

of teenagers with mild TBI but not in regards of life habits. However, in the case of clients with moderate or severe TBI, peers and families were interviewed instead of the teenagers and young adults themselves. As part of our goal to identify the actual needs of young clients, teenagers and young adults with moderate or severe TBI themselves were interviewed.

Method: 18 young persons with moderate or severe TBI aged 14 to 20 years old completed questionnaires, by live interview, documenting their needs regarding life habits, performance and satisfaction levels for accomplishment of their life habits, as well as their social roles. They also provided the reasons explaining their levels of satisfaction, their views of themselves and of their future, as well as their needs in terms of self-esteem, sexuality, and consumption habits.

Results: Results show that driving a car is the life habit with the lowest level of performance and satisfaction. Teenagers reported that maintaining good interpersonal relationships, being autonomous, fulfilling their responsibilities, warding off loneliness, as well as being supported in their efforts to reach a satisfying answer to their needs and concerns were their highest priority needs. They also indicated that they rely primarily on familial support, then on peer support, and lastly on the support provided by the rehabilitation team. Teenagers with moderate or severe TBI envision their future just like any other teenager and hope to start a family, buy a house, and find a good job. The results also raise issues regarding the self-perception and judgment functions of young persons with moderate or severe TBI in the identification of their own needs.

Conclusions: This study confirms the necessity to asked teenagers and young adults who sustained moderate to severe brain injury themselves to identify their needs and then organised optimal services for them based on their life habits oriented on autonomy (mobility, education, work) and personal relationship (self-esteem, communication).

0053

Association of Medically Attended Traumatic Brain Injury and Behavioral Infractions in a Statewide Offender Population

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Objectives: Traumatic brain injury (TBI) is highly prevalent among offender populations. And it is hypothesized that offenders with TBI would be more likely to commit in-prison behavioral infractions. The objective of this presentation is to describe a retrospective cohort study that examined the association between medically attended TBI, time in prison, and in-prison behavioral infractions in a statewide offender population.

Method: Calculated 1) gender-specific incidence rates of medically attended TBI by incarceration status at time of injury over a period of 11.5 years (N = 16299 male and 1270 female offenders), and 2) rate ratios of behavioral infractions comparing offenders with and without medically attended TBI.

Results: Medically attended TBI among male offenders was 5.88 (95% CI: 5.26, 6.67), and among female offenders 16.67 (95% CI: 5.88, 50), times more likely to be observed during periods of non-incarceration than while incarcerated. In both males and females, while a smaller proportion of inmates with medically attended TBI had infractions, those who had infractions appeared to have higher annual rates of behavioral infraction overall, as well as for violent infractions and non-violent infractions, compared to inmates with no medically attended TBI.

Conclusions: 1) Incarceration was protective of repetitive TBI among this population. 2) A subset of inmates with TBI had increased behavioral infraction rates. Further understanding of the association of offenders with TBI and in-prison behavioral infractions is needed in order to implement public health prevention programs and effective treatment and management of persons with TBI within offender populations.

0054

The Role of Narratives in the Reconstruction of the Self following Acquired Brain Injury

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Objectives: Brain injury is often described as a hidden disability. This sometimes means that people experience a lack of understanding from family, friends, professionals and the wider society. Consequently people seek ways of validating and making sense of

their experience. One way of doing this is through reading and writing stories, as people attempt to regain some control of their life and maintain a positive self-identity following a brain injury. Previous research has largely focused on the content of their narratives rather than why people are authoring or reading them. We, therefore, know little about why people read and write stories and what impact these stories have upon both the readers and the authors.

Method: This mixed methods study includes a review of the literature, a self-report questionnaire and in-depth interviews. This paper presents data following the completion of a self-report postal questionnaire, distributed to a database of people affected by encephalitis in the U.K. (n = 790) with a response rate of 52% (n = 414). As well as collecting demographic information, the questionnaire included the European Brain Injury Questionnaire (EBIQ) which comprises 63 questions regarding diverse problems or difficulties that brain-injured people, and their relatives sometimes experience, along with a unique set of 27 questions to ascertain people's experiences of reading and writing stories following their or their family member's illness. We also present the results of in-depth semi-structured interviews conducted with 21 authors and readers of stories following brain injury due to encephalitis.

Results: Combining both the quantitative and qualitative data we will present preliminary conclusions from the findings.

Our findings show that significant numbers of people affected and their family members are reading stories by or about people who have been affected by brain injury. We found statistically significant associations in gender, and are also able to present data detailing the reasons people ascribe to why they read and write stories, and the impact this has upon both author and reader. We will also present EBIQ scores for this population, contrasting their levels of dis/ability when compared to other brain injured populations.

Conclusions: Traditional service provision often struggles to address and support people in coming to terms with the long-term consequences of acquired brain injury. Analysis of this data will provide a general account of how people experience the after-effects of encephalitis, which will be of use to practitioners in understanding the importance and impact of the written and read narrative for this population. This in turn may help practitioners in providing better support to this population in terms of facilitating opportunities for people to recount their story and be heard.

0056

Long-term support for those who survive Encephalitis in the US: A UK model perspective.

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Objectives: Encephalitis is inflammation of the brain caused by infection (usually viral, for example Herpes Simplex and West Nile viruses) or by autoimmune disease. Encephalitis is indiscriminate, striking adults and children alike, showing no respect for age, gender, ethnicity or culture. Mortality rates are high and many who survive are left with an acquired brain injury, the degree and severity of which will vary.

In addition feelings of isolation, loneliness and a sense of 'feeling different' may be difficult to come to terms with. Once the acute and rehabilitative phases are complete many of those who have survived return to their communities with varying degrees of success. People's need for information, understanding, and support continues long after they have left hospital or rehabilitation and despite attempts to realise this through transitional rehabilitation, it can be difficult to achieve.

This presentation offers for consideration a successful model of ongoing support provided by the Encephalitis Society. This model may also act as a blueprint for similar organisations supporting people affected by other neurological disorders.

Method: Using both text and video this presentation will use a review of the literature and a range of recorded and observational data collected by the Encephalitis Society during the last fifteen years to present a successful model of on-going support.

Results: We will outline individual elements of the model which include support and information, awareness, training and research. We will stress the importance of providing evidence-based information and support, the value and benefits of working in partnership, with particular focus on our colleagues in medicine and rehabilitation, along with examples of how to best utilise the 'social capital' that often already exists among the membership of similar organisations.

Conclusions: We need more innovative solutions to long-standing and complex problems, such as ongoing support for brain injured populations when they return to their communities, particularly since this is an area in which mainstream provision

may struggle. Innovatory thinking and a can-do attitude has resulted in a successful model emerging as illustrated by the Encephalitis Society. This model can be adapted for use by other organisations that are committed to improving outcomes for people who have sustained a brain injury, and to working in partnership with colleagues in professions allied to medicine and rehabilitation.

0057

Minimal Conscious State (MCS), Two-year follow-up: recovery, independence and community participation level after inpatient program discharge.

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FLENI, Buenos Aires, Argentina

Objectives: Currently, there are few research studies on MCS recovery, independence and community participation level achieved after discharge as a result of TBI. Objective: record/register independence and community participation level in patients that remained at least one month and then emerged from MCS after two years from inpatient program discharge.

Method: During 2006–2007 fifty-three patients that suffered TBI were included in the sensory-motor stimulation program. Only seventeen emerged from MCS. Giacino defined MCS as a condition of severely altered consciousness in which minimal but definite behavioral evidence of self or environment awareness is demonstrated. Several diagnostic criteria have been proposed. At least one criterion should be present and occur on a reproducible or sustained basis to diagnose MCS: follows simple commands, gestural or verbal “yes/no” responses, intelligible verbalization; movements, that occur in contingent relation to relevant environmental stimulus and are not attributable to reflexive activity.

The following assessment instruments were used to characterise and monitor patients functioning: JFK Coma Recovery Scale-Revised; Disability Rating Scale (DRS); Functional Independence Measure (FIM), Community Participation Questionnaire and Extended Glasgow Outcome Scale (GOS-E).

Results: Results: at discharge from inpatient program the following average scores were obtained: FIM 57.5%, requiring assistance in most of Basic ADL; DRS 16% (Severe) ; and all patients were considered at an outcome category of Low Severe Disability according to GOS-E. At discharge the 17 patients returned to their home but did not participate in community activities. The Follow-up program

was used after discharge to assess community participation level and work reintegration. Two years after discharge, 41% of the patients achieved “total” community participation and 47% were able to return to work or academic activity.

Conclusions: Conclusion: this study shows evidence that the majority of these population continue improving their daily functioning after two years from the injury achieving high levels of community and work reintegration.

Contribution to our practice: it is necessary to develop specific rehabilitation approaches and effective therapeutic strategies. Last but not least, take into account the valuable data that the follow-up program provides to our practice not only for investigation purposes but also to suggest relevant intervention strategies.

0058

Identifying barriers to physical activity participation amongst adults with traumatic brain injuries enrolled in a Day Neuro program

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Objectives: Annually, 1.4 million American’s have a traumatic brain injury (TBI) leading to physical, cognitive, and psychosocial disabilities, creating significant economic burden (CDC, 2009). Consequently, TBI is a serious public health concern (CDC, 2006) costing an estimated \$60 billion in the US (CDC, 2009). Thus, effective interventions that promote healthy lifestyles and reduced economic burden post injury are needed (Finkelstein et al. 2004). One intervention is physical activity (PA - leading indicator of health; Healthy People 2010) education programs which can improve health and reduce health-care costs, risk of disease, and mortality (Raveslout et al., 2005). However, if PA education interventions are to be successful several social marketing processes must be implemented to ensure behavior change (Sutton et al., 1995; USDHHS/CDC, 1999). Thus, the purpose is to present findings from our pilot work and discuss the implications for future TBI PA education interventions.

Method: The current project identified (1) barriers to PA participation, (2) amount of moderate PA (MPA), and (3) readiness to exercise (using trans-theoretical model) for outpatients with TBI

enrolled in a 'Day Neuro' program. Inclusion criteria included; outpatients with TBI in the Day Neuro program, aged over 18 years, without significant cognitive impairment (based on neuropsychological assessment). The final sample consisted of 28 women (n=12) and men (n=16) with a TBI, primarily Caucasian (46%), married (67%), and independent walkers (61%).

Results: Participants reported completing M=48 minutes of MPA/week which is only 32% of the 150/min week recommended by the USDHHS (2008). However, 51.9% of participants reported being in the 'action stage' of participation which is characterized by "exercising regularly for the past 6 months". Participants faced M=2.25 barriers (range 0–9) including environmental (lack of transportation and accessible facility) and personal barriers (insufficient endurance, feeling self-conscious in a fitness center, and lack of time).

Conclusions: A discrepancy existed between the perceived amount of PA completed and amount required to obtain the associated health benefits, placing individuals at a greater risk of morbidity and mortality (USDHHS, 2008). Practitioners must provide educational interventions (inpatient and outpatient settings) to increase individual's knowledge and adoption of MVPA, with the goal of improving health and reducing health-care costs. Future interventions should focus on (1) defining PA and the amount required to achieve health benefits, (2) emphasizing the positive relationship between PA and health post TBI, and (3) including behavioral strategies to facilitate the adoption of PA behaviors.

0059

Interpretation of Gestural and Verbal Requests by Adults with Severe TBI

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Objectives: Little empirical information exists about non-verbal pragmatic behaviors of survivors of traumatic brain injury (TBI). Research in this area has focused on recognition and production of facial affect and prosody; however, little research has investigated how survivors of TBI integrate gestures and verbal information to understand communicative messages. The purpose of this investigation was to determine the extent to which individuals with

and without TBI correctly interpret indirect requests given gestural and verbal information alone and in combination.

Method: Participants included 18 adults with severe TBI and 18 neurologically-intact adults. Statistical analyses revealed no significant differences between groups on age, gender, or level of educational achievement. Stimuli were a series of 36 video vignettes created by Kelly and colleagues (1999). Vignettes depicted communicative interactions containing indirect requests produced in three conditions: verbal-only (VO), verbal-plus-gesture (VG), and gesture-only (GO). Each participant individually viewed 4 vignettes from each condition (i.e., 12 vignettes total) selected in a counterbalanced order across participants. Probe question responses revealed the extent to which verbal and gestural information contributed to accurate interpretations.

Results: A series of mixed-group factorial ANOVAs with follow-up pairwise comparisons revealed the following results:

- Neurologically-intact participants provided more correct responses to prediction probes than to interpretation probes and participants with TBI responded equally well to both probes. Therefore, subsequent analyses used only prediction probe scores as the dependent variable.
- A main effect of group membership occurred [$F(1,34) = 55.472, p < .001$], with better overall performance on the prediction probe by control group participants.
- A main effect of condition occurred [$F(2,68) = 10.337, p < .001$], with follow up analyses confirming significantly better performance in the VG condition than either the VO ($p = .004$) or GO ($p = .001$) conditions. The VO and GO conditions did not differ significantly ($p = 1.000$).
- Descriptively, incorrect response analysis revealed over half the errors for both groups were due to alternative responses in the VO and VG conditions and unrelated responses in the GO condition. Alternative responses were comments demonstrating reasonable interpretation beyond the literal meaning of an indirect request but not referencing the intended meaning. Unrelated responses were comments relating to the context of the conversation or environment but not addressing the indirect request.

Conclusions: Overall, both groups correctly interpreted intended meanings of indirect requests significantly more often when verbal and gestural information occurred together rather than in isolation; however, individuals with TBI responded significantly less accurately regardless of

experimental condition. Hence, individuals with a history of severe brain injury have impaired comprehension compared to neurologically-intact individuals. In addition, error analysis suggested impaired comprehension relates to misinterpretation rather than literal interpretation of implied meanings.

0060

Prevalence of Traumatic Brain Injury in Offender Populations: A Meta-Analysis

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Objectives: A variety of studies report that anywhere from 25–87% of offenders have sustained a head injury or traumatic brain injury (TBI). The objective of this presentation is to report a meta-analysis that narrows this range, as well as estimates more specific prevalence rates by subgroups: gender, case definition of TBI, method of determining TBI, and type of offender.

Method: Reviewed relevant articles in Pubmed, PsycInfo, Medline, EmBase (1983–2009) and communicated with researchers to identify 20 epidemiologic studies that met pre-established inclusion criteria. Conducted random-effects meta-analysis on TBI prevalence in offenders, as well as sub-group analyses by gender, case definition of TBI, method of determining TBI, and type of inmate.

Results: The estimated prevalence of TBI in the overall offender population was 60.25 (95% CI: 48.08, 72.41), with a prevalence of 67.7% (95% CI: 49.59, 85.82) in those currently incarcerated. The estimated prevalence was 64.41 (95% CI: 53.3, 75.53) for male offenders, and 69.98 (95% CI: 50.18, 89.79) for female offenders. The overall estimated prevalence of TBI with loss of consciousness was 50.19% (95% CI: 39.77, 60.61), while the estimated prevalence using structured in-depth interviews to identify TBI was 66.9% (95% CI: 54.62, 79.19).

Conclusions: Study differences in populations, methods, and definitions lead to a wide range of TBI prevalence estimates in offending populations. Increased uniformity in TBI definition and detection should lead to better precision. This could benefit offenders and society by more appropriate screening, resource allocation, and management of persons with TBI in offender populations.

0062

The specificity of post-concussive symptoms in the pediatric population

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Objectives: Traumatic brain injury (TBI) is an important cause of morbidity and mortality in children and adolescents. In Sweden, the incidence of head injuries in children (0–15 years) has been reported to be 865/100,000 children with the highest incidence among children less than 18 months of age (2379/100 000). The aim of the study was to compare symptoms both at the time of presentation to the ED and three months later between a mild head injury group of children and a comparison group consisting of children with abdominal complaints to describe the pattern of reported symptoms.

Method: Data were collected from the medical records at the time of the child's ED visit and follow-up questionnaires, three months post ED visit from the child and/or parent.

The cases were identified by reviewing medical records for all children (0–15 years) seen in the ED at the Astrid Lindgren Children's Hospital during one month (15 Sept – 15 Oct, 2002) with a history of head injury with the initial, tentative diagnosis of concussion. The comparison group, with an initial diagnosis of abdominal complaints (constipation or unspecified abdominal pain) was identified at the ED. The children were divided into two agegroups for comparison, children less than 5 and children over 5 years of age.

Results: A total of 96 head injured children, mean age 5,2 years (62% boys/38% girls) and 96 children, mean age 7,5 years (51% boys/ 49% girls) from the comparison group participated in this study.

There were no significant differences found between the head injury group (34%) and the comparison group (34%) for children over five years of age whether or not the parents reported symptoms at three months. In the subgroup of children less than 5 years, the comparison group (18%) reported more change in behaviour than the head injury group (12%) at three months follow-up.

A significant difference was found between the head injury group and the comparison group with higher intensity of symptoms reported in the comparison group compared to the head injury group. Significant difference was found in the symptom, dizziness. However, the comparison group reported

significantly more frequently symptoms of nausea, sleeping disorders, sadness and irritation at three months follow-up compared to the head injury group.

Conclusions: The initial differences in the amount and presence of symptoms between the two groups did not reflect the findings at three months. Within the age-groups, the reported symptoms or changes at three months differed significantly between the two groups. The evaluation of children with a head injury less than 5 years of age should be studied more carefully and further research is clearly indicated. Thorough follow-up should be offered to children with head injuries and especially in the youngest children to improve the identification of late sequelae.

0063

Independent Relationships between Problems Presented by Individuals with Dementia and Caregiver Psychosocial Outcomes

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Objectives: Introduction: Caregiving for individuals with chronic disease has been show to negatively impact the caregiver's emotional well-being. Caregiving for individuals with dementia is particularly difficult, due to the physical, cognitive, and behavioral/emotional problems presented by the person with dementia. *Objectives:* To examine the independent relationships between problems experienced by the individual with dementia, as reported by the caregiver, and caregiver psychosocial functioning. *Method:* 73 family caregivers were recruited from the Central Police Hospital in Bogota, Colombia.

Method: Materials: A checklist, completed by the caregiver, of physical, cognitive, and behavioral/emotional problems presented by the person with dementia, the Patient Health Questionnaire (PHQ-9; depression), Zarit Burden Interview (ZBI), Interpersonal Support Evaluation List Short Version (ISEL-12; social support), and Satisfaction with Life Scale (SWLS).

Results: Results: SWLS scores were not associated with any type of problem presented by the individual with dementia. Controlling for socio-demographic and caregiving factors, cognitive problems predicted ZBI scores ($\beta = 0.49$, $p < 0.001$) and PHQ-9 scores ($\beta = 0.29$, $p < 0.05$), and emotional/behavioral problems predicted ZBI scores ($\beta = 0.57$, $p < 0.001$), PHQ-9 scores ($\beta = 0.37$, $p < 0.001$), and ISEL scores ($\beta = -0.25$, $p < 0.05$). Physical problems presented by the individual with dementia were not associated with any caregiver psychosocial outcome.

Conclusions: Conclusions: Cognitive problems experienced by the individual with dementia are an independent predictor of caregiver burden and depression, while emotional/behavioral problems independently predict caregiver burden, depression, and lack of social support. As found in previous studies, physical problems did not influence psychosocial outcomes. Almost all caregivers reported high levels of satisfaction with life, and no type of problem presented by the individual with dementia affected it. In Colombian culture, caregiving appears to have detrimental effects on some psychosocial aspects (e.g., depression and burden), but is also rewarding. Interventions designed to improve the cognitive and emotional/behavior functioning of individuals with dementia may help to alleviate burden and depression in their caregivers.

0064

Relationships among Family Caregiver Needs and Health-Related Quality of Life in a Group of Spanish-Speaking Dementia Caregivers

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Objectives: Introduction: Family caregivers play a vital role in the care of dementia patients and previous research has shown that these caregivers need assistance from their social network, as well as from the health care system, to meet their needs. *Objective:* To determine the relationship between family caregiver needs and family member caregiver health-related quality of life (QOL). *Method:* 102 family member caregivers recruited from the Central Police Hospital in Bogota, Colombia.

Method: Materials: The SF-36, a self-report instrument measuring subjective general health status and QOL in eight component areas; a 27-item Caregiver Needs Questionnaire, a self-report instrument measuring 9 separate categories of needs.

Results: Results: Family caregivers reporting needing more community support had more role limitations due to physical health ($\rho = -0.26$, $p < 0.05$). Those with more household chores needs had worse physical functioning ($\rho = -0.21$, $p < 0.05$), worse mental health ($\rho = -0.21$, $p < 0.05$), worse social functioning ($\rho = -0.21$, $p < 0.05$), and more pain ($\rho = -0.29$, $p < 0.01$). Caregivers with more respite needs had more pain ($\rho = -0.29$, $p < 0.05$). Those with more sleep needs had less vitality ($\rho = -0.23$, $p < 0.05$), worse mental health ($\rho = -0.22$, $p < 0.05$), and more pain ($\rho = -0.21$, $p < 0.05$). Caregivers reporting more physical health needs had worse physical functioning ($\rho = -0.35$, $p < 0.01$), more role limitations due to physical health ($\rho = -0.34$, $p < 0.01$), more role limitations due to emotional problems ($\rho = -0.28$, $p < 0.01$), worse mental health ($\rho = -0.41$, $p < 0.01$), worse social functioning ($\rho = -0.39$, $p < 0.01$), more pain ($\rho = -0.39$, $p < 0.01$), and worse general health ($\rho = -0.33$, $p < 0.01$). Caregivers endorsing more information needs had higher vitality ($\rho = 0.20$, $p < 0.05$) and better mental health ($\rho = 0.24$, $p < 0.05$).

Conclusions: Conclusions: In this sample there is a robust relationship between caregiver needs and health-related QOL. Addressing caregiver needs may lead to improved quality of life among family caregivers of individuals with dementia.

0065

Reliability Of The Community Balance And Mobility Scale (CB&M) In Children And Youth With An Acquired Brain Injury

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Objectives: Balance impairments are prevalent following ABI. During rehabilitation, children with ABI often have goals that require high-level balance to participate in sports and recess. The Community Balance & Mobility Scale (CB&M) is used by physiotherapists at our pediatric centre to measure high-level balance. It was selected by our PTs to address measurement gaps experienced with the Gross Motor Function Measure (GMFM) and Berg Balance Scale with these

high-level patients. The CB&M's psychometric properties have been confirmed with adults, but have not been evaluated in pediatrics. The objective of this study was to determine the inter-rater and test-retest reliability of the CB&M in ambulatory children and youth with an ABI. Reliability was evaluated for live-rating and video-rating situations. Videorating was hypothesized to be more accurate than live-rating.

Method: A repeated measures design was used. Seven physiotherapists (PTs) were trained as assessors. Each passed the study's CB&M criterion test. At baseline, one PT assessor (PT1) administered and scored the CB&M, and a second PT (PT2) observed and scored independently (inter-rater reliability). Participants were reassessed 3 to 10 days later by PT1 alone (test-retest reliability). All assessments were videotaped. Assessors independently scored the child's CB&M video at least one month after their live-rating. They had no access to previous scores.

Results: Results: There were 32 participants (19 girls and 13 boys, mean age = 14.1 years [SD = 2.1]). The youngest child was 7 years of age. Participants' GMFM mean score at baseline was 93.4% (SD = 7.8). The mean time to administer the CB&M was 29 minutes (minimum = 20 minutes, maximum = 45 minutes). CB&M baseline mean scores were 67.4% (PT1) and 66.7% (PT2). The retest mean score (by PT1) was 69.3%. Inter-rater reliability ICC for live-rating was 0.93 (95% confidence interval [CI] = 0.87 to 0.97), and 0.95 (95%CI = 0.85 to 0.97) for video-rating. Bland-Altman plots revealed a slight indication of smaller inter-rater differences for lower CB&M scores. The test-retest ICC for live-rating was 0.90 (95%CI = 0.81 to 0.95), and also 0.90 (95%CI = 0.70 to 0.95) for video-rating. Minimum detectable change (MDC90) was 13.2% points. Our previous clinical review of 17 youth with ABI showed a CB&M mean change score of 23.6% points [SD = 13.5] from admission to discharge, suggesting this study's MDC estimate is clinically realistic.

Conclusions: The CB&M showed excellent inter-rater and test-retest reliability in the live-rating situation in youth with an ABI, with estimates similar to those of the published CB&M reliability work by Howe et al. (2006) with adults post-ABI. Since video-rating did not increase rating accuracy, the less expensive live-rating approach is suitable. There was little room for GMFM score gain, while the CB&M showed scoring scope to detect improvement. Future work should focus on formal evaluation of responsiveness to change.

0066

Treatment of Traumatic Brain Injury with Collagen Scaffolds and Human Marrow Stromal Cells (hMSCs) Increases the Expression of Tissue Plasminogen Activator (tPA) in Rats

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Objectives: This study was designed to investigate the effects of combination therapy of collagen scaffolds and human marrow stromal cells (hMSCs) on the expression of tissue plasminogen activator (tPA) and urokinase type plasminogen activator (utPA) and plasminogen inhibitor (PAI-1) after TBI in rats. tPA plays an important role in neurorestorative functions in the central nervous system.

Method: Adult Wistar rats (n = 30) were injured with controlled cortical impact and treated either with hMSCs (3x10⁶) alone (n = 10) or hMSCs (3x10⁶) impregnated into collagen scaffolds (n = 10) transplanted into lesion cavity one week after TBI. A control group (n = 10) was injected with saline. The rats were sacrificed 14 days after TBI and the expression of plasminogen activators tPA and uPA as well as plasminogen inhibitor PAI-1 was measured with quantitative real-time polymerase chain reaction (qRT-PCR) and Western Blot analysis.

Results: Western Blot analysis and qRT-PCR both showed that scaffold + hMSCs and hMSCs-alone treatment enhanced the expression of tPA (p less than 0.05) but scaffold + hMSCs was significantly better than the hMSCs-alone group (p less than 0.05). The scaffold + hMSCs but not the hMSCs-alone treatment suppressed the expression of PAI-1 (p less than 0.05). Western blot analysis showed no significant difference in the expression of uPA in all three groups whereas qRT-PCR studies showed a significant increase in the expression of uPA in the scaffold + hMSCs group (p less than 0.05).

Conclusions: Both scaffold + hMSCs and hMSCs-alone treatments increase the expression of tPA after TBI; however, the combination treatment of scaffold + hMSCs is significantly better than hMSCs-alone treatment. This induction of tPA by hMSCs after TBI may be one of the mechanisms involved in promoting functional improvement after TBI, which our previous studies have shown.

0067

Group Interactive Structured Treatment: A Social Competence Intervention - Application with Military TBI Groups

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Objectives: Group Interactive Structured Treatment: GIST- Social Competence is a holistic cognitive-behavioral group therapy intervention aimed at improving social competence impairments following brain injury. This manualized, 13 week intervention addresses the underlying cognitive, communicative, and emotional impairments impeding social competence following BI. GIST blends a structured curriculum with a group therapy process emphasizing self awareness, individual goal setting, development of residual strengths, group interaction and support, family involvement, real world application, and the alliance of two co-therapists from different professional backgrounds. This program was developed by a Lenore Hawley, LCSW, CBIST and Jody Newman, MA, CCC-SLP, each with over 25 years experience in brain injury rehabilitation. GIST was found to be efficacious in an RCT funded by NIDRR and completed at Craig Hospital. This paper will describe the application of the GIST model with groups of active duty soldiers and military veterans. Preliminary clinical observations will be discussed and recommendations for the use of the GIST program with military personnel will be outlined.

Method: Military personnel with TBI participated in 13 weekly sessions of the GIST treatment program in Colorado Springs, Colorado. Treatment groups consisted of 5 to 8 participants and two therapists. Each participant received a GIST workbook, and choose 2 to 3 individual social competence goals to work on during the group. Family members were encouraged to be involved in homework assignments, ongoing problem solving at home, goal setting, and two family sessions.

Results: Preliminary clinical observations, self report surveys, and goal attainment scaling, reveal that military personnel participating in GIST groups were able to show improvement in social competence skills.

Conclusions: The Group Interactive Structured Treatment -GIST intervention for social competence has previously been shown to be efficacious. Initial clinical observations indicate that active duty soldiers and military veterans with TBI can also benefit from this program, showing improvements in social self confidence, social self awareness, and

improved social and communication behaviors in the group setting and at home.

0068

Implementing Culture Change for Individuals with Brain Injury

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Objectives: Culture change is a movement based on the belief that people are capable of continued personal growth, regardless of their cognitive or mental abilities, within a humanistic, holistic environment. This philosophy demonstrates how a person-centered environment, coupled with empowered direct support staff can promote well-being and a thriving human habitat for individuals with brain injury whose lives have been interrupted by disability, but still have a full life of opportunity in front of them.

Method: The Culture Change movement has historically focused on transforming nursing homes and other long-term care for Elders. With a grant from the Seaton Foundation, a Demonstration Project was completed to evaluate the applicability and effectiveness of utilizing the Eden Alternative principles and philosophies of Culture Change for children and adults with brain injury.

Results: Over a 2 year period, the Project adapted the Eden Alternative training materials to address the unique needs of individuals with brain injury in community-based environments and the individuals who provide support to them. The Project resulted in the development of Eden LifeLong Living (ELL), a licensed product of Eden Alternatives, and subsequently implementing training programs for individuals with brain injury in a variety of community settings.

Conclusions: This panel presentation will include discussions about the operational, development and business benefits of applying Culture Change and ELL in a variety of different supportive living and working settings for people with brain injury.

0069

Clinical Outcomes of Patients with Traumatic Brain Injury: A Longitudinal Study

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Objectives: Traumatic brain injury (TBI) is a major public health problem, and usually causes a variety of physical and neurobehavioral disturbances. The persistence of these disturbances are strongly associated with the ongoing disruption of social networks, family relationship and employments, and are even considered potential risk factors for lifetime disability. Unfortunately, Even though many studies examined the long-term clinical outcomes of patients with TBI, the cross-sectional method to investigate outcomes in those studies usually failed to uncover the process of recovery after head traumas. Thus, the present study aimed to examine the long-term global clinical outcomes of patients with TBI, and further to analyze possible risk factors for unfavorable outcomes.

Method: A total of 327 patients, diagnosed as TBI by a neurosurgeon in a level I trauma center, were recruited retrospectively in this longitudinal study. According to a comprehensive review of these patients' chart records, the score of Glasgow Outcome Scale Extended (GOSE) was then documented as an index of the clinical outcomes. Moreover, the GOSE was recorded at one-week, one-month, six-month, one-year, three-year, six-year and ten year respectively after head traumas.

Results: Our results revealed that 24 percent patients had favorable outcomes at one-month after head traumas, while more than half of the TBI patients (57%) have not fully recovered until 6 months post-injury. When the clinical outcomes were continuously evaluated by the GOSE from 1 week to 6 years post-injury, our results further showed only 6% (1/16) patients could be assessed as good outcomes since 6 months after traumas, while 50% (8/16) patients could reach a fully recovery at 6 years post-injury. Although only 5 patients' clinical outcomes could be continuously followed until 10 years after head injuries, our results indicated that those patients started to have good clinical outcomes after 3 years post-injury.

Conclusions: This study might be the first one to longitudinally evaluate the clinical outcomes of patients with TBI from one week to 10 years post-injury. According to the GOSE evaluation, TBI patients still suffered from the difficulties in the social interactions and family relationship until 6 years post-injury, even though they could live and work independently. Therefore, the professionals should pay more attention to the underlying factors which may cause the patients' difficulties

in those problems in their long-term recovery processes.

0070

Prevalence of TBI in a Prison Population and Associated Risk for Re-Offending

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Objectives: Previous studies suggest that TBI is relatively elevated in offender populations. We aimed to establish the rate of TBI in a representative sample of adult offenders and patterns of custody associated with TBI.

Method: We conducted a self-report survey of adult, male, offenders within a prison. Of 453 offenders, 196 (43%) responded.

Results: TBI was found in 64% of the population sample. Of the overall sample, 16% had experienced moderate to severe TBI, and 48% Mild TBI. Those with TBI were younger at entry into custodial systems and had higher rates of repeat offending. They also reported greater time, in past 5 years, spent in prison.

Conclusions: There is a need to account for TBI in the assessment and management of offenders. This may lessen re-offending.

0071

Assessing Balance In Children After a Mild Traumatic Brain Injury: Choosing the Right Tools

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Objectives: The assessment of balance after a mild traumatic brain injury (MTBI) is now recognized as an important aspect of comprehensive management protocols. The Balance Error Scoring System (BESS) has gained in popularity in the athletic population but there is limited data available

regarding its use with the pediatric population. Many other well recognized, standardized, norm-referenced balance assessment tools exist for this population and, among them, the Bruininks-Oseretsky Test of Motor Proficiency-2nd edition (BOT2) has been shown to be sensitive to balance difficulties post-MTBI. The objective of this study was explore the concurrent validity of the BESS and the BOTMP with children post-MTBI by comparing their performance on both tests.

Method: Twenty children and adolescents (M: 14,4 years; SD: 1,9 years), followed in the MTBI/Return to Sports Clinic of the Montreal Children's Hospital. Once symptom-free for at least one week, each child's balance was assessed with the BOT2 and the BESS. Performances on each test were compared using Spearman Correlations.

Results: Overall, the BOT2 was reported as easier to administer and score than the BESS. Total scores on both tests were related ($R = 0.590$; $p < 0.01$). Single leg stance ($p < 0,001$) and tandem ($p < 0,001$) positions gave rise to more errors on the BESS when performed on the foam surface compared to the floor. On the balance subtest of the BOT2, children had more difficulties on items requiring the absence of visual cues (eyes closed). Individual item correlations revealed that the foam conditions of the BESS appear to test different aspects of balance than items of the BOT2.

Conclusions: Balance is a complex and one single measurement tool may not be sensitive to detect all impairments after a pediatric MTBI. Recommendations for the assessment of balance in the pediatric MTBI population, both athletes and non-athletes, will be discussed.

0072

PTSD after Mild TBI versus Orthopedic Injury: Role of Neurological Severity, Event Appraisal and Memory, and Social Support in Predicting Symptoms

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Objectives: MTBI represents the single most disabling condition in working age adults. Persistent concussional symptoms and mood disorders (e.g., depression, anxiety) are common sequelae. There is growing evidence that PTSD (Post-traumatic Stress

Disorder) can occur post TBI. We investigated the role of severity of injury, event appraisals and trauma memory quality in predicting PTSD symptoms. We also explored the role of social support.

Method: We recruited 140 participants in a prospective study of MTBI and Orthopedic (control) from attendees at an Emergency Department. They were assessed at 2 weeks and at 3 months post-injury on self-rating measures for: Post concussional Symptoms (PCS) (Rivermead PCS scale); cognitions/beliefs about event (including “blame” and “seriousness”); Trauma Memory Quality Questionnaire (TMQQ); Trauma Screening Questionnaire (PTSD symptoms); Life satisfaction; social support and General Health Questionnaire. Details of attendance event at ED were also recorded.

Results: Data will be presented on comparison between “complicated” MTBI, MTBI and Orthopedic control group in terms of rates of PTSD symptoms. Furthermore, regression analysis and exploratory structural equation modeling (SEM) will be presented regarding predicting PTSD symptoms at 2 weeks and 3 months.

Conclusions: With a more comprehensive understanding of the development of PTSD following MTBI, earlier, targeted interventions may become possible.

0073

Neurodevelopmental outcome after severe Traumatic Brain Injury in very young children: Role for Sub-cortical lesions.

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Objectives: To evaluate the role of sub-cortical lesions on neurodevelopmental outcomes of young children after Traumatic Brain Injury (TBI).

Method: Long-term outcomes of 50 children with severe TBI before 4 years of age (accidental injury, n=21, non-accidental injury, n=29), were reviewed retrospectively and compared to late MRI findings (no visible lesions, cortical or sub-cortical lesions).

Results: Sub-cortical lesions occurred in both accidental and non-accidental TBIs. TBI severity (initial GCS or coma duration) was significantly associated with sub-cortical lesions. Long-term motor or visual deficiencies occurred in one third of patients and

cognitive deficiencies in 52,1%. Although deficiencies occurred without visible MRI lesions, global outcome scores, motor delay, visual impairment, head growth slowing, global IQs and planning performances were significantly worse in patients with sub-cortical lesions. An alarming IQ deterioration over time was noted.

Conclusions: Neurodevelopmental outcomes are worrisome after severe TBI in young children, and sub-cortical lesions impact the prognosis.

0074

Dual-Task Effect on Joint Kinetics during Gait in Individuals following Mild Traumatic Brain Injury

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Objectives: Deficiencies in attention and executive function have been documented in patients with mTBI. Performing a concurrent cognitive task while walking was used to examine interactions between attention and motor function of mTBI individuals. Decreases in gait velocity and increases in center of mass (COM) medial-lateral (M-L) sway during dual task conditions were reported in individuals with mTBI. However, it is still not clear whether any neuromuscular strategies, i.e. changes in the lower extremity joint kinetics, have been adopted to reduce balance perturbation during dual task gait. If there are, what is the effect of mTBI on the ability of performing these strategies? The purpose of this study was to investigate the effects of dual task conditions on joint kinetics during gait in individuals with mTBI. We hypothesized that altered joint kinetics during dual task walking could be identified, and these changes would enhance balance control. Furthermore, mTBI would diminish an individual's ability to implement such kinetic changes.

Method: Study participants included 11 young individuals who had recently sustained a grade II concussion and 11 age and sports activity matched controls. Twenty-nine markers were placed on bony landmarks, and whole body motion was recorded with a motion capture system. Subjects walked at a self selected pace along a walkway with two force plates in the center. Five trials were collected under both single and dual task (i.e., spell word backwards, recite months in reverse order, or subtraction) walking conditions. Three-dimensional joint kinematics and kinetics were calculated, and sagittal peak moments at the hip, knee and ankle along with frontal peak moments at the hip and knee were

identified. A two-way ANOVA was used to detect the effect of walking condition and subject group on joint moment values.

Results: Single and dual walking conditions were found to impose different effects on the control and mTBI subjects. Significant reductions in the hip and knee abductor moments, 15% and 18%, respectively, were found in the healthy controls during dual-task walking when compared to single-task walking. However, no such differences were identified in mTBI subjects.

Conclusions: Reduction in frontal plane joint kinetics of normal subjects while walking with a concurrent cognitive task could indicate an strategy of moving the whole body COM and supporting hip joint closer. This would better utilize the skeletal structure for stabilization and require a less hip abductor moment to counter-balance the moment produced by body weight. However, such strategy was not observed in subjects immediately following a concussion. Following a concussion, the neuromuscular control may be impaired thereby inhibiting the ability to move the body weight closer to the hip joint during a dual task. This could potentially explain the increased medio-lateral sway observed following a concussion.

0075

Brain Acoustic Monitoring for Prediction of Return to Work Following Mild Traumatic Brain Injury

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Objectives: A reliable method is needed to identify mild traumatic brain injury (mTBI) patients who do not return to work. Despite a common belief that mTBI patients recover quickly and experience minor long term effects, many fail to make a complete functional recovery and thus contribute to the economic burden of mTBI. Brain acoustic monitoring (BAM), which correlates with clinical outcome in severe TBI patients, may be a useful predictor of vocational outcome in mTBI patients. We hypothesized that BAM screening and detailed symptom

assessment in combination with other medical, social, cultural, and environmental factors would accurately predict those patients who do not return to work after mTBI.

Method: 369 mTBI patients were initially tested with BAM prior to hospital discharge. They were given a modified Rivermead Post-Concussive Symptoms Questionnaire (RPQ) and initial demographic survey. Repeat RPQ occurred by phone 7–10 days following the injury. Patients were invited to return for BAM, RPQ, and follow up surveys at 3, 6, and 12 months. The outcomes of 53, 45, and 36 patients were analyzed at 3, 6, and 12 months, respectively.

Results: At each time point, 15–25% of mTBI patients failed to return to work, and most patients did not change employment status between two consecutive follow up time points. Significant characteristics of patients who failed to return to work included older age, working or attending school only part time prior to injury, pre-existing medical conditions, and a history of alcohol, tobacco, or non-intravenous drug use. 71% of patients had abnormal initial BAM readings, whereas 25–33% had abnormal readings at the follow-up time points. Initial BAM had predictive value, particularly for return to work at 12 months, as did the number of RPQ symptoms at 7–10 days. The combination of BAM and RPQ yielded even greater sensitivity and specificity, with 100% of patients normal on both tests back to work at 12 months.

Conclusions: Failure to return to work after mTBI can be predicted from patient characteristics and a detailed symptom survey, and with improved sensitivity when objective BAM data is included. BAM is a valuable tool for early assessment since it is noninvasive, rapid, portable, inexpensive, and does not require the prolonged attention of the patient. Since mTBI is ill defined and return to work is complex, a single measure is unlikely to be sufficient for perfect prognostication, but our data indicate further clinical protocols incorporating BAM testing. Earlier identification of patients at risk will enable more focused rehabilitation and improved outcome in this vulnerable population.

0077

Clinical Correlates And Predictors Of Dextrous Hand Function In Chronic Stroke Survivors

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Objectives: Upper limb weakness and loss of function is common after a stroke. With a few exceptions, most existing studies evaluating upper limb recovery only followed patients up to 6 months after stroke. The aims of this study are to evaluate recovery of dextrous hand function, document patient's use of the paretic upper limb in activities of daily living (ADL) and establish predictors of dextrous hand function in patients who have survived 1 year or more after stroke.

Method: This is a cross-sectional study of one hundred and thirty-nine patients who were more than a year post-stroke, and was conducted at the outpatient clinic of a tertiary rehabilitation centre. The outcome measures were upper limb function as assessed on the Motor Assessment Scale and use of the upper limb in activities of daily living (ADL).

Results: The mean age was 61.0 ± 13.3 years and patients were evaluated at 41.7 ± 35.1 months after stroke onset. Dextrous hand function was present in 39 (31.2%) patients and was significantly associated with upper limb strength, but not spasticity, functional status and use of the upper limb in ADLs. Of the 112 (64.7%) patients who reported no functional use of the upper limb in ADLs were 15 patients who were assessed to have dextrous hand function. Among the predictors of dextrous hand function, upper limb strength on rehabilitation admission was the most significant ($p=0.02$) followed by lower extremity strength ($p=0.07$). Age, sex, nature and site of stroke, stroke severity, neglect and dysphasia did not predict dextrous function.

Conclusions: Dextrous hand function was present in 31.2% of chronic stroke patients and initial upper limb strength on rehabilitation admission was the most important predictor. In 15 of the 39 patients, dextrous function was not translated to functional use, and we postulate that this may be a result of "learned nonuse".

0078

Emergency treatment after mild traumatic brain injury: Current situation in Switzerland and recommendations

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Objectives: The current status of emergency treatment for patients with mild traumatic brain injury (MTBI) in Switzerland was investigated.

Method: The physicians responsible for emergency care of MTBI patients at university, cantonal and district hospitals were surveyed with a questionnaire. The questions were grouped around eight topics relating to MTBI, whereby some questions required multiple choice answers and others an individual response.

Results: Unconsciousness was named as a diagnostic criterion by 65% of hospitals and the presence of amnesia by 75%. Although incorrect, 35% of hospitals considered headache to be a sure sign of MTBI, 60% cited nausea and 60% vomiting as definitive signs. Responses differed widely with regard to the Glasgow Coma Score (GCS) as a diagnostic criterion. 45% of hospitals reported that guidelines are used. All hospitals reported that patients with MTBI undergo physical and neurological examination. 45% of hospitals gave radiographic views of the skull as a relevant supplementary aid to diagnosis, 25% listed computed tomography of the head. Hospitals infrequently advise patients or give written instructions on appropriate conduct. None of the responders reported knowledge of special guidelines for the management of athletes after MTBI.

Conclusions: The quality of medical care available to injured persons after mild traumatic brain injury in Switzerland is highly disparate. An improvement in medical care can be achieved through the systematic application of guidelines for emergency treatment.

0079

Measuring Rehabilitation Readiness after TBI: A Psychometric Overview of the URICA-TBI

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Objectives: The purpose of the studies presented here was to explore the psychometric properties and clinical utility of the URICA-TBI. The University of Rhode Island Change Assessment (URICA) is commonly used to assess awareness and readiness to change in substance abuse treatment, and it has been adapted to assess readiness to engage in cognitive rehabilitation after Traumatic Brain Injury (TBI).

Method: The URICA-TBI is a 32-item self-report instrument. Items are rated on a 5-point scale. Four subscales (Precontemplation, Contemplation, Action and Maintenance) and a total readiness-for-change (RC) score are obtained. The URICA-TBI was administered to 162 individuals with

documented TBI ranging from mild to severe. Cronbach's alphas, and test-retest reliability were calculated, and correlations between the intent and intensity of treatment involvement and subscale and total scores were calculated. On a smaller sample (N = 49), Pearson's correlations and ANOVAs were used to explore the relative benefits of the URICA-TBI and the Self-Awareness of Deficits Interview (SADI), a commonly used interview-based measurement of awareness of cognitive deficits, as a measure of readiness to engage in rehabilitation after TBI.

Results: Cronbach's alpha ranged from .70 to .86 for the four subscales, suggesting good internal consistency. Test-retest reliability ranged from .35 to .75. Scores on the URICA-TBI subscales of Contemplation, Action, and Readiness for Change correlated strongly with treatment duration. A comparison of individuals' scores on the URICA-TBI and the SADI yielded no significant correlations. Closer inspection revealed an extremely restricted range of SADI scores, whereas participants were widely dispersed across stages of change as measured by the URICA-TBI (Coefficients of Variation = 0.882 and 7.081, respectively).

Conclusions: The URICA-TBI provides a promising assessment tool of rehabilitation readiness that could be used to maximize correspondence between readiness for treatment and intervention in order to improve outcomes and reduce attrition. Given its theoretical foundation and psychometric integrity, further validation is needed to establish its utility in clinical settings. Because existing measures of awareness of deficits, such as the SADI, have been used to gauge an individual's ability to set appropriate rehabilitation goals, it was surprising to find no significant relationship between the URICA-TBI and the SADI. The lack of relationship between the two measures could be attributed to the considerable ceiling effect of the SADI in this treatment-seeking TBI sample. The findings suggest that the URICA-TBI may be a more useful pre-treatment screening tool, and it may also be more sensitive to detecting changes in awareness with treatment over time. Further research is currently in progress to assess the validity of the URICA-TBI as a screening tool for treatment planning and an outcome measure of treatment efficacy.

0080

The Effect of Dipeptide of Glutamate and Alanine on Patients with Severe Traumatic Brain Injury

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Objectives: To explore the effect of the dipeptide of glutamate and alanine in managing severe traumatic brain injury (TBI).

Method: 56 patients with severe TBI were randomly classified into two groups: group G and group C. Group G received nutritional remedy with the dipeptide of glutamine and alanine, whereas group C received routine nutritional therapy only. Compare the GCS changes, the length of stay (LOS) in NICU and mortality; The count of lymphocytes; related complications such as lung infection and stress ulcer of alimentary tracts etc in two groups.

Results: I The fatality rate and LOS in NICU in group G (21.7%, 11.7 ± 2.6 days) was lower than these in group C (39.4%, 18.4 ± 3.8 days) (P > 0.05), but no obvious difference in change of patients GCS between the two groups (P > 0.05); II The cases with lung infection and alimentary tracts hemorrhage due to stress ulcer in Group G was less than those in group C. (P < 0.05); III the count of lymphocyte in group G was more than that group C (P < 0.05), but no difference in other nutritional data.

Conclusions: The dipeptide can increase the abilities of patients against stress resulted from severe TBI, thus lowered mortality of patients with STBI and shortened LOS in NICU.

0081

ABI-care: a joined (ad)venture?

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Objectives: ABI in children and youth often leads to complex behavioral, cognitive and educational problems. General healthcare, rehabilitation and mental healthcare are relatively separated institutions in Holland. How can we innovate, make a fusion (psychiatry, neuropsychology, neurology, rehabilitation) in a 'joint consult' for the more complex cases with ABI?

Method: In a pilotproject, during 24 months 5 organisations collaborated in 1 polyclinic, 38 patients were referred. Planned on 2 days within a week on 1 or 2 locations the various disciplines performed their assessment, in a joint meeting the results were discussed and in one meeting and report the diagnosis and advice were discussed with parents and patient, within a month after referral.

Results: This procedure has been positively evaluated by parents, patients, professionals and their organisation: efficient (focussed, integrated, timesaving), good practice (specialised team, complementary expertise, direct follow-up) with a spin-off in cooperation.

The analysis of 38 referrals will be presented.

Conclusions: The joint polyclinic is successful and now implemented as a joined venture. The enthusiasm of professionals and their organisations leads to the development of a regional, multicenter, integrated therapy program: a challenging and promising joined adventure.

0082

Top down or Bottom up? Executive and implicit function contributions to awareness after Traumatic Brain Injury.

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Objectives: Deficits in self-awareness are commonly seen after Traumatic Brain Injury (TBI) and adversely affect rehabilitative efforts, independence and quality of life (Ponsford, 2004). Awareness models predict that executive deficits contribute to impaired awareness post-TBI (Toglia & Kirk, 2000; Ownsworth, Clare & Morris, 2006). Executive functions inhibit, initiate and integrate other functions to mediate self-regulatory and goal-directed behavior (Miyake, Friedman, Emerson, Witski, Howerter & Wager, 2000). Implicit cognitive functions are also thought to contribute to awareness of deficits post-TBI. Findings show that TBI patients with impaired implicit cognition have poorer insight into behavioral deficits than those with intact implicit functions (Barker, Andrade, Romanowski, Morton & Wasti, 2006). Some models of awareness include an implicit cognitive component, although the putative relationship between implicit cognition and awareness has not been previously investigated (Toglia & Kirk, 2000; Ownsworth, Clare & Morris, 2006). The current study measured the contribution of executive function and implicit cognition to awareness in 34 TBI participants with predominantly frontal pathology using a broad range of measures.

Method: Traumatically brain injured participants completed a range of executive, implicit and awareness tasks. Executive measures included, the Sorting

Test (Delis, Kaplan & Kramer, 2001), the Self-Ordered Pointing Task (SOPT, Petrides & Milner; 1982), and the Brixton Test (Burgess & Shallice, 1997). Implicit cognition was measured using two experimental tasks known to be sensitive to frontal pathology, the Serial Reaction Time task (SRT; Nissen & Bullemer, 1987) and the Mere Exposure Effect task (MEE; Zajonc, 1980). Awareness measures included the Awareness Questionnaire (AQ; Sherer, Boake, Levin, Silver, Ringholz, & Walter, 1998), Dysexecutive Questionnaire (DEX; Wilson, Alderman, Burgess, Emslie & Evans, 1996), Self Awareness of Deficits Interview (SADI; Fleming, Strong & Ashton, 1996), and Self Regulatory Skills Interview (SRSI; Ownsworth, McFarland & Young, 2000).

Results: Results of hierarchical regression analyses showed that executive and implicit functions made significant unique contributions to selective aspects of awareness. Executive function scores (Sorting Test and SOPT) significantly predicted 'online' (SRSI measure) and metacognitive awareness (AQ and DEX measures). Implicit cognition measured by the SRT task significantly predicted online/emergent aspects of awareness (SRSI).

Conclusions: Implicit and executive functions make unique and significant contributions to awareness after TBI. Future models of awareness should account for the role of both implicit and executive contributions to post-injury awareness of deficits.

0083

Effects of age at time of injury on executive and implicit functions and behavioral insight: The latent deficit hypothesis.

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Objectives: This study investigated the 'latent deficit' hypothesis in two groups of frontotemporal head-injured patients, those injured prior to steep morphological and corresponding functional maturational periods for frontotemporal networks (\leq age 25 - Early Injury Group), and those injured

>28 years (Late Injury Group). The latent deficit hypothesis proposes that early injuries produce cognitive deficits that manifest later in the lifespan with graver consequences for behavior than adult injuries, particularly after frontal pathology (Eslinger, Grattan, Damasio & Damasio, 1992). Implicit and executive deficits both contribute to behavioral insight after frontotemporal head injury (Barker, Andrade, Romanowski, Morton & Wasti, 2006). On the basis of morphological and behavioral data, we hypothesized that early injury would confer greater vulnerability to impairment on tasks associated with frontal functioning than later injury. We investigated the effect of age at time of head injury in 32 traumatically brain injured (TBI) patients with frontotemporal lesions on implicit cognitive tasks, executive function ability and a measure of behavioral insight used in clinical assessments. Age- and IQ-matched controls also completed experimental tasks to provide normative data.

Method: Patients and age- and IQ-matched controls completed experimental tasks of implicit cognition: Serial Reaction Time task (Nissen & Bullemer, 1987) and Mere Exposure Effect task (Zajonc, 1980). Executive function tasks included, the Behavioral Assessment of the Dysexecutive Syndrome (Wilson, Alderman, Burgess, Emslie & Evans, 1996), The Hayling and Brixton tasks (Burgess & Shallice, 1997), Wisconsin Card Sort Test (WCST, Heaton, 1981), and the Controlled Oral Word Association Test (FAS version, Benton & Hamsher, 1989). Post-injury behavioral insight was measured using by computing DEX-Insight scores (Wilson et al., 1996).

Results: The Early Injury group were more impaired on implicit cognition tasks compared to controls than the Late Injury group. There were no marked group differences on most executive function measures. Results of interaction analyses indicated that age at time of injury moderates the contribution of executive function to behavioral insight in the predicted direction for the Early Injury group, and shows a similar but weaker effect for implicit cognition. There was no moderating effect of age at injury on executive contributions to DEX-Insight for the Late Injury group, and the contribution of implicit cognition to DEX-Insight followed an inverse pattern to Early Injury group data. Executive ability only contributed to behavioral awareness in the Early Injury Group.

Conclusions: Findings suggest that early brain injury has graver consequences for implicit and executive functions and behavioral insight than later injuries. Future work investigating functional deficits after frontotemporal insult should account for possible moderating effects of age at time of injury.

0084

Traumatic Coma: What To do After We Made It

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Objectives: Low consciousness state remains the major consequences of severe traumatic brain injury, Till now, less progress was achieved even though more and more attentions were paid on this issue. The question raised in every neurosurgeon's mind is what a physician can help the coma patients and their families when the lives were saved through intensive medical intervene. To investigate safe and efficient coma awakening strategies is among the targets of treatment of severe brain injury.

Method: In this present clinical trail, we applied the right median nerve stimulation (RMNS) technique on patients suffered from coma at the acute stage following primary brain stem injury. 87 cases of patients recruited into this multi-center clinical trail were randomly divided into treatment and control groups. In treatment group, RMNS was taken as the coma awakening method during NICU period and the data of intracranial pressure, Glasgow coma scale, vital signs were daily taken for patients in both groups. Patients received RMNS treatment eight hours per day for 2 weeks, and followed up at three months.

Results: The initiation of RMNS was 9.2 ± 1.36 days in treatment group. RMNS showed no significant relationship with the change of ICP value, regardless the variation of intracranial status. At the end of two-week treatment, the mean GCS of treatment group was significantly higher compared with that of control ($P < 0.01$), Three-month follow up indicated more patients regained consciousness in treatment group and the GOS was higher compared with control group ($P < 0.05$).

Conclusions: Currently RMNS exhibits potential therapeutic function on patients of long term coma and patients in vegetative state. To our understanding, the present study firstly report the application of RMNS on patients of acute traumatic coma resulted from primary brain stem injury. Clinical data indicated RMNS was a safe method to arouse the injured consciousness related brain structures, even though the patients were still under NICU treatment, and the GCS and GOS data indicated that right median nerve stimulation can hasten the recovery of decreased consciousness and improve the prognosis, at least on the subgroup of primary brain stem injury among brain trauma patients.

0085

Are there links between severity of initial concussion and persistence of neurocognitive functions?

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Objectives: Concussion can lead to cognitive, mood and behavioural disorders. However, there is much controversy as to whether persistent symptoms are due to neurological injury per se or psychosocial factors. We aimed to establish whether there were links between severity of injury as assessed “at trackside” and later neurocognitive functions as assessed at yearly baselines in professional jockeys.

Method: Over 80 jockeys of 300 who had been “concussed” in previous 5 years gave consent for their medical data to be accessed and linked to neurocognitive measures taken post-concussion and at yearly baseline. Data from Racecourse Medical Evaluations (RME) consisted of “Turner Questions”, the Mini Mental State Examination and clinical neurological examinations. Neurocognitive testing included computerised and traditional “pen & paper” tests of, for example, memory (Digits Span), attention (Trails a & b) and executive function (Stroop). Information about immediate post-concussional symptoms includes any loss of consciousness (LOC) and length, post-traumatic amnesia (PTA) and length, presence of retrograde amnesia (RA), vomiting, neurological deficits and whether hospitalisation occurred.

Results: Analysis of associations between acute symptoms of concussion and later neurocognitive functions will be presented.

Conclusions: Findings will be relevant for better understanding of early predictors of outcome in concussion and for the management of symptoms.

0086

Gang Bangs, Banged Out and Banged Up: Exploring gang identification, gang violence and head injury in offending behaviour in a young offender population

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Objectives: Head injury has been associated with offending behaviour, and violent offences in particular. Research exploring the issue of head injury in young offenders has tended to overlook the importance of group influence on offending behaviour. 75% of youth crime occurs within a group context. Utilising social identity theory, our study aimed to explore the extent to which an individual’s gang identification impacts upon the key clinical and forensic outcomes of head injury, psychological wellbeing and conviction rates.

Method: 186 young offenders, characterised by the presence of at least one conviction, were individually administered a questionnaire designed to elicit information regarding head injury history, offence history, level of gang identification and gang violence, and wellbeing.

Results: High rates of reported head injury were observed. 64% of the overall sample reported a history of one or more head injuries, 75% of which had sustained two or more head injuries. Participants reporting head injury had an average of two more convictions than their non-injured counterparts. Correlations were found between key variables. Path analysis indicated that gang identification predicted number of criminal convictions, gang violence, and frequency of head injury. Which in turn predicted mental health problems and increased criminal convictions.

Conclusions: Gang identification is a self-defining psychological construct that predicts key clinical and forensic outcomes including head injury, criminal conviction and wellbeing. The study provides a basis for the consideration of alternatives to custodial sentences in this already socially excluded group.

0087

Psychophysiological Aspects of Alcohol Epileptic Syndrome

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Objectives: Alcohol epileptic syndrome is one of the most frequent neurologic manifestations of alcohol dependence occurring during withdrawal. The goal of the study was to investigate psychophysiological peculiarities of patients with alcohol epileptic

syndrome in order to develop special diagnostic algorithms for its detection and selection of correct treatment and management approaches.

Method: There have been examined 251 Caucasian persons, their average age was 42.3 ± 0.89 . At the time of the study, they stayed at the Neurological Department of the Severodvinsk City Hospital, the Arkhangelsk region, Russia. In the course of the study, three groups of patients have been distinguished.

I group – patients with ES and CAI without brain localized organic damages in anamnesis (89 persons), average age $41.66 + 1.15$.

II – patients with ES without CAI (78 persons)

II-a – patients with ES and brain localized organic damages (craniocerebral injuries, insults, tumors) in anamnesis (22 persons), the average age $54.23 + 3.04$;

II-b – patients with ES and without brain localized organic damages (56 persons), the average age $36.98 + 1.86$.

III (comparison group) – patients with lumbar osteochondrosis, disciculatory encephalopathy I and II stage secondary to arterial hypertension and cerebral atherosclerosis, migraine and vegetative-vascular dystonia, not suffering from ES and CAI (84 persons), the average age $43.40 + 1.66$.

The main methods of the study were screening, a clinical method, electroencephalography, computerized tomography, a laboratory method. As part of the study, frequency of occurrence of separate clinical, psychophysiological and laboratory indexes was compared in patients with idiopathic, symptomatic epilepsy, alcohol epileptic syndrome.

Results: In the neurological status of the patients from the I group, focal symptoms were not revealed, however in 68.5% of cases, polyneuropathy of lower extremities has been detected. In 100% of cases, EEG of the patients from the I group had the following features: low-amplitude type, absence of zonal differences and alpha-rhythm modulations, dysrhythmia, light diffuse changes in the form of slow waves, multiple artifacts of recording; epileptic and local slow wave activity was not detected on the EEG. 82.0% of the patients from the I group had diffuse hypotrophic hydrocephaly on brain CT. In 94.3% of the patients from the I group, high activity of blood serum ALT, AST, GGTP was registered. The characteristic feature was that the normal level of blood serum bilirubin was accompanied by extremely high GGTP and ALT indexes what allowed to distinguish between hepatitis of different aetiology and alcoholic hepatitis.

Conclusions: On the basis of the study conducted, it has been concluded that the patients suffering from AES had the following significant anamnestic and neurophysiological characteristics. A correct

classification of attacks and accurate detection of ES types will provide rational and individual basis for therapy, allow to improve prognosis and quality of life of patients suffering from different epileptic attacks.

0088

Modulated Startle Response: An Objective Measure of Emotional Responses After Traumatic Brain Injury

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Objectives: Problems with emotional awareness and regulation after traumatic brain injury (TBI) are often long-lasting and detrimental to social outcomes. Finding better ways to study emotion in this population is a crucial precursor to better management of the problem. The purpose of this study was to determine the utility of an acoustic startle reflex (ASR) paradigm to objectively measure emotional responses in persons with TBI. ASR involves measuring the eyeblink response to a loud sound, and this response is modulated by one's emotional state when the startle noise occurs.

Method: ASR modulation by emotional imagery was studied in five participants with TBI. Participants listened to personal and hypothetical emotional scripts, followed by a startle noise. Scripts targeted emotions of joy, anger, and fear, along with neutral. Personal emotional situations were provided by each participant and used to create personal scripts (PS), whereas the hypothetical scripts (HS) were the same for all participants. Eyeblink and skin conductance responses (SCR) to startle stimuli were recorded. Participants also rated scripts for arousal, pleasantness, and emotion. Supplemental measures included questionnaires about irritability, aggression, anger, mood, and empathy.

Results: Magnitude of startle eyeblink responses during imagery of hypothetical and personal emotional scripts were analyzed separately with repeated measures ANOVA. Responses following hypothetical scripts did not significantly differ by emotion ($p = .169$), whereas responses following personal scripts did ($p = .036$). Within subject contrasts for personal scripts showed that startle responses were significantly smaller following anger scripts than

fearful ($p = .006$) and neutral ($p = .023$) scripts, but not joyful scripts ($p = .143$). Arousal ratings for anger scripts did not significantly differ from those for joy or fear scripts. Both anger and fearful scripts were perceived to be equally unpleasant. Several correlations were found between behavior measures and blink responses, as well as subjective script ratings.

Conclusions: In persons with TBI, personal emotional imagery of anger scripts resulted in reduced startle responding which was not found for hypothetical scripts. Since both script-types were perceived to have similar arousal and valence, differences could not be explained by these attributes alone. Startle data suggest that personal anger imagery engendered an “approach” motivation to the event rather than an “avoidance” motivation. This finding is consistent with behavioral reports of anger expression in this population. This study supports that ASR is a promising method for studying anger in persons with TBI. Future research should concentrate on replicating these findings, incorporating a control group, and utilizing this procedure as a tool to measure change in emotion after treatment.

0089

Brain Plasticity-Based Cognitive Skill-Building for Individuals with Traumatic Brain Injury (TBI)

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Objectives: The purpose of the studies presented here was to explore the feasibility of using a brain plasticity-based cognitive training (BPCT) program for individuals with TBI on both inpatient and outpatient settings. The computerized BPCT program was originally designed for use with older adults, and has been shown to improve cognitive functioning in neurologically disordered and normal adults.

Method: Materials: BPCT is administered with a computer software program designed to improve processing speed, attention, memory, and visual precision through a graduated series of structured exercises. Outcome assessments include the Automated Neuropsychological Assessment

Metrics (ANAM-4), a validated computerized neuropsychological battery that tests processing speed, working memory, attention, encoding, spatial processing, and accuracy; the Cognitive Failures Questionnaire (CFQ); Frontal Systems Behavior Scale (FRSBE); and User Experience Survey (UES).

Study 1: Ten community-dwelling individuals with mild to severe TBI (>6 months post-injury) were given the BPCT software to install on their home computers. Participants were asked to use the software 40 minutes per day, five days per week for six weeks; they received daily reminders to do their training and progress was monitored.

Study 2: Three inpatients on an acute TBI rehabilitation unit were recruited to use BPCT during their hospital stay. Training sessions (8–14 sessions lasting 30–45 minutes) were scheduled around patients’ rehabilitation program. Outcomes were assessed before and after treatment.

Results: Study 1: All participants were able to use the software at home. Improvements were noted on five of seven standardized neuropsychological assessment measures for all participants (ANAM-4; Cohen’s d of .28 to .58), and all participants reported fewer cognitive “blunders” (CFQ; Cohen’s d of .33 to 1.45), and/or fewer symptoms of executive dysfunction at post-test (FRSBE; Cohen’s d of .14 to .38). On the UES, participants reported improvements in concentration, executive function, visual processing, memory, and cognitive stamina.

Study 2: Case data are presented for one patient who completed 14 training sessions and all outcome assessments. Patient was able to use the computer with assistance, comprehend instructions, and progress through the program. He reported a positive experience on self-report survey and interview. Although not distinguishable from gains made due to standard rehabilitation and spontaneous recovery, he showed improvements in speed on tests of simple reaction time and delayed memory, as well as improved accuracy across all domains tested.

Conclusions: These studies indicate that BPCT may be a viable intervention for individuals with TBI. For community-dwellers, the intervention can be delivered in patients’ homes as an adjunct to comprehensive outpatient rehabilitation. On an inpatient unit, a subset of individuals may be able to use the program as an adjunct to standard inpatient rehabilitation. Obstacles to implementing the intervention and recommendations for increasing the feasibility of this intervention on an outpatient and inpatient basis are discussed.

0090

The Importance of Staff-Client Working Alliance in Determining Rehabilitation Outcomes for Adults with Acquired Brain Injuries

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Objectives: Despite the large literature showing the importance of client-therapist therapeutic alliance in predicting outcomes in psychotherapy for individual and family therapy, there is very limited research in rehabilitation, especially for those with acquired brain injuries. This presentation will provide the outcomes for a study of the correlation between working alliance and rehabilitation success.

Method: This oral presentation will provide the outcomes for a study of the correlation between working alliance, as measured by the Working Alliance Inventory (Horvath & Greenberg, 1989), and rehabilitation success, as measured by a version of the Goal Attainment Scales (Kiresuk, Smith, & Cardillo, 1994) with thirty-five community living, long-term survivors of an acquired brain injury (mean length of injury of 15 years) provided rehabilitation from a community-based ABI agency.

Results: Similar to findings in the psychotherapy literature, total alliance was significantly correlated with GAS outcomes in the moderate range (.45 for staff, .34 for clients). Contrastingly, bond alliance was more consistently correlated with success by both staff and clients than goal or task alliance.

Conclusions: Bond alliance was more consistently correlated with success by both staff and clients than goal or task alliance, a finding suggesting the overwhelming importance of the therapeutic bond in influencing rehabilitation success for long-term survivors. The role that social isolation and mental health plays in determining this relationship will be discussed.

0091

Determiners of Quality of Life among Adults Living with a Brain Injury

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McMaster University, Hamilton, ON, Canada

Objectives: Considerable research has been conducted on the determiners of quality of life for

adults living with a brain injury. The results have not been consistent across studies, largely because of differing populations of subjects (time since injury), and different measures of quality of life and other variables.

Method: Seven years ago Brain Injury Services of Hamilton (BISH) initiated a large scale study conducted over three years involving 126 adults from two community agencies and the BISH waiting list. A broad range of well standardized and normed self-report and staff-report measures were selected in an effort to improve upon the methodology of past studies. Measures of quality of life, mental health, adaptive functional skills, behavioural problems, neurobehavioural functioning, and self-awareness were administered to all subjects and their staff.

Results: A large scale correlational analysis was conducted to identify those factors most strongly associated with quality of life. Despite the presence of significant differences between client and staff results, a pattern of correlations was found that indicated that level of functioning/independence and the adaptive skills associated with independence were not well correlated with quality of life. In contrast, mental health and level of behavioural problems were most strongly predictive, a finding especially true for those with self-awareness deficits. The implication of these results for successful post-acute community-based rehabilitation will be discussed.

Conclusions: A large scale correlational analysis was conducted to identify those factors most strongly associated with quality of life. Despite the presence of significant differences between client and staff results, a pattern of correlations was found that indicated that level of functioning/independence and the adaptive skills associated with independence were not well correlated with quality of life. In contrast, mental health and level of behavioural problems were most strongly predictive, a finding especially true for those with self-awareness deficits. The implication of these results for successful post-acute community-based rehabilitation will be discussed.

0092

A Community Study of Determiners of Depression Among Adults with Acquired Brain Injury

Bruce Linder

McMaster University, Hamilton, ON, Canada

Objectives: Surprisingly few studies exist concerning the multiple determiners of depression among

post-acute community living adults with acquired brain injury. Yet, mental health is the most significant determiner of quality of life for the long-term surviving ABI group (mean length of injury of 15 years).

Method: Using a correlational research design and standardized self-report surveys and interviews, we conducted a study of a wider range of predictive variables in a group of 45 community living adults with acquired brain injury receiving services from Brain Injury Services in Hamilton including some typical variables such as gender, length of injury, severity of residual disability, marital and vocational status, and some less typical but probably important ones such as quality of life, loss of quality of life, coping style, quality of intimate relationships, friendships, pet ownership and degree of anthropomorphizing such relationships, religiosity and executive functioning.

Results: Several variables were found to be significantly correlated with depression: quality of life and the extent of loss of quality of life, coping style (cognitive avoidance, acceptance and resignation, emotional discharge), friendships, and religiosity distress.

Conclusions: This talk will discuss these results and their implications for providing effective treatment and support.

0093

The Effectiveness of Community-Agency-Based Therapeutic Groups with Adults with Acquired Brain Injury

Bruce Linder

McMaster University, Hamilton, ON, Canada

Objectives: This presentation will report the results of cognitive-behavioural therapeutic (CBT) groups specially designed for adults with acquired brain injuries conducted under the direction of Brain Injury Services of Hamilton over the last 9 years.

Method: Sixty-three adults with acquired brain injuries participated in 13 groups for either anger management or self-esteem/depression. Ten to 15 group sessions 1.5 hours long were facilitated by two therapists including the senior author or therapists trained by the senior author to follow the CBT style structured format. The effectiveness of the groups were assessed by administering a group of paper-and-pencil self-report measures before

and after the group intervention and included (1) standardized measures for depression or anger expression (BDI, STAXIS, Tennessee Self-Concept Scales), (2) knowledge tests of CBT material for anger or depression, and (3) satisfaction surveys.

Results: Statistical analyses of pre- vs post-intervention change found statistically significant positive change in most measures. Contrary to expectations, knowledge gains did not correlate with symptom reduction.

Conclusions: This presentation will provide information about the CBT group curriculum and methods of implementation in addition to a careful analysis of the results. Typical problems encountered with facilitating such groups and the issue of generalization of skills learned in groups to the real world will be discussed.

0094

Evaluation of Caregiver Styles in Group Home Settings for Adults with Acquired Brain Injuries

Bruce Linder

McMaster University, Hamilton, ON, Canada

Objectives: Research in parenting styles, starting with Baumrind's (1968) tripartite model of Authoritarian-Authoritative-Permissive styles, has demonstrated correlations between style and children's behaviour. Virtually no research exists for congregate living settings for children and adult with various disabilities in which staff are the primary caregivers, despite frequently expressed concerns that staff can be overly authoritarian.

Method: This study looked at the prevalence of Baumrind's three styles among fifty-nine staff in seven group home settings for adults with ABI at Brain Injury Services (Hamilton, Ontario, Canada). The Parental Authority Questionnaire - Revised (PAQ-R) by David Reitman et al. (2002) was modified to be appropriate for staff to complete about their own style. A supervisor rating scale was designed to be completed on each staff as well. Other measures included staff ratings of their own parenting style, the style of their parents, the level of behavioural problems and consistency of routines in each setting, and the Crowne-Marlow Social Desirability Questionnaire.

Results: Results showed that staff reports were significantly influenced by social desirability bias with over 95% describing their style as Authoritative.

Contrary to expectations, supervisor ratings showed that the predominant style was Permissive at 46%. No significant correlations among the other measures were found.

Conclusions: Results will be discussed in terms of philosophies of appropriate staff training.

0095

Brain Activation During Task-Switching Following Traumatic Brain Injury

Charlene Halterman, Louis Osternig, Li-Shan Chou, Ulrich Mayr & Paul van Donkelaar

University of Oregon, Eugene, Oregon, United States

Objectives: The long term pathophysiology of traumatic brain injury (TBI) has not been fully elucidated. Individuals that have a history of one or more TBIs frequently suffer deficits in the ability to maintain and properly allocate attention within and between tasks. This study examines the influence of TBI on this ability by assessing injury-induced changes in brain activation during task switching performance.

Method: Individuals with chronic TBI were tested at least 10 months after their most recent injury. Healthy gender, age, height, weight & activity level matched controls were also tested. Subjects underwent fMRI scanning while completing a task-switching task. Activation patterns were compared to a baseline condition in which no switching occurred.

Results: Controls displayed greater activation in the lateral prefrontal cortex during the task-switching task relative to the non-switching baseline trials. Conversely, TBI subjects displayed greater activation in the ACC as well as in the medial frontal cortex in this contrast.

Conclusions: Lateral prefrontal cortex has been shown to play a role in set selection and maintenance, whereas medial frontal cortex and anterior cingulate have been implicated in conflict resolution and error monitoring. Thus, the greater activation of the lateral prefrontal cortex in the control subjects illustrates that they were more fully engaged in selection and maintenance of the appropriate task set during task-switching performance. By contrast, the greater activation in the anterior cingulate cortex and medial frontal cortex in the TBI subjects indicates a disproportionate effort to resolve conflict and monitor errors during performance of task switching in this population.

0096

Growth hormone and insulin-like growth factor-1 deficiencies in children and adolescents following traumatic brain injury: the impact on neuropsychological recovery

Julia Wamstad, Peter Patrick, Ken Norwood, James Blackman, Matthew Gurka, Alan Rogol, Mark DeBoer, Marcia Buck & Jodi Darring

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Objectives:

- Traumatic brain injury (TBI) is associated with a decrease of growth hormone (GH) and insulin-like growth factor-1 (IGF-1) levels in children and adolescents.
- GH and IGF-1 have binding sites in the hippocampus, among other locations. Therefore, it has been proposed that GH and IGF-1 deficiency may contribute to neurocognitive effects, particularly learning and memory.
- GH and IGF-1 deficiency have been shown to have neurocognitive effects in adults.
- GH and IGF-1 deficiency have been shown to negatively affect quality of life in adults.
- We set out to investigate the relationship between performance on neuropsychological testing and markers of the GH axis (GH and IGF-1 levels).

Method:

- Fifty nine patients referred to the TBI clinic at KCRC were offered the chance to enroll. Of these, 32 elected to participate and 29 were able to participate in neuropsychological testing. The parents of subjects who were unable to participate in neuropsychological testing (N = 3) participated in a Vineland-II interview. Subjects were admitted to a GCRC and had serial testing of GH overnight by intravenous sampling every 20 minutes. In the morning, subjects underwent glucagon/arginine stimulation testing with GH levels assessed every 30 minutes.
- Neuropsychological areas of interest included IQ, memory, executive functioning, and quality of life. These were assessed with select subtests from the WAIS, WRAML2, DKEFS, CHQ, and BRIEF.
- Subjects were classified as GHD if their GH was <5 ng/mL at all times during overnight testing.

- Subjects were classified as IGF-1 deficient based on Tanner stage for breast (girls) or genitalia (boys).

Results:

- Severity of injury did not predict GH and IGF-1 deficiency.
- GH and IGF-1 deficiency had no statistically significant impact on IQ.
- Subjects who were GHD had statistically significant lower scores on measures of visual memory and health related quality of life ($p < .05$).
- Subjects with abnormal levels of IGF-1 had statistically lower scores on measures of memory, visual attention & concentration, and executive functioning ($p < .05$).

Conclusions:

- Our findings suggest that deficient levels of GH, as well as IGF-1, negatively impact neuropsychological functioning.
- These findings are not explained by severity of injury or IQ.
- GHD appears to impact skills that require visual processing.
- Future research should explore the covariance between GH and IGF-1 deficiency. A person with both GH and IGF-1 deficiency may present with a more global impact on memory, executive functioning, and quality of life.

0097

How accurate are the cognitive complaints of individuals with traumatic brain injuries?

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Objectives: The purpose of this study was to explore the accuracy of cognitive complaints in individuals who sustained a traumatic brain injury (TBI). To accomplish this, we compared the response patterns of patients with moderate-to severely TBI to those with mild TBI.

Method: A multi-group comparative research design was utilized. An outpatient sample of 61 individuals with TBI utilizing the Ruff Neurobehavioral Inventory (RNBI), neuropsychological test battery, and clinical interviews were included for analysis.

The participants' self-ratings of attention, memory and learning, language skills, and executive functioning were correlated with their corresponding neuropsychological test scores. The potential influence of emotional residuals were also explored by TBI group severity.

Results: Compared to the mild TBI group, the moderate-to-severely TBI sample exhibited greater dysfunction on neuropsychological measures of memory and learning. For the moderate-to-severe TBI group, significant correlations were found between their neuropsychological memory test scores and their self-reported impairments assessed by the RNBI Postmorbid Memory and Learning scale. In contrast, the mild TBI group endorsed significantly higher RNBI Postmorbid scales for Attention and Concentration and Executive Functioning as compared to the more severely injured counterparts. In the mild TBI group, the RNBI Attention and Concentration scales predicted the performance of neuropsychological measures of attention. Analyses of the mildly injured participant's RNBI emotional scale indicate that PTSD symptomatology may lead to higher endorsement of self-reported cognitive difficulties and thus impair the accuracy of self-report.

Conclusions: Used in conjunction with traditional neuropsychological tests, standardized questionnaires that document a range of cognitive and emotional functions can yield important information regarding a patient's perception and also the flag synergistic effects between emotional and cognitive complaints.

0098

A comparative analysis of virtual reality systems within motor rehabilitation for children and youth with Acquired Brain Injury: Development of a treatment model

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²University of Melbourne, Melbourne, Australia

Objectives: Virtual reality (VR) therapy for motor skill enhancement is a rapidly developing area of practice and research within pediatric rehabilitation. Multiple VR systems exist which provide interaction with the virtual environment through interfaces ranging from fully-immersive, head-mounted displays to video- or sensor-based motion-capture gaming systems. VR therapy is a component of clinical practice for

children and youth with ABI, yet very little research has included this population. Many aspects of VR therapy, including practice of safe, meaningful tasks within an enriched environment, motivational gaming appeal, and provision of abundant feedback may be highly relevant to the rehabilitation needs of children and youth with ABI. However, other features may be less applicable. The purpose of this project is to review the literature pertaining to pediatric VR therapy and undertake a comparative analysis of VR systems to compare and contrast their potential relevance to the heterogeneous needs of this population. This analysis will identify directions for future research and will inform the development of a preliminary treatment model to facilitate clinical decisions in the absence of population-specific evidence.

Method: A taxonomy to classify VR systems was created based upon material collected through literature review. Using a data charting framework, the authors extracted information from the literature pertaining to characteristics, empirical support, advantages and disadvantages of each VR classification within the taxonomy. A comparative analysis was undertaken to compare, contrast and match features of each VR classification with the needs and characteristics of children and youth with ABI undergoing motor rehabilitation.

Results: VR taxonomy classifications describe how users interact with, and are represented within, the virtual environment. Thirty-four publications were identified describing or evaluating the use of VR therapy to improve motor skills in pediatric populations, of which five included or mentioned ABI. The potential benefits and challenges of rehabilitation-specific and commercially available VR systems for ABI motor rehabilitation are summarized within a comparative table. Based on this analysis, a treatment model is proposed to guide clinical decision-making with respect to potential inclusion of these VR systems within rehabilitation towards specific motor goals.

Conclusions: There is very little research exploring the use of VR systems within motor rehabilitation for children and youth with ABI. A comparative analysis of the field as a whole has identified areas in which systems are potentially well-suited to this population, as well as characteristics which may imply that integration of VR systems into therapy may be more challenging. A decision-making algorithm serves as a preliminary treatment model. Specific suggestions for research in this population are presented, including the need to evaluate transfer of skill improvement to real life tasks and explore the role of the therapist during VR therapy.

0100

Apathy Syndrome-What we know and don't know. A Case study-to better understand Apathy Syndrome in a patient following Traumatic Brain injury

Vaidya Bala

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Objectives: Apathy Syndrome is defined as a syndrome of primary motivational loss not attributable to emotional distress, intellectual impairment or diminished level of consciousness. If it is severe, it shades into Abulia and Akinetic Mutism depending on severity.

Apathy Syndrome can be secondary to Brain injury, Stroke, anterior Communicating artery aneurysm etc. The Case study is to assess Apathy Syndrome in a patient with extremely severe traumatic brain injury and to identify appropriate management options in Rehabilitation setting at The Victorian Rehabilitation centre in Melbourne Australia.

Method: A 35 year old man was admitted to the Victorian Rehabilitation centre following a motor bike accident as a rider on the 16th of June 2009. He sustained Severe Traumatic brain injury associated with multiple fractures. Following acute stabilisation he was admitted to Rehabilitation care. He was in minimal conscious state for a while before he was observed to be more alert. As he emerged to be more alert, he was observed to be more physically inert, speaking only few words and was not keen to participate in Rehabilitation. He had a very flat affect with poor facial reaction. He was observed to be stimulus bound and lacked spontaneity. We applied the diagnostic criteria for Apathy Syndrome as published in DSM-4 Criteria assessing his behaviour, cognition and emotional response. Apathy Evaluation scale was not used as patient refused to participate. A trial of Selective Serotonin and Nor-adrenaline re-uptake inhibitor (Venlafaxine XR) was commenced. The rationale being pure SSRI by themselves can aggravate Apathy as a symptom based on literature. We decided to use SNRI instead. Following increase in dose to 150mg daily over a 3 week period. I then increased his dose to 225mg daily. On reviewing his other medication, we could not find anything that could contribute to his symptoms.

Results: The Rehabilitation team observed some changes in his behaviour, cognition and emotion. He started communicating better, spontaneously started eating and started participating in Rehabilitation therapy sessions. He denied any

depressive symptoms when asked about suicidal ideation. However I felt this required further assessment. Overall the patient and his family were quiet happy that he started participating in therapy and was observed to have improved motivation.

From a Allied health's perspective the patient started engaging in sessions from the 21 st of September which is 3 wks from starting medication. Communication improved to full meaningful sentences. Active participation was observed in functional tasks. Overall his transfers improved and is now actively participating in ADL re-training.

Conclusions: Apathy Syndrome is a disorder of Motivation which can result following Brain injury. It can be assessed using the diagnostic criteria (DSM4) and using Maurin's Apathy Evaluation Scale-Clinician's Version. The management principle involves better understanding of the disorder followed by comprehensive assessment and multi-disciplinary treatment model. So far we are not able to clearly categorise Apathy Syndrome based on its severity. I think Apathy Syndrome deserves more attention and more clinical trials in order to develop an appropriate treatment options in the future.

0101

Encephalitis and its Consequences - An Introduction.

Ava Easton

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Objectives: Encephalitis is inflammation of the brain caused by infection (usually viral) or by autoimmune disease. Encephalitis is indiscriminate, striking adults and children alike, showing no respect for age, gender, ethnicity or culture. Mortality rates are high and many of those who survive are left with an acquired brain injury, the degree and severity of which will vary.

Despite an increasing global spread of some of the causes of encephalitis (e.g. viruses and their vectors), and the severity of outcome for many people affected, little understanding exists among health and social care practitioners, particularly around the on-going consequences and impact upon the individual and their families.

This workshop aims to address some of these gaps and provide an overview of the main issues around

encephalitis and its consequences, enabling practitioners, therapists and educationalists to better understand and address the needs of their patients and clients.

Method: Using existing literature, real-life video case histories and other evidence-based examples collected by the Encephalitis Society (the Society is evidence-based and supported by a full clinical panel of international reputation) we will share with delegates common experiences and problems along with strategies and coping mechanisms that may improve outcomes for people affected by Encephalitis and subsequent brain injury. The workshop will be interactive and will explore with delegates through discussion other successful approaches and techniques that participants have used or are aware of. The workshop will also facilitate opportunity for any common problems to be discussed and possible solutions sought.

Results: The result of this workshop will include delegates having a better understanding of encephalitis, its outcomes and a range of strategies with which to call upon and better support their clients and their families. The Encephalitis Society is a UK-based organisation which is exploring opportunities to expand to the US and therefore the workshop would also present an opportunity for individuals interested in Encephalitis to network and exchange contact details.

Conclusions: The contents and outcomes of the workshop will subsequently be written up by the facilitator and circulated to all participants for their information along with the contact details of those that participated (with their permission). Each participant will be provided with a comprehensive workshop pack during the session.

0104

Classification of Head Injury with Early Magnetic Resonance Imaging

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Objectives: There have been numerous attempts to classify head injury. A classification based on

computerized tomography (CT) findings has never been proven to be of high predictive value. Magnetic resonance imaging (MRI) is difficult to perform in comatose patients while these are ventilated, but it has been done lately with increasing frequency.

Method: From 1998 to 2009 in a prospective study 220 patients in coma after a head injury were examined at our institution. All patients were in coma for at least 24 hours, MRI was obtained within 8 days of the injury, median after 3.5 days after an initial CT had been performed. T1 and T2 weighted images were obtained with a 1.5 Tesla magnet. Lesions were identified by a team of neuroradiologists blinded to the clinical findings. The location of the brain, where a lesion was identified was noted, not the extent or volume of the lesion. Outcome was classified according to the Glasgow Outcome Scale. Results 6 months after the injury were calculated with statistical means including cross tables, Fisher's exact test, Anova, Chi² test.

Results: The frequency of brain stem lesions was 67%, almost none of these contusion could be identified with CT. Statistical analysis identified a significant correlation of mortality with a brain stem lesion. Within the group of brain stem lesions bilateral pontine lesions had the worst prognosis.

Conclusions: Obviously the brain stem lesions are associated with increased mortality. It may be concluded that compression of the brain stem from swelling, edema or hematoma should be avoided. This appears to support the idea of a generous indication to perform craniectomy when clinical signs of brain stem compression, such as anisocoria or posturing, are noted.

0105

A Longitudinal Study on Driving Skills after a Traumatic Brain Injury

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Objectives: Resuming driving after a severe traumatic brain injury is an important step in the patients' rehabilitation process. However, driving a car requires good cognitive functions that may be strongly impaired after a brain injury. Thus, it

seems important to study how cognitive functioning evolves in long terms after a brain injury. The aim of this research was to study the dynamic evolution of cognitive functions and driving competence in drivers with a severe traumatic brain injury.

Method: Eleven patients (5 to 32 days of coma) were included in this longitudinal study. They had been followed during the whole rehabilitation process and evaluated on a battery of cognitive tests at three chosen steps of the rehab process: the first evaluation occurred when they entered the rehabilitation centre (at the end of post-traumatic amnesia); the second evaluation occurred few months later when they left the rehabilitation centre; and the third neuropsychological evaluation occurred one year later. A driving assessment was also organised at the same time of the second cognitive evaluation. It was conducted on an open road by a certified driving instructor who gave a global assessment of fitness to drive. An experimenter was also present in the car and made an "online" assessment with an evaluation scale scoring errors on different observable behaviours at intersections or specific traffic situations. A camera also recorded the driver's behaviours.

Results: Most of the patients included in the study have a good recovery of their cognitive functions during the year following the brain injury. We also showed that there were important individual differences in the recovery: Some patients mostly improved their cognitive abilities during the rehabilitation program while others had a longer recovery during the year following the accident, with remaining impairments. Concerning the driving assessment (9 patients included), half of the patients' group obtained a positive assessment (fit to drive without any restrictions), 3 patients failed and were considered as unfit to drive at this time of the rehab, and 2 patients were considered fit to drive with driving lessons advices. The online assessment showed that most of the patients who failed the assessment had impairments in visual exploration and in anticipation behaviours.

Conclusions: This aim of this follow-up study was to examine how the recovery of cognitive functions can have an impact on resuming driving after a severe traumatic brain injury. The outcomes were that patients with a good cognitive recovery had better chance to have a positive driving assessment. This study also reveals that driving based re-education programs could be developed during the rehabilitation process, before a behind-the-wheel evaluation (Masson, Marin-Lamellet, Colliot, & Boisson, 2009).

0106

Identifying Factors that Enable and Constrain Client-Centred Care in Brain Injury Rehab

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Objectives: Client-centred care (CCC) is increasingly advocated as an important underlying principle for the delivery of health and rehabilitation services. CCC is associated with increased compliance and adherence to treatment, improved functional outcomes, decreased length of stay, and increased cost-effectiveness. Despite the benefits of CCC, barriers to its systematic implementation persist suggesting that further exploration is required of factors that enable and constrain CCC. The objective of our study was to explore the perceptions of practitioners working in the field of traumatic brain injury (TBI) regarding the nature of current practice, and how/why it is consistent/inconsistent with CCC.

Method: Thirty-two interviews with practitioners were conducted in two different in-patient rehabilitation hospitals in Ontario, one serving an urban population and the other rural. Questions focused on their perceptions of the nature of TBI care on the unit, how consistent/inconsistent it is with CCC, and facilitators and barriers regarding CCC. All interviews were tape recorded, transcribed verbatim, and analyzed using standard qualitative coding techniques.

Results: Facilitators of CCC included knowing the client, the nature of specific disciplines, and community assessment. Barriers included mismatched expectations between practitioner and client, the artificiality of the rehab setting, poor staff communication, insufficient training, standardization, and knowing the cause of the TBI.

Conclusions: Our findings support the need for recognition of the systemic factors that impede the implementation of CCC in TBI rehabilitation. Our findings further support the need for educational interventions to address grieving, cognitive disability, as well as differences in practitioners' roles and their perceived conduciveness to practicing CCC.

0107

Tracking Traumatic and Non Traumatic Brain Injury in a Publicly Insured Population

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Objectives: Although the consequences and rehabilitation of non traumatic brain injury (NTBI) can be similar to that of traumatic brain injury (TBI), there is no common central database that includes non traumatic cases in addition to those for TBI. The aim of this pilot project was to develop a central database for both TBI and NTBI and to assess the ability of population based administrative data to provide information on incidence, cause of ABI, severity of the condition, geographic location (we have location of treatment), demographic characteristics, movement through the health care system, health outcomes and, resource intensity.

Method: The study utilized a cross-sectional and longitudinal design. We utilized administrative data from the publicly insured health care system in Ontario regarding emergency room visits, acute care and inpatient rehabilitation that are collected on a mandatory basis throughout the province. ICD-10 codes included were for TBI and for NTBI which included anoxia, brain infections such as encephalitis, meningitis, brain tumors, and vascular causes other than stroke. Care episodes were based on emergency room admissions and/or hospitalizations. Demographic and clinical characteristics were compared among these 2 types of acquired brain injury.

Results: There were over 36,000 episodes of care for the fiscal year 2006 for 31,077 patients representing rates of 1.3 and 1.2 per 1,000 respectively for TBI and NTB in Ontario. Persons with NTBI were significantly older, and had longer length of acute care stay.

Conclusions: This study shows that the incidence of care episodes for NTBI is similar to TBI from a population-based perspective and as such an important set of conditions to track. In addition, NTBI has a different demographic and clinical profile than TBI which may have greater implications for resource utilization. The next phase of the pilot will merge data from continuing care, physician visits and home care agencies to address the continuum of care. Strengths and weaknesses of

using administrative data will be discussed. We will also describe our knowledge transfer plan that provides needed data on TBI and NTBI to local health units.

0108

Social networking and concussion awareness: the emerging concept of “iSupport”

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Objectives: Facebook is an exceptionally fast-growing Social Networking Site (SNS) containing membership groups with discussion boards on a wide variety of topics. Specialised groups with a focus on health and injury issues are starting to emerge, including those devoted to concussion. Considering the rapid international growth of Facebook and other SNSs their role in facilitating information and knowledge transfer about concussion needs to be explored. The purpose of this study is to explore selected Facebook sites devoted to dialogues on concussion and to scrutinise the postings to determine their content and potential role as support networks.

Method: 472 Facebook groups related to concussion were identified and screened relative to the inclusion criteria of whether they focused on concussion (mild TBI) and had a minimum number of postings. Data were abstracted, using a consensus approach, with a focus on the demographics of the postee, and the purpose of the posting. Supporting quotes were extracted with respect to emerging themes.

Results: From the 17 Facebook groups which met the inclusion criteria, 145 postings were included for analysis. The predominant demographic group which posted on the Facebook discussion boards were North American males. In the main, postees utilised Facebook groups to relate personal experiences of concussion (65%), although it was also used to seek (8%) or offer advice (2%). Supporting quotes were used to highlight these findings.

Conclusions: This study highlights the evolving nature of healthcare support in the 21st century and the rich information present relating to concussion on SNSs such as Facebook. Whilst the information being shared on these sites is important, the peer-to-peer interaction may be the key aspect of this health education medium. We have coined the term for this interaction as “iSupport”. SNSs need to be further

explored and monitored to ensure accurate information on concussion and safe return to activities is available through this expanding non-traditional medium.

Funding: International Rugby Board.

0109

Managing Complex Concussions in Children and Youth: A Multidisciplinary Approach to a Multifaceted Problem

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Objectives: In the past five years, concussion referrals to the Pediatric Acquired Brain Injury Community Outreach Program (PABICOP) have increased substantially. Referrals may be made acutely or at any time post-injury, and may follow a first, or repeat concussion. Clients are followed using a needs-based model that is not time limited (up to age 18). The PABICOP program implements a multidisciplinary approach to support the physical, educational, and psychosocial needs of the child and family. Education and support is provided to the child’s school and broader community to aid understanding regarding ‘normal’ concussion sequelae (e.g., pain, fatigue, decline in academic performance, social isolation). In light of the increased number of concussion referrals, program staff members were interested in identifying possible trends in the demographics of these referrals to PABICOP. An additional objective was to look for possible complex concussion profiles in an effort to explore factors that may be related to concussion recovery, in order for the program to take a more targeted proactive approach for supporting children and youth with concussion.

Method: A retrospective chart review was conducted of all concussion referrals received by the program over the past two years to obtain demographic data (i.e., age, gender), as well as information regarding number and duration of symptoms reported. Information regarding the amount and nature of client contact with our program was also obtained.

Results: Chart review identified that 65 (47%) of the 139 referrals to PABICOP over the past two years were diagnosed as concussion. Findings were generally in line with previous research that has identified that a higher number of males than females sustain concussions. In addition, the 13–18

year old age group sustained concussions more frequently and had a more complicated course of recovery. This was evident for each gender. However, somewhat conversely, females in the 13–18 year old age group had the highest percentage of complex and long-term concussion sequelae, requiring ongoing and multidisciplinary intervention.

Conclusions: Review of data from clients of the PABICOP program indicates that youth in the 13–18 year old age group are at highest risk for sustaining concussion and for having ongoing and complex sequelae. Furthermore, despite more males than females sustaining concussions in all age groups, ongoing and complex sequelae are more prominent among females than males in the 13–18 year old age group. Understanding trends in the data allows program staff members to provide a more targeted proactive multidisciplinary approach to educating and supporting children and youth, and their families, schools, and communities toward alleviating stress and other difficulties associated with recovery from concussion.

0110

A Proposed Injury Criterion for Mild Traumatic Brain Injury Based on Crash Injury and Vehicle Test Crash Data

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Objectives: Mild traumatic brain injury (MTBI) due to rapid deceleration is common, however injury thresholds have not been established. An established threshold for skull fracture has allowed effective design of helmets and other injury prevention measures. Similarly having an acceleration exposure threshold for MTBI would assist in design of prevention measures.

Method: Frontal auto crashes were selected from the Crash Injury Research and Engineering Network (CIREN) database. This database contains the make, model and year of the vehicle, a crash reconstruction which provides the change in velocity of the vehicle during the crash, as well as information on occupant restraint use and medical documentation of injuries which may or may not have included MTBI with loss of consciousness less than 1 hour. From the National Highway Traffic Safety Administration's New Car Assessment Program (NCAP) frontal crashes on similar model vehicles were matched to the actual crashes. In NCAP test

crashes, detailed data on dummy head accelerations is recorded. The data were scaled for differences in the speed change in the actual crash since NCAP crashes are performed at a standard 36 mph (58 kph) at 0 deg (head on) relative to the vehicle. Therefore, the probable head acceleration that the victim of the actual crash was exposed to could be estimated from the NCAP equivalent to the actual collision. Then an analysis of risk of MTBI to acceleration of the occupant's head was determined using a logistic regression analysis.

Results: There were 29 crashes in the MTBI group (cases) and 78 in the non-MTBI group (controls). The average speed change of the actual crashes was 56.8 kph at an angle of 9.5 deg compared to 57.9 kph at 0 deg for NCAP crashes so no scaling was needed between test and actual crashes. There were no differences in the percentage of males to females, age, or height of the subjects or the percentage which used belts between the two groups. There were significant differences in mean peak head acceleration (58.3g for MTBI v 40.5g for non-MTBI), and subject weight (90.2 kg v 73.4 kg). Exposure of the occupant's head to a 40g rearward acting horizontal (X) acceleration over about 80 msec, yielded a 20% probability of MTBI, 80g, a 50% probability, and 120g, an 80% probability.

Conclusions: A separate study based on analysis of football game video yielded an almost identical result (79g at 50% probability). Our results showed that exposure to linear acceleration acting posteriorly with little rotation results in a 50% probability of MTBI at an exposure of 80g. The car crash sample encompassed a large segment of the population, ranging in age from 18 to 82 years of age, and tolerance to acceleration decreased as age increased.

0111

Effect of Brain Tissue Undulation on Mechanical Properties

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Objectives: In areas such as corona radiata, axons are observed to have high undulation (Stephen and Waxman, 1995). In the present study, guinea pig optic nerve axons from a previous study of Meaney (2003) are considered to determine the impact of

such undulations on the material property, as well as stress-strain distribution.

Method: In this research a computational micromechanics method for characterization and analysis of brain tissue, and in particular, the white matter of the brain was utilized. The method employed the microstructure characteristics as well as the mechanical properties of the individual elements constituting the tissue. The influence of various material and geometrical parameters such as the viscoelasticity, hyperelasticity and undulations of the axons were examined. Waviness behavior was implemented into the model to cover axonal undulations at different regions of white matter. The unit cell geometry is defined on the basis of the wavelength and the amplitude of axons. Since the volume fractions (Vf) of the axons and matrix inside the tissue changes for different areas of white matter, a parametric study on the Vf is also conducted. Four different models are created to represent different undulation sizes. A sinusoidal waviness along the axial length of axons is assumed and different undulation values of 1, 1.0684, 1.1310, 1.1947 and 1.2620 are utilized.

Results: In all tensile and shear loading cases, the axons are observed to have higher stresses than the matrix, whereas the matrix attains higher strains than the axons. A similar effect to those of overall tissue mechanical behavior is observed for local stress and strain with varying undulation factors. Change in magnitude of undulation increases the tensile stresses and shear strains in fiber directions are highly affected by the change of undulations. From the result of this study, it was found that axon undulation had a large impact on how the stresses were distributed between the axon and the matrix. Under axial loading, as axon undulation increased, the maximum stress and the stress in the matrix increased while stress in the axons decreased. When the displacement load was applied in a direction that was perpendicular to the longitudinal axis of the axon, the stresses in the constituents were more evenly distributed than they were for a displacement along the longitudinal axis. Both of the geometrical variables had a significant importance on the results that were generated.

Conclusions: An efficient micromechanical modeling for biomechanical analysis of axon and ECM of the white matter of brain was introduced. The axonal injury depends on the brain tissue mechanical properties which in turn depend on various parameters such as the local undulation of axons themselves. The analysis showed that the axon undulations significantly influence the resulting stresses and strains under external loading.

0113

Use of Gaming system for rehabilitation of an adolescent with post-traumatic brain injury.

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Objectives: The gaming industry has introduced a form of video gaming that requires the participants to be physically involved in the games. The physical involvements in these games include a great deal of movements and activities that may be used to augment rehabilitation of children with disability. The purpose of this case report was to describe the use of a low cost, commercially available gaming system and its efficacy to improve balance in an adolescent diagnosed with post-traumatic brain injury.

Method: The patient was a seventeen-year old girl diagnosed with post-traumatic brain injury and presented with right side hemiparesis, balance deficits and unsteady gait. The child was treated in a school-based setting. The patient participated in ten sessions for 20 to 30 minutes session, over a period of 11 weeks. Training was performed using the Nintendo Wii Fit games software, including balance, weigh bearing, strength training, aerobics, and yoga games. The games were played in a training and game mode.

Results: The child was assessed before and after the training periods. The outcome measure included the Berg Balance Scale and weight distribution symmetry during standing as measured by the Wii Fit Age. The outcomes of this case report showed improvements in the Berg Balance Scale and the symmetry of weight distribution during standing.

Conclusions: This case report describes the use of a low cost, commercially available gaming system as an intervention to improve balance in an adolescent diagnosed with post-traumatic brain injury. The outcomes of this case report demonstrate the successful improvements in the patient's balance and the symmetry of weight distribution during standing. The promising results of this case report suggest that further studies are warranted to validate the potential benefits of a low cost, commercially available gaming system as a treatment strategy to supplement rehabilitation of children with disabilities.

0114

Treatment to Promote Self Regulation and Strategy Use within Functional Activities: An Exploration of the Multicontext Approach

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Objectives: Persons with brain injury frequently demonstrate decreased ability to monitor and apply strategies learned in treatment to everyday situations. The aim of this study was to refine, explore, and provide case series data on results of the Multicontext approach in promoting strategy use across situations, increasing self-regulation, awareness, and functional performance. Specifically this study explored the effect of the Multicontext approach on self regulation, awareness, strategy use and instrumental activities of daily living (IADL).

The Multicontext approach is a multi-component intervention framework that emphasizes the need to explicitly “train for transfer”. Intervention incorporates principles of learning transfer by systematically varying treatment activities and context and gradually increasing transfer distance. Key elements of this approach include: a focus on strategy self generation and training; practice across multiple contexts; structuring intervention activities so that similarity is gradually decreased; an emphasis on metacognitive training; and use of everyday activities.

Method: This study used a single-subject design with repeated measures pre- and post intervention, with data analyzed descriptively and graphically. Four persons with difficulty following multi-step directions, 3–5 years post TBI, received a nine session intervention program. Outcome measures collected immediately after treatment and again 4 weeks after treatment included the Awareness Questionnaire, Self -Regulation Skills Interview, Behavior Rating Inventory of Executive Function, Multiple Errands Test, and an Executive Function Performance Test subtask. The process of change within each treatment session was examined with strategy and awareness ratings.

Results: Multicontext intervention was associated with positive changes in self regulatory skills and strategy use that was observed across trained and untrained multiple step activities in all four participants. In addition to decreased errors,

strategies and challenges identified by participants increased in specificity. As expected, general awareness of deficits remained unchanged. Examination of individual participants revealed important, varying patterns of change in strategy use, learning transfer, and self awareness across intervention.

Conclusions: This study took important steps toward clarifying and operationalizing the Multicontext approach and translating it into specific treatment procedures. Despite different levels of severity and clinical manifestations, observed results suggest benefit to all four TBI participants and provide insight into how the multicontextual approach can be employed to improve functional performance in persons with TBI. Preliminary findings also suggest that transfer of strategies to everyday situations can be achieved to varying degrees if treatment is structured with principles of transfer in mind. Although no changes were observed in general awareness, results strongly suggest that changes in specific awareness and self regulation can contribute to effective strategy use across situations. Additional investigation, including a larger controlled study, is warranted to test and extend these observations.

0115

Prognosis of 6 month functioning after moderate and severe traumatic brain injury: a systematic review of prospective cohort studies

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Objectives: To systematically review, which determinants assessed within the first month after a moderate to severe traumatic brain injury, predict 6-month functional outcome.

Method: Databases were searched for relevant publications between 1995 and August 2008. Selection criteria: prospective cohort studies; determinants associated with functional outcome six months after moderate to severe traumatic brain injury in adult patients; determinants assessed within the first month post-injury. Two reviewers independently performed the selection and quality assessment. A best-evidence synthesis was performed for prognostic factors assessed in two or more studies.

Results: Twenty-eight studies were included, 27 of high quality. Most studies used the Glasgow Outcome Score at 6 months post-injury as outcome measure, sometimes in combination with other outcome measures. Strong evidence for predicting outcome at six months was found for Glasgow Coma Scale (GCS), GCS admission, motor score, midline shift on CT scan, subdural haematoma and pulsatility index. Strong evidence of no association was found for gender and intraventricular haemorrhage. For other determinants, inconclusive or no evidence was found.

Conclusions: GCS, GCS on admission, motor score, midline shift, subdural haematoma and pulsatility index predicted outcome six months after traumatic brain injury. Gender and intraventricular haemorrhage did not have predictive value.

0116

New Facts on Epidemiology and Prevention in Traumatic Brain Injury in Germany

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Objectives: The purpose of epidemiology is disease control and prevention. A review of the data published on the epidemiology of traumatic brain injuries (TBI) reveals that the data of almost all studies are drawn from local or regional series. Nationwide data are rarely available. In Germany, there has been a nationwide mortality register since 1968 and since 1994 all hospitals have provided data on all admissions. In addition, the whole country is divided into trauma centers which have provided data since 1995.

Method: All head injuries between 1972 and 2008 were analysed according to ICD-9 and after 1998 according to the updated ICD-10. The data were provided by the Federal Bureau of Statistics. The data of hospitalized cases and fatal cases were correlated with population data to calculate incidences and mortality rates. Age-group specific data as well the specific situation after the reunification were also available and analysed.

Results: The incidence rate of fatal head injuries in Germany decreased continuously from 27.2/100 000 in 1972 to 8.3/100000 in 2006. The mortality is highest in the group older than 75 years. 50.04% of persons with severe head injuries die before admission to a hospital. After the reunification in 1989, the number of fatal head injuries showed a temporary increase till 1994. The number of patients

treated in hospital increased from 266 944 in 1995 to 316 573 in 2006.

The majority of hospitalized patients suffered minor head injuries.

There has been an increase in the number of vehicles and motorcycles on German roads and highways (in 2002 over 53 million vehicles and 3.6 million motorcycles), but a marked decrease in severe traffic accidents.

The number of surgical procedures is highest in the age group 70 to 75 years.

Conclusions: Analysis of the data of all German hospitals reveals surprising views of incidence, morbidity and mortality rates of head injuries in this country.

Rapid changes of motorization during the reunification period caused an increase of severe head injuries.

Prevention by laws and technical standards are very important.

Less head injuries caused by traffic accidents occur due to the increasing age of the population. But with increasing age more severe accidents occur at home.

0117

Community integration after moderate to severe traumatic brain injury 3 years post-injury

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Objectives: To evaluate the course of community integration up to 3 years post-injury in moderate to severe traumatic brain injury (TBI) patients, and secondly to identify determinants for community integration 3 years post-injury.

Method: In an inception cohort of 119 patients with moderate and severe TBI the Community Integration Questionnaire (CIQ) was prospectively assessed at 3, 6, 12, 18, 24, and 36 months post-injury and the pre-injury CIQ was measured retrospectively. Repeated measures analyses of variance were performed to determine changes over time in the CIQ total and its subscales home integration, social integration, and productivity. Multivariate regression analysis was used to identify the major determinants of the CIQ at 3 years post-injury.

Results: Compared to the pre-injury situation, home integration, social integration, productivity and total CIQ had deteriorated at 3 months post-injury. Improvement was found in the first year after injury, and to a lesser extent home integration, productivity, and CIQ total remained to increase from 1 year to 3 years post-injury. Only the subscale home integration recovered to the pre-injury level. Age, the post-acute Barthel Index score, and the pre-injury CIQ score were found to be the major determinants of the CIQ at 3 years post-injury ($R^2 = 52\%$).

Conclusions: After an initial decline community integration after TBI may improve until 3 years post injury. Insight in the course of community integration and its determinants is relevant in depicting a prognosis on functional outcome after TBI.

0118

Children's Every-day Executive Function skills and Parental Distress in Families Attending The Holistic Pediatric Rehabilitation Program for Brain-Injured Children (HOPE)

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Objectives: Executive function (EF) deficits are common after childhood ABI causing problems for the child and his/her family in many important areas of daily life. According to the literature, a bi-directional influence exists between brain-injured child's behaviour and parental distress level. EF deficits affect every-day functioning of the child and thereby may increase parental distress.

The Holistic Pediatric Rehabilitation Program for Brain-injured Children (HOPE) provides comprehensive outpatient rehabilitation for brain-injured children and their families. The goals of the program are to increase the child's and his/her family's functioning and quality of life along with increasing collaboration with local authorities. The HOPE is the only rehabilitation program for brain-injured children in Finland in which the whole family attends and a regular follow-up and collaboration with school or day-care is included.

The purpose of the study was to examine every-day EF skills of the brain-injured children and parental distress within the families attending the HOPE program and after one year follow-up. The

assumption was that a significant correlation exists between EF skills of the child and parental distress level.

Method: The study group consisted of 24 families attending the HOPE Program during years 2005–2008. Ages of the children varied between 9 and 16 years (11 girls). In choosing the methods, the ecological validity of the assessment tools was emphasized. During the baseline assessment the background information was gathered using basic neurocognitive tests, the Five to fifteen-scale and the BRIEF and HIBS questionnaires. The classroom performance was evaluated by the child's teacher. The follow-up assessment occurred one year later.

Results: A statistically significant correlation was found between children's EF skills and parental distress. The Spearman non-parametric correlation was significant at the .05 level during the baseline ($p .034$) and the follow-up assessment ($p .022$). Parents reported reduced distress after attending HOPE program. A statistical significance however, was not found between the baseline and follow-up measurements.

Conclusions: As hypothesized children's EF skills correlated significantly to parental distress level. A high number of every-day EF problems indicated a high parental distress score. This reciprocal relation should be further analyzed and considered in planning rehabilitation interventions for brain-injured children and their families.

0119

High speed films as a new tool for diagnosis of neurological disorders, especially when they include voice function - a prospective cohort study of 55 patients with localized and universal dystonia

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Objectives: There is nowadays a better understanding of universal and local voice related dystonia. High speed films of the vocal cords have shown to be a valuable tool of treatment effect.

Method: 55 patients with localised and universal dystonia with various etiologies, were prospectively referred to the clinic in a period of 8 months mostly, from our co-workers in physiotherapy. The patients were complaining of all round voice problems. The physiotherapists wanted a systematically, routinely

given overall status of the patients immune systems and eventual treatment of upper airway mucosal problems.

The patients were in dystonia training groups already established. Surprisingly, the effect of mucosal treatment of the larynx was in several cases that the dystonia was reduced or even disappeared. Therefore, visual scores from 1–100 of the treatment effect of the immune system were graded by the patients after end of treatment. A control group of normal individuals was set up.

The routinely made high speed films included on average 2 seconds of film including 8000 frames, which were analysed in the following modes: kymography, electroglottograms (EGG), acoustical analysis and specific presentation of the right and left vocal cords' movement in the front, middle and rear area of the open phases. A calculation was made of the open quotient by the software in the front, middle and rear part of the vocal cords (Wolf Inc). Statistics were made of differences before and after the given treatment (using the SAS statistics).

Results: The dystonia related changes of voice were seen on the kymography and the EGG, especially when compared with the acoustical curves. We evaluated the "cycle look" of the variance of frequency, which was mostly from 5–20 cycles. In those cases where there was a treatment effect, the "cycle look" disappeared. The open quotients between the vocals cords normalized. Using Nominal Logistic Fit for improvement, a chi square calculation was significant for the treatment effect of the upper airway mucosa, measured with calculation of the opening phases between the vocal cords.

Conclusions: With the use of high speed films, many voice related neurological disorders can be more accurately diagnosed. High speed films should therefore be used much more in the field of neurology, at least as a standard of diagnosis of neurological voice disorders. High speed films can also prove to be a useful tool in documenting the effect of treatment.

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0120

Motor function, activity and participation one year post stroke: a 1 follow-up of a randomised controlled trial in persons with stroke

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Objectives: Main objective in this study was to evaluate two different exercise approaches during twelve months post stroke and study the effect they might have on I-ADL, gait performance, postural control, perceived endurance, grip strength and muscle tone.

Method: The study was a double-blind longitudinal block randomised trial of first time ever stroke patients. A total of 75 persons with stroke were included and randomised; 35 in the Intervention Group (IG) and 40 in the Regular training Group (RG). Both groups received functional task-oriented training during the acute rehabilitation. After discharge patients allocated to the IG were set to have physiotherapy four times during the first year after their stroke, with a minimum amount of 80 hours. The patients belonging to the RG were not sent to follow-up treatment nor were any specific treatment recommended.

Main Outcome Measures- Information on Instrumental Activities of Daily Living (I-ADL), 6 Minute Walk Test (6MWT), Bergs Balance Scale (BBS), Timed Up-and-Go (TUG), grip strength (Martin Vigorimeter), Modified Ashworth Scale (MAS) and pulse monitoring during activities. The patients were tested on admission, at discharge, and after 3, 6 and 12 months after the stroke incident.

Results: Both groups reported a higher extent of participation on all the items of I-ADL, improved 6MWT, BBS scores, TUG and grip strength. There were no significant differences between the groups on admission or at discharge in any of the variables. At the three, six and twelve months follow-up there were significant differences in favour of the RG on several items. Modified Ashworth Scale revealed no differences in muscle tone between the two groups at any time. There were significant associations between the results of 6MWT, BBS and the different I-ADL items with good to moderate correlations, rs ranging from 0.57–0.79. TUG had a significant but moderate correlation to the I-ADL items 2, 3, 4.5 and 8, (rs: –0.46 to –0.57). Grip strengths of the paretic and the non-paretic hand were

significantly but moderately associated to I-ADL items (rs: paretic hand 0.48–0.64; non-paretic hand 0.36–0.49) whereas scores measured with Modified Ashworth Scale was poorly associated with all I-ADL items.

Conclusions: Both groups improved to similar degrees in IADL, gait, balance and grip strength. The test occasions themselves were strong motivators for training, irrespective of group allocation. IADL was to a higher degree explained by the results of 6-Minute walk test and Berg Balance Scale than Timed-Up-and-Go and grip strength.

0121

Outdoors or indoors walking, what is more beneficial? A comparison of exercise methods in a randomized trial.

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Objectives: The main aim with the present study was to evaluate treadmill training versus walking outdoors in order to improve quality aspects like step length, step width, cadence and quantitative aspects like endurance, walking speed and distance in walking. A secondary aim was to evaluate factors that might be influential in retrieving walking capacity.

Method: A single-blind randomised controlled trial. Patients were tested within the first day after arriving, and were randomised into two groups directly after the test, by a person not involved in the study: one group for treadmill exercises and the other for outdoor walking. Inclusion criteria were neurological impairment and age above 50 years. Exclusion criteria were barriers to taking part in a physical rehabilitation programme, insufficient language, an unstable cardiac status, neurosurgery and a pre-morbid history of orthopedic problems or any problems that would prevent patients from walking. Outcome measures were: item 3 in Motor assessment Scale, 6 Minute Walk Test and 10m walk test with markers.

Results: A total of 39 persons were initially included in the study. There were no baseline differences between the groups, and the length of stay was equal in the two groups (mean 2.5 weeks). The mean treadmill speed during exercise was 0.5 m/s, with a range of 0.4 to 1.1 m/s and a flat surface. The mean time per session for treadmill walking was 12 minutes, and the total exercising time was

107 minutes. The outdoor walks were carried out at a comfortable walking speed. The time spent exercising depended on the weather conditions, but was on average 29 minutes per session. The total mean time for outdoor walking was 316 minutes, this difference was significant ($p = 0.02$). This difference in time influenced significantly between the groups on walking speed (6MWT, $p = 0.03$, 10m, $p = 0.03$), distance (6MWT, $p = 0.04$), step length (right leg; $p = 0.009$, left leg; $p = 0.003$), step width ($p = 0.01$) but not cadence ($p = 0.78$). A multiple regression analysis including all independent variables explained 57% of walked distance in 6-Minute Walk test ($F = 4.5$, $p = 0.002$). A final model 2 with independent variables group assignment and time exercising explained 28% of 6-Minute Walking Test ($F = 5.6$, $p = 0.009$), 28% of 10m walking speed ($F = 5.6$, $p = 0.009$), 21% of right stride length ($F = 3.9$, $p = 0.03$), 19% of left stride length ($F = 3.4$, $p = 0.04$), 15% of step width ($F = 2.5$, $p = 0.09$) and 22% of cadence ($F = 4.2$, $p = 0.03$).

Conclusions: Treadmill walking achieved improved function in less time and regarding bilateral step length with higher degree of symmetrical use. The treadmill group gained increase in walking speed and distance, equally long and longer step length bilaterally in less time than the outdoor walking class supports the notion exercises on a treadmill walking is an effective and important tool in rehabilitation. The patients were well past the acute period of time after stroke, the fact that both treadmill and walking outdoors did improve in functional activities supports the importance of “booster doses” of rehabilitation in order to maintain physical function levels.

0122

Complaints of Patients, Malpractice and Medical Liability Law Suits in the European Union

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Objectives: Medical liability law suits are a personal burden for the person concerned and could lead to an increase in insurance premium and consequently affect the whole health care system and the number of particular medical specialists.

Patient's safety and healthcare quality, right of self-determination, and complaint management are the topics.

Method: A standardized questionnaire was distributed throughout the European Union. It was evaluated for hospitals, departments, serious medical errors, malpractice. The varying legal aspects were considered. The results were analyzed by the author - a forensic expert for medical law suits, chairman of the expert conference of the Austrian Medical Association and the committee for quality assurance of medical expert opinions. The competence of health care systems within the EU was evaluated. The EU is a new structure (came into force 01.11.1993) in contrast to the United States of America (Bill of Rights 1787). At present the EU consists of 27 sovereign states with 500 million inhabitants (USA 306 millions) and 23 official languages. In 2002 the European Charter of Patients Rights was agreed upon. "Every individual has the right to information regarding state of health, health services and their usage. Accurate, reliable and transparent information has to be provided for new technological, pharmaceutical and scientific innovations. All information has to be easily accessible and understandable by health services. Access is granted to clinical files, photocopy is allowed. The hospital patient has the right to continuous and thorough information". With these preliminaries the data were evaluated.

Results: Most complaints and medical law suits were related to incomplete or non-existent patient information (80–90%). Throughout the EU a possible medical error is considered rather high: very worried 10%, fairly worried 30%, not very worried 43%, not at all worried 15%. 27% of the complaints were in traumatology. Overall the eventuality of a treatment-related incident was considered in 75% in Estonia and 20% in Sweden. 18% of the respondents state to have experienced a treatment error in a hospital. 11% received an inappropriate medication. The legal situation in the EU member states still differs very much. An incentive for medical liability law suits is the amount of compensation. In Austria the highest account up to now is € 200.000,-.

Only about 2% of patients complaints (malpractice) are handled at court.

The newest results will be presented by power point.

Conclusions: Actions to avoid or reduce the number of medical liability law suits:

- (1) Most important for patient safety is quality control and risk management.
- (2) To appoint an ombudsman, arbitration, constructions of the medical chambers. Depending on facts, reduction of law suits is possible (p. e. 50% in a hospital of 2.200 beds).

- (3) To establish a compensation fund irrespective of liability.
- (4) Because of the medical and legal difficulties special senates should be formed in particular at the Supreme Court, responsible for medial cases. This could prevent unreal sentences.
- (5) A limit should be set for the account of compensation.

0123

**Predicting Improvement on the Mayo
Portland Adaptability Inventory:
Findings from a Community-Based
Model System**

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Objectives: The purpose of this investigation is to ascertain which variables best predict improvement in the Mayo Portland Adaptability Inventory (MPAI) for participants of Lakeview Healthcare Systems' (LHS) residential treatment programs. This study examines domains of premorbid status, demographic information, severity of injury, and treatment interventions as potential predictor variables of improved MPAI performance for residents with a diagnosis of acquired brain injury.

Method: The researchers developed a comprehensive database from eight community-based, residential sites within the Lakeview Healthcare System. The database was formulated retrospectively. The current study sample consists of more than 100 cases diagnosed with acquired brain injury who were provided with residential support, services, and treatment. Issues of reliability obtained from retrospective medical data review are acknowledged and data cleansing occurred if documentation was suspect (i.e., discarded). Predictor or independent variables within the database targeted for this study reflect the domains of premorbid status, demographic information, severity of injury, and treatment interventions. More discrete subcategories for each domain are also contained within the database. For example, additional data points within premorbid status include but are not limited to history of brain injury, drug use, alcohol use, psychiatric history, etc. Scores for the Mayo Portland Adaptability Inventory (MPAI), the dependent variable, were recorded based on performances at

admission, discharge, and six months post discharge. A stepwise logistic regression using SPSS addresses the research question of which variable(s) best predict improvement on the MPAAI. Institutional Review Board approval through James Madison University was secured prior to the initiation of this investigation.

Results: The database is completed. Data coding and loading into SPSS are in progress. Although a subset analysis of current data suggests certain trends relative to predictors of improved MPAAI scores, definitive statements are premature at this juncture. Comprehensive statistical analysis with interpretation is forthcoming.

Conclusions: The findings for this investigation should assist healthcare providers to focus their efforts relative to both service provision and educational programming following acquired brain injury. Quantification of which predictor variables are most salient to improved MPAAI performance for community-based program participants certainly contributes to the present knowledge base.

0124

Differences in TBI symptom reporting for veterans with and without PTSD

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Objectives: Both mild traumatic brain injury (mTBI) and posttraumatic stress disorder (PTSD) have become known as the “signature wounds” of Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) and are often found to co-occur in clinical practice. According to previous studies, approximately 20% of returning veterans meet criteria for PTSD. In addition, returning veterans frequently report exposure to events that place them at risk for mild traumatic brain injury (mTBI). These veterans report a number of cognitive difficulties and somatic symptoms, often thought to be due to chronic postconcussive syndrome (PCS). However, the relationship between mTBI, PTSD, and the somatic and cognitive symptoms reported by these veterans remains unclear and has sparked much debate in the field. The purpose of this study is to examine the rate of positive PTSD screen in a population of OEF/OIF veterans who have also screened positive for mTBI and the effect of a concurrent positive PTSD screen on symptom report during secondary level evaluation.

Method: Retrospective review was conducted of medical records of OEF/OIF veterans who screened positive for mTBI on the Traumatic Brain Injury Screening Questionnaire administered to all returning service members in an urban VA Medical Center setting ($n = 252$; age = 33.92 ± 9.52 ; 90.5% male; 54% Caucasian). At the time of the mTBI screening, patients were also administered a four question screen for PTSD. At a follow-up evaluation following positive TBI screening, the veteran completed the 22-item Neurobehavioral Symptoms Inventory (NSI) as standard of care. Analyses of variance were conducted for all 22 items on the NSI to compare those with and without positive PTSD screens for differences in symptom reporting.

Results: More than sixty percent of the population screened positive for PTSD ($n = 153$). Significant differences ($p < .001$) with medium to large effect sizes ($\eta^2 = .061-1.11$) were found between those who screen positive and those who screen negative for PTSD for more than half of the symptoms, particularly those that relate to cognition (e.g., poor concentration, memory problems) and affect (e.g., anxiety, depression, irritability).

Conclusions: A significant number of returning veterans who screened positive for mTBI also screened positive for PTSD. This number was greater than previous reports, which may be due to sample characteristics, chronicity of the symptoms, or the screening measure itself. Patients with positive PTSD screens report a higher rate of symptoms on the NSI, particularly in the cognitive and affective domains. This study has implications for follow-up evaluation as careful attention should be paid to the contribution of PTSD to symptom report during the mTBI evaluation.

0125

Natural history of recovery from brain injury after prolonged disorders of consciousness: outcome of patients admitted to inpatient rehabilitation with 1–4 year follow-up.

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Objectives: The natural history of recovery from brain injury typically consists of a period of impaired consciousness, a subsequent period of confusion and

amnesia, followed by a period of post-confusional recovery of function. Patients with more severe injuries may have more prolonged episodes of unconsciousness or minimal consciousness and may not fully evolve through this continuum of recovery. There is relatively limited information on the course of recovery and long term outcome of patients with prolonged unconsciousness, particularly those with extended periods in the minimally conscious state.

Method: A consecutive series of 36 patients with traumatic (TBI) and non-traumatic brain injury (nonTBI) in a vegetative state (VS) or minimally conscious state (MCS) when admitted to a specialized, slow-to-recover brain injury program in an acute rehabilitation hospital was retrospectively reviewed to evaluate course of recovery during rehabilitation hospitalization and in follow-up, 1 to 4 years post-injury. Independent variables included: time to resolution of VS, MCS and confusional state/post-traumatic amnesia (CS/PTA), based on Aspen criteria, CRS-R and GOAT scores. Outcome measures included: proportion of patients who recover beyond VS, MCS, CS/PTA stages, who achieve household independence, return to school or work, and DRS scores at 1,2,3 and 4 years post-injury.

Results: The majority emerged from MCS (72%) and CS/PTA (58%) by latest follow-up. It took significantly longer for patients admitted in VS (means: MCS, 16.43 wks; CS/PTA, 30.1 wks) than in MCS (means: MCS, 7.36 wks; CS/PTA, 11.5 wks) to reach both milestones. Almost all who failed to clear CS/PTA by latest follow-up were patients with nonTBI or TBI with VS over 8 weeks. There was a strong relationship between the duration of MCS predicting the duration of CS/PTA, accounting for 57% of the variance. Nearly half of the patients followed up at least 1 year achieved recovery to safe, daytime independence at home and 22% returned to work or school, 11% at or near pre-injury levels of functioning.

Conclusions: The data in this series suggest that those patients who recover to the MCS level of recovery, especially if they make the transition within 8 weeks of onset, have very good prospects to continue recovering to a meaningful level of cognitive functioning, half to independent levels, and a substantial number to productive pursuits. Patients with TBI are more likely to progress to higher levels of recovery than patients with nonTBI, though significant improvement in the nTBI group is still possible. Active, high intensity rehabilitative efforts should be strongly considered for patients with severe brain injury with severely impaired consciousness, especially for patients with TBI who have signs of progression to the MCS.

0126

Functional prognosis and quality of life in traumatic brain injury (TBI) patients

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Objectives: Knowledge on the determinants of functional outcome would support rehabilitation physicians in their task to develop more 'tailor-made' treatment protocols and give a more detailed prognosis on specific disabilities. The present study aims to establish which factors are predictive of the patient's functioning and quality of life (QoL) one year post-injury. In order to place the results in a meaningful context, the following secondary questions were formulated, 1) what is the prevalence of problems in general, physical, cognitive, and emotional functioning, 2) what is the prevalence of being limited in psychosocial activities, 3) what is the prevalence of work restrictions, and 4) what is the prevalence of a lowered QoL.

Method: The Rotterdam TBI study is a prospective follow-up study on determinants of daily functioning in patients with a moderate or severe TBI. We included 126 TBI patients. Exclusion criteria were: 1) insufficient knowledge of the Dutch or English language to participate in the study, and 2) serious (pre-traumatic) neurological, psychiatric, oncological or internal impairments that were expected to interfere with TBI-related disabilities. Daily functioning and quality of life was assessed by using the Glasgow Outcome Scale, Disability Rating Scale, Barthel Index, Functional Independence Measurement, Functional Assessment Measurement, Rancho Level of Cognitive Functioning Scale, Neurobehavioural Rating Scale, Wimbledon Self-Reporting Scale, Frenchay Activity Index, Community Integration Questionnaire, Sickness Impact Profile-68 and the Rand SF-36.

Results: One year post-injury 75% of the patients reported problems in their general functioning, 13% in physical functioning, 35% in cognitive functioning, and 26% in their emotional functioning. In total, 76% of the patients were limited in psychosocial activities, 72% experienced work restrictions, and 91% of all patients reported a reduced QoL. General functioning was predicted by physical and cognitive limitations at discharge (Risk Ratio (RR) 0.3). Physical functioning was predicted by physical limitations at discharge only (RR 0.4). Cognitive functioning was predicted by severity of TBI (RR -0.2), and physical and cognitive

limitations at discharge (RR 0.3 and 0.4, respectively). Psychosocial functioning was predicted by gender (RR 0.3) and physical limitations at discharge (RR 0.3). Return to work was predicted by severity of TBI (RR -0.2), and physical and cognitive limitations at discharge (RR 0.3 and 0.4, respectively). QoL was only predicted by physical limitations at discharge (RR 0.3).

Conclusions: Gender, severity of TBI, as well as physical and cognitive status at discharge from hospital, are important variables in predicting functional outcome and QoL one year after TBI.

0127

Neuropsychological Assessment for Spanish-Speaking Patients with Brain Injury

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Objectives: Day to day neuropsychological practice in Mexico requires of specific instruments for assessment of Spanish speaking patients with brain injury. The majority of existent tests are adopted from distant cultural contexts and languages and do not consider specific syntactic and phonological features of Spanish language and its correlation with brain functioning. The objective of this work is to present our proposal called Brief Neuropsychological Assessment for Adults (Quintanar & Solovieva, 2009).

Method: The instrument is directed to assessment of functioning state of brain mechanisms: sinesthetic integration; motor sequential organization; audio-verbal retention; visuo-spatial retention; spatial analysis and synthesis and phonematic integration. Verbal and non-verbal items are proposed for each mechanism. The systemic effect of disturbances of brain mechanisms on verbal and non-verbal levels can be established by qualitative analyses of errors of patients during assessment. Qualitative characteristics of errors of patients are related to cortical and profound localization of brain injury and to educational level of subjects. The verbal tasks consider syntactic and phonological features of Spanish language.

Results: Initially, Assessment was applied to 150 normal subjects of different educational levels in Mexico in order to characterize types of execution. The Assessment is constantly applied in our practice to patients with brain injury and is useful to determine and precise types of neuropsychological

syndromes and to verify effects of rehabilitation. Examples of executions of patients with left and right brain injury of different education levels and different etiology are presented. Examples before and after neuropsychological rehabilitation are presented.

Conclusions: The Brief Neuropsychological Assessment could be useful for specialists interested in assessment and rehabilitation of Spanish speaking patients with brain injury. The Assessment can serve as instrument of control of achievements of patients during rehabilitation.

0128

Project Airport – Airline Travel After Disability

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Objectives: Collaborate with Continental Airlines to allow individuals with newly acquired disabilities to train and practice skills in a simulated environment that is less stressful than actual air travel and raise airport personnel's awareness of barriers in air travel for individuals with disabilities.

Method: Individuals with neurologic dysfunction, including brain injury, participate in a full-day outing to Bush-Intercontinental Airport in Houston, Texas. This outing is facilitated by recreational, physical, occupational and speech therapists and airport personnel. Participants can identify potential barriers and develop solutions by completing the following:

- wheelchair mobility through the airport concourse
- check-in process
- modified security check
- learning procedures for storing wheelchair during flight
- boarding and deboarding procedures
- learning Transportation Safety Administration regulations
- understanding the role and utilization of the Complaint Resolution Official
- traveling with ventilator and oxygen

Results: Since the program's inception, over twenty individuals with newly acquired disabilities have participated in eight Project Airport outings. Anecdotally, participants expressed increased confidence and likelihood to travel by air and increased

awareness of the need for effective communication with airline personnel. Airline personnel expressed increased knowledge of unique accessibility challenges for individuals with disabilities and increased desire to facilitate improved accessibility during all phases of air travel.

Conclusions: This unique program has subjectively demonstrated that participants are positively impacted by Project Airport. Recommendations for further development include objective measurement of outcomes, including follow up with participants and airline personnel to determine the effectiveness of the program, and expansion of the program to include former patients or individuals with disabilities from the community.

0129

Mild TBI causes a long-lasting elevation of the transcranial magnetic stimulation motor threshold

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Objectives: Transcranial magnetic stimulation (TMS) is a noninvasive tool suitable for investigation of central motor pathways. Cortical excitability can be evaluated by recording electromyographic (EMG) responses elicited by single pulse TMS and measuring the minimum intensity (motor threshold; MT) that can evoke motor evoked potentials (MEPs). MT provides a relatively easy measure of corticospinal tract integrity. Mild traumatic brain injury (MTBI) is associated with long lasting symptoms that, although not motor, may be caused partly by diffuse damage to cerebral white matter tracts and could therefore affect the MT as well.

Method: We used navigated TMS and recorded MEPs from the right m. abductor pollicis brevis by means of EMG in order to determine patients' left hemisphere MT. MT is defined as the lowest stimulation intensity at which 5 out of 10 pulses evoke 50 μ V MEP or greater, when stimulating the primary motor cortex. 19 patients (11 with persistent symptoms, 8 recovered) who had suffered a MTBI on average 5 years earlier were studied, and compared to 9 healthy controls. All patients had

normal MRIs, ie. no signs of damage. None used CNS affecting medication.

Results: The average MT was 43.0% (SD 0.8) of maximum stimulator output in the control group. Both patient groups had statistically significantly higher MTs, 52.5% (SD 3.1) in the symptomatic and 54.6% (SD 3.4) in the recovered group.

Conclusions: MT may be a useful measure in evaluating brain damage caused by MTBI. This study shows that MT elevation can last until at least several years after the injury, and that it is not necessarily related to subjective complaints. The similar results of the symptomatic and recovered groups imply that simple MT by itself is not sufficient as a measure of injury severity or outcome, but it can be useful in combination with other methods.

0130

Differences in TMS-evoked EEG responses between healthy controls and symptomatic and recovered patients with mild TBI

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Objectives: Mild traumatic brain injury (MTBI) is often associated with persistent symptoms in the absence of obvious signs of damage on MRI. It has been hypothesized that these sequelae to MTBI are due to diffuse neuronal damage, affecting especially the more frontal areas and white matter tracts. Our aim was to measure these changes in both symptomatic and recovered patients using navigated transcranial magnetic stimulation (nTMS) combined with EEG.

Method: Eleven symptomatic and eight recovered patients and nine healthy controls participated in this study. The patients had suffered an MTBI (GCS 13–15) on average five years before being tested. The symptomatic patients presented with chronic symptoms related to their TBI, while the recovered patients had made a full recovery. No participants had abnormalities or signs of injury on MRI or used CNS affecting medication. We measured the motor thresholds (MT) from left primary motor cortex (MI) and EEG responses to left dorsolateral prefrontal cortex (DLPFC) and left MI stimulation at intensities 90, 100 and

110% MT. Navigation assisted in defining DLPFC stimulation site and guaranteed that the stimulation sites and coil orientation were kept the same throughout the delivery of all the pulses. TMS-evoked EEG responses were averaged and compared between groups. A predictive model for group membership was built using linear discriminant analysis.

Results: In all groups, the same peaks were identified in the TMS-evoked EEG responses. Statistically significant differences were observed in the N100 peak, which after DLPFC stimulation tended to have the greatest amplitude in the symptomatic patients and smallest in the recovered patients. The late (370–440 ms) negativity on temporal and parietal electrodes, both after DLPFC and MI stimulation, also differed between the groups, symptomatic group having the greatest and controls the smallest amplitude. Patients in the symptomatic group also lacked more often one or more of the normally appearing peaks in the waveform. Using these differences as a basis for discriminant analysis, we were able to correctly classify 82% of the present sample.

Conclusions: Combined TMS-EEG is a promising method for evaluating changes caused by MTBI. In this limited sample, some of the significant differences were seen between the symptomatic and recovered patients group (e.g. the N100) and not between controls and patients, thus possibly reflecting compensatory mechanisms. Accordingly, certain TMS-EEG deflections may also be useful as objective measures of patient recovery, or lack of it, after MTBI.

0131

Role of oxidative stress and the preventive effects of EGCG on fetal alcohol syndrome in mouse

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Objectives: Fetal alcohol syndrome (FAS), induced by ethanol abuse during pregnancy, exists as a

challenging public health problem. The compound (–)-epigallocatechin-3-gallate (EGCG) is a powerful plant-derivative antioxidant extracted from green tea. Since oxidative stress has been related to FAS, the present study aims to confirm the act of oxidative stress in ethanol embryonic toxicity and to develop the protective potential of EGCG in FAS.

Method: To assess the morphological damages of alcohol on fetal development, pregnant female mice were intraperitoneally injected EtOH (25%) at doses ranging from 0.01 to 0.02ml/g body weight on G8 (with 3 mice in each ethanol dose group). On G10.25, embryos were collected and photographed for recording the head lengths (HL) and crown rump lengths (CRL). In the EGCG treatment test, FAS model was produced by 0.02ml/g EtOH at G8. EGCG (100, 150, 200mg/kg body weight) was administered through a feeding tube at G7 and G8 respectively. Fetal brains were used for oxidative stress indexes, RT-PCR and western blot, also G10.25 embryos were evaluated morphological measurements.

Results: Alcohol intake during pregnancy led to severe developmental retardation. Besides morphological changes and oxidative-related indicators such as H₂O₂ and MDA, EtOH (0.02ml/g) caused significant down-regulation of neural marker genes Otx1 and Sox2. These damage could be ameliorated by pre- and co-administration of EGCG (200mg/kg, twice a day at G7 and G8).

Conclusions: Maternal alcohol is embryotoxic because it gives rise to oxidative stress. It's encouraging that EGCG as a natural antioxidant is competent for injuries aroused by alcohol. Our results suggested that EGCG is a safe and forceful preventive therapeutic component for FAS.

0132

Vestibular disorders in mild traumatic brain injury: Mixed head injury

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Objectives: Mild traumatic brain injury (mTBI) is the most common injury seen in the current conflicts in Iraq and Afghanistan. The etiology of these injuries can occur from blunt head trauma or blast head trauma. Many individuals suffer a combination of the disorders. We have characterized injury

patterns seen after blunt head injury and blast injury and now begin to look at the complex injury patterns seen when individuals suffer a combination of blunt injury and blast injury.

Method: Fifty consecutive individuals with mixed head injury (blast injury and blunt head trauma occurring in proximity to each other) were evaluated at our tertiary care facility. All individuals underwent a comprehensive standardized vestibular evaluation including a history and physical exam, audiological testing, rotational chair testing, and a postural/gait evaluation. The results of the exams on each individual were utilized to develop diagnostic patterns and to determine best practices for clinical treatment.

Results: Individuals can be divided into diagnostic groups utilizing the information obtained from our comprehensive evaluations. The group characteristics differ from those seen in our blunt and blast populations but share some similar criteria. Prognostic implications and treatment strategies are critically dependent on the diagnostic group determined by the initial classification.

Conclusions: This is the first large series dedicated to examining the symptomatology of individuals who have suffered mixed head injury (blunt and blast exposure with resultant mild traumatic brain injury). This is an important group of patients since this injury pattern is increasingly more common in current conflicts world wide as well as in the civilian sector. Understanding diagnostic classifications is important since these classifications provide vital information for best treatment practices. Utilizing standard diagnostic criteria is also important because it allows for standardized reporting practices so that the science of the study of mTBI can move forward.

0133

Developmental Outcome of Infants with Moderate and Severe Head Injury

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Objectives: In many settings, there are inconsistent practices with respect to the assessment and follow-up of infants and toddlers following unintentional traumatic brain injury (TBI). While professionals in most TBI Programs continue to monitor children with TBI who show immediate deficits, those who present with no initial impairments are

discharged with little routine long-term follow-up or rehabilitation. If subsequent problems do arise, parents or professionals rarely consider the TBI as being related to the current difficulty. The purpose of this study was to review clinical data on children who had sustained a moderate or severe head injury under 2 years of age seen by our Infant TBI Clinic. Specific objectives included 1) To describe the developmental trajectories of these children from the time of injury up to 6 years; 2) To identify tests that would be sensitive and domains that would be specifically affected following the injury; and 3) To explore subjectively, whether additional domains would benefit from standardized, routine assessment.

Method: Thirty one children who sustained a moderate or severe TBI between the ages between 28 days to 18 months (mean age at injury 6,94 months \pm 5,69 months) were included in this prospective cohort study. Common mechanism of injury included falls from tables, sofa, beds, sibling's arms, parent's arms as well as motor vehicle collisions. Children were examined by an occupational therapist, a speech and language pathologist and an audiologist on the same day at the following times post-injury: 9 months (if injured prior to that age); 18 months, (if injured prior to that age); 2½ years; 3½ years; 4½ years and 6 years old. Various measures addressing multiple domains such as hearing sensitivity, receptive and expressive language as well as perceptual and motor skills were used.

Results: The majority of children had normal hearing status at each testing intervals and hearing losses were minimal and transient in view of middle ear conditions. Descriptive analysis identifies normal speech and language development in most children. Similarly, gross and fine motor as well as perceptual motor and visual perceptual development were situated within the normal range for most children. However, and although this was not formally included in the assessments, several patients were presenting with questionable attention skills and several had required neuropsychological evaluation and services.

Conclusions: Results from this exploratory study emphasize that although infants and toddlers with moderate and severe TBI may not present with deficits at the time of injury, it may be important to reassess them at the time of school entry. Although this data was collected clinically over a period of 7 years, our sample size remains small to generate definitive findings about the developmental trajectories of infants and toddlers post-TBI thus underscoring the need for multi-center research in this area.

0134

Cografted Wharton's Jelly Cells-derived Neurospheres and NT-3 Promote Functional Recovery after Rat brain Injury

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Objectives: Traumatic brain injury (TBI) is a major cause of mortality and disability in the world. 5 million individuals living with the devastating emotional and economic costs. An animal model of traumatic brain injury (TBI) was used to test the hypothesis that cografted human umbilical mesenchymal stem cells-derived neurospheres (HUMSC-NSs) and neurotrophin-3 (NT-3) can promote morphologic and functional recoveries of injured brain.

Method: fifty-six SD rats were used in this study. For the different treatments, the rats were divided into four experimental groups: (A) control group, culture medium-treated group (n = 15); (B) HUMSC-NSs-treated group (n = 15); (C) HUMSC-NSs and NT-3 treated group (n = 15); (D) Sham group (n = 11). Motor function of the animals was evaluated by the Rotarod test both before and after TBI. The cell survival and differentiation as well as axonal regeneration was detected by immunohistochemical staining and Western blot. The cavitation area was also being calculated.

Results: In vitro, HUMSC-NSs terminally differentiated into higher percentages of cells expressing neuronal markers: β -tubulin III and MAP2ab by the supplement with NT-3. Following grafted into injured cerebral cortex, very few grafted cells survived in the HUMSC-NSs + NT-3-treated (<5%) and HUMSC-NSs-treated (<2%) groups. The survived cells were differentiated into various cells, which were confirmed by double staining of BrdU and neural or glia markers. In comparison, more grafted cells in the HUMSC-NSs + BDNF group transformed into mature neural-like cells, while more grafted cells in the HUMSC-NSs group transformed into oligodendrocyte-like cells. HUMSC-NSs + BDNF-treated group had more greatly improved motor function, compared with HUMSC-NSs-treated and medium-treated groups.

Additionally, axonal regeneration showed significant improvement in rats receiving HUMSC-NSs + NT-3, compared with HUMSC-NSs-treated and medium-treated groups, as demonstrated by the NF-200-positive staining. Lastly, a significant reduction in the percentage cavitation was seen in the two cell-treated groups compared with medium control group. These results means NT-3 could promote the neural differentiation of HUMSC-NSs in vitro and in vivo.

Conclusions: cellular replacement is unlikely to explain the improvement in functional outcome. The functional recovery might more rely on the axonal regeneration and neuroprotective action that active by the grafted cells. Cografted HUMSCs and NT-3 is a potential therapy for brain injury.

0136

Contextual influences on outcome after brain injury in children: Towards a cultural model of management

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Objectives: With its cultural and linguistic diversity, South Africa presents an ideal context to examine the impact of a range of socio demographic variables on outcomes after childhood brain injury. The country has an exceptionally high incidence of traumatic brain injury in its childhood population but very little systematic research has been conducted on the outcome of such injury or of its impact on functional outcomes including education, social participation and communication aspects. The objective of this study was to explore the outcomes of a sample of culturally diverse children with traumatic brain injury (TBI) in South Africa, with regard to schooling, communicative, cognitive, behavioral and physical domains, and to determine those characteristics that influence such outcomes in order to derive more culturally attuned models for assessment and management.

Method: The study took the form of a retrospective record review of a sample of a group of 100 childhood traumatic brain injury survivors who had undergone extensive testing for medico-legal reasons. The mean age of onset of TBI in this sample was 6.2 years (SD 3.06) and the mean interval between the accident and time of assessment was 4.2 years (SD 2.42). Data captured included demographic information, age at accident, time since

onset, first language, history of relevant disorders, pre- and post injury education, injury information and results of communication and cognitive testing together with a coding of residual physical, behavioral and emotional aspects. These variables were linked to educational outcomes for the sample.

Results: The results demonstrated the important role of language and demographic variables on the outcome of the children. The majority of the sample returned to a mainstream school. However analysis indicated that about 75% of the sample were in need of specialized support while only 22% of that sample had received any additional support. Difficulties were evident in the majority of the sample across all domains examined. Neither severity, nor profile of deficits served as reliable predictors for school placement.

Conclusions: The findings will be used to support a contextual model for managing TBI. While South African children carry an exceptional burden of disease and poverty, with increasing globalization and migration patterns, the results suggest the importance of embedding and awareness of socio-demographic variables in traumatic brain injury into global models of assessment, management and policy.

0137

Identification of CT- and CT+ TBI in the Emergency Department(ED) using Automated Electroencephalogram (EEG)

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Objectives: To develop an automated continuous quantitative EEG discriminant index to identify patients with mild (MTBI/concussion) or moderate-severe traumatic brain injury in the ED and to investigate the relationship between this index and clinical presentation.

Method: In a convenience sample of ED patients, the presence of altered mental status (AMS), loss of consciousness, amnesia, neurological symptoms and other related TBI symptoms were documented. EEG data was collected using a BrainScope device, currently under development, from 105 patients with

report of head injury and 50 ED controls. The patients were in three groups: positive CT (CT+), negative CT(CT-) and ED controls. Frontal electrodes were applied to the FP1, FP2, FPZ, F7, F8 locations of the International 10/20 system, referenced to linked ears. Ten minutes of eyes closed resting EEG data was collected from which 1–2 minutes of “clean” data was selected for analysis. Extracted features were Z-transformed relative to age and submitted to a discriminant classification algorithm. Discriminant scores were expressed as a probability index (0–100), where normal controls fell in the low range of the scale, CT- in the middle range and CT+ in the high range. Differences between these ranges were statistically explored, as well as correlation with presence of clinical symptoms.

Results: On a scale of 0–100, CT+ patients had a mean TBI discriminant index of 80.3, CT- patients had a TBI discriminant of 38.9, and controls had a TBI discriminant of 24.5. Highly significant differences between the groups was obtained, $F=89.0$, $P<.0001$. there were no significant differences found between presence of clinical symptoms and membership in the CT+ or CT- group.

Conclusions: The QEEG derived discriminant index for TBI appears to be a sensitive index of brain function that can be used to suggest whether or not a patient presenting with altered mental status is statistically likely to have CT+ or CT- imaging and as such, aid in the triage of such patients in the ED. This is further suggested by the fact that clinical symptoms did not differentiate between these groups. Such an easy to use, automated system may greatly enhance the clinical utility of EEG in the ED.

0138

Substance Abuse after Brain Injury Community of Practice: A Systems Intervention to Improve Access to Care in Ontario

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Objectives: Across Ontario, and elsewhere in Canada, individuals with neurocognitive impairment who are

also experiencing problems associated with substance use/abuse have very few viable treatment options. The Substance use and Brain Injury Bridging Project (SUBI) project was originally conceived as a means of addressing the need for appropriate treatment options within existing resources. Beginning in February, 2009, The Ontario Neurotrauma Foundation provided funding to develop a network of interested clinicians who can continue to develop and refine the existing treatment materials, provide clinician education and promote program development. SUBI's initial needs assessment found that Ontario clinicians were not consistently screening for substance use in their ABI clients, and ABI in their addictions clients. Barriers to treatment included a lack of training and treatment partners and exclusionary admission criteria. In response, the SUBI provider manual, workbook and client educational materials were developed along with training workshops. This presentation will include a review of the outcome assessment completed on the SUBI materials and as well as an evaluation of the success of the community practice in promoting the development of service options.

Method: An electronic survey of clinicians with exposure to SUBI workshops and materials was conducted to evaluate the SUBI materials and shape the activities of the community of practice. A focus group was conducted with 32 addictions and brain injury professions from across Ontario. Findings from these activities were used to formulate a series of educational and networking opportunities to promote program development and adoption of practice recommendations.

Results: Sixty respondents provided information about their use of the SUBI materials. In general, the materials were regarded as user friendly, attractive and accurate. Individuals attending workshops (rather than single one-hour sessions) expressed greater change in their comfort level in managing individuals with ABI and substance abuse. Recommendations for further development of SUBI materials emphasized the need for a family handbook and a manual of information/ instructions for SUBI groups that includes interactive exercises. Respondents tended to favor live training over distance options, and topics most often mentioned included advanced clinical skills (such as motivational interviewing) and specific information about how to start and run SUBI programs.

SUBI educational materials and sessions resulted in the development of 4 new program partnerships across Ontario. Within existing programs, screening, outcome assessment and intervention strategies were positively affected. Preliminary findings suggest that the SUBI training is successful in providing the

information needed by addiction-focused programs to integrate individuals with neurocognitive impairment. Brain Injury-focused providers demonstrated greater awareness of appropriate treatment options, and a willingness to adapt their program policies to accommodate individuals with active substance use issues.

Conclusions: The SUBI materials have shown promise as a vehicle for increasing access to care for individuals with substance abuse and brain injury. The program connections developed during the course of the project hold the promise for multi-site intervention studies. A new SUBI Family Handbook is under development.

0140

Clinical outcome following decompressing craniectomy with minimal brain exploration for ballistic injuries to the brain

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Objectives: Method of surgery for ballistic brain injuries have been changing from Second World War up to now. At the beginning aggressive decompression and evacuation of hematoma was the practice. However according to the data from the second Iraq war the practice has been changed to less aggressive decompression to deal with hematomas and foreign bodies.

A prospective study was conducted to evaluate the clinical outcome following decompressing craniectomy with minimal exploration of the brain for penetrating brain injury sustained in a war situation.

Method: 150 patients brought to Teaching Hospital Anuradhapura Sri Lanka with penetrating brain injuries during the recently ended civil war over a period of 8 months have been evaluated to assess the clinical outcome.

Patients who had ICH, acute SDH, and cerebral contusions due to penetrating brain injury with mass effect were included in the study.

All patients had decompressing craniectomy with removal of bone flap. Total evacuation of acute SDH were done while only the easily accessible haematomas, bone fragments and contusions were allowed to come out.

All patients had fascia lata on lay dural graft and creation of SCF fistula before closure.

Clinical outcome was evaluated using Glasgow outcome scale and Glasgow coma scale at the end of 2 weeks and 6 months time.

Results: 30% of the patients had bullet injuries and 70% had shrapnel. 6 patients died due to injuries. 80% of patients had ICH, 70% had contusions and 55% had acute SDH. 40% of the patients had GCS 6/15- 8/15, 50% had GCS 9/15-11/15, and 10% had GCS 12/15- 13/15.

At the end of 2 weeks 5% of the of patients had GOS 1/5, 95% GOS 3/5. At the end of 6 months 40% of patients had GOS 5/5, 45% had 4/5, 10% had 3/5.

Conclusions: Minimal damage surgery with decompressing craniectomy is a satisfactory way to manage penetrating brain injuries during war situation.

0141

Traumatic brain injury in the United States: National estimates of prevalence and incidence, 2002–2006.

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Objectives: Traumatic Brain Injury (TBI) is an important public health problem in the United States (US) resulting in disabling conditions and long-term societal costs. Thus, there a compelling need for prevention, treatment, and rehabilitation initiatives informed by national, population-based data. Objective: To estimate the prevalence and incidence of TBI in the US utilizing several nationally representative data sets.

Method: To produce national estimates, we averaged and analyzed data from 2002 to 2006 for TBI-related visits to hospital-based emergency departments (EDs), hospitalizations, and deaths from the National Hospital Ambulatory Medical Care Survey (NHAMCS), the National Hospital Discharge Survey (NHDS), and the National Vital Statistics System, respectively.

Results: The incidence of TBI for 2002–2006 was calculated and a comparison to a prior CDC study was made using data from 1995–2001. Additionally, this presentation will include the leading causes of TBI, overall and stratified by age, gender, and race. Information about TBI-related hospital-based ED visits, hospitalizations, and deaths will be described. Finally, the results of trend analyses for the leading

causes of TBI incidence for 2002–2006 will be discussed.

Conclusions: Traumatic Brain Injury continues to be a serious public health problem in the US.

0142

Non Traumatic Brain Injury: Systematic Review and Pilot Project Data

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Objectives: Little is known about acquired brain injury and the burden of care from both traumatic and non traumatic causes (NTBI). The objective of this study was to examine NTBI epidemiology by conducting a systematic review and abstract information on incidence, prevalence, case definitions, and nature of cognitive deficits. We also accessed Ontario hospital administrative data that is mandatorily collected to examine NTBI diagnoses and discharge destinations from acute care.

Method: PubMed was searched for NTBI conditions including meningitis, encephalitis, encephalopathy, toxic effects, and anoxia and hypoxia. Included were search terms and Medical Subject Headings, including keywords for International Classification of Diseases, 9th and 10th revisions. Codes used, study characteristics and incidence/prevalence rates were abstracted. Administrative data from Ontario's publicly insured health care system was utilized including the National Ambulatory Care Reporting System and the Discharge Abstract Dataset that describe emergency department visits and acute hospital admissions respectively for the years 2003–2007.

Results: In total, 28 studies were reviewed, of which 15 were population based (54%). The overall size of the study populations ranged from small to very large (N = 181 to 2.4 x 106). Rates per 100,000 also ranged from very low for meningitis (mortality rate: 0.02–0.4) to very high for neonatal encephalopathy (incidence rate: 220–450) and toxic effects (hospitalization rate: 89.8). Case definitions were as expected and none of the studies reported on cognitive deficits. Diagnosis data for NTBI showed that emergency room visits predominated for encephalopathy (6.8 vs. 1.9%) and toxic effects (7.6 vs. 1.3%), compared to acute care admissions. Acute care admissions were most common for meningitis

(4.4 vs. 2.7%) and brain neoplasms (17.1 vs. 9.4%), compared to emergency room visits. Vascular insults excluding stroke predominated in both types of data (~72%). Differences were less notable for the remaining NTBI conditions including encephalitis and anoxia and hypoxia. Discharge destinations varied significantly across NTBI categories including meningitis, encephalitis, encephalopathy, toxic effects, anoxia and hypoxia, vascular insults excluding stroke, and brain neoplasms.

Conclusions: Acquired brain injury subgroups have a different epidemiological profile that has not been captured as a group. This heterogeneity should be considered in future studies, with implications for primary prevention and health services planning. Ontario administrative health care data is an important resource for surveillance of NTBI. Future directions include broadening the literature search for the systematic review and examining the trajectory of care for individuals with NTBI longitudinally to include care in the community.

0143

Brain Power: Empowering Healthcare Specialists in the Legal World

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Objectives: To provide treatment providers information and tips to properly prepare their notes, records and reports in a way that will best assist the brain injury survivor in working through the insurance and litigation process.

Method: Handouts and Power point presentation.

Results: The Rehabilitation teams key function is to harness the power after a brain injury. Unfortunately in many cases a significant obstacle to that is the litigation process whether it is due to a lawsuit brought by the insured person or as a result of a disputes with their no fault carrier.

The team is often caught up in this legal process. They might appear as an expert witness on behalf of a party to a lawsuit or as a treating specialist.

The court system is foreign to most Healthcare Specialists and very different from their day to day practice. The objectives of lawyers and their clients are frequently at odds with those of the Healthcare Specialist. Lawyers look for definitive answers to specific questions. Lawyers seek answers which fall within their own theory of their case. Their

presentation will help you steer through the legal process from clinical notes and/or reports to giving evidence at trial.

A Healthcare Specialist's clinical notes and/or reports form the foundation of evidence they are permitted to give at trial. This presentation will state the do's and don'ts as well as the ethical and legal duties one has in proper note taking and reporting writing. Further we will look at how it can benefit the injured individual and give them more power to obtain treatment, assistive devices and financial stability needed after a brain injury.

Conclusions: This presentation will assist in empowering a Healthcare Specialist to support and advocate for their clients by giving them the tools to clearly express their expert opinion both in writing and at trial.

0144

Increase in TBI Discharges and Associated Diagnoses in the U.S., 2001–2007

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Objectives: Background: Recent evidence suggests that TBI hospitalizations and deaths are increasing in the U.S. There is also evidence of a rising incidence of certain conditions associated with an increased risk of hospitalization for TBI (ex: arrhythmias). Meanwhile, treatment of certain common medical conditions, such as hypertension, has become more aggressive in recent years, possibly increasing the risk of falls and TBI.

Method: Methods: Retrospective review of data from the HCUP national inpatient survey and US Census data for 2001 and 2007, to determine changes in overall number of TBI hospitalizations and rate, as well as changes in associated diagnoses. These were compared with changes in these diagnoses for the overall hospital population.

Results: Results: The total number of U.S. hospital discharges with a primary diagnosis of TBI rose 36% from 139,949 in 2001 to 189,783 in 2007 ($Z = 3.74$, $p = 0.0002$). The rate per 100,000 population rose 28%, from 49.1 to 63.0 ($Z = 3.57$, $p = 0.0004$). By contrast, the overall rate of hospital discharges in the U.S. rose only 0.6% ($p = 0.82$). The rate of TBI discharges with an associated fall rose 43%, from 18.5 to 26.4 ($Z = 6.46$, $P < 0.0001$), as compared

with an overall 12.6% increase in associated falls in the total hospital population. The rate of TBI discharges with a secondary diagnosis of Diabetes rose 114% ($Z=16.0$, $p<0.0001$), Hypertension 95% ($Z=15.2$, $p<0.001$), Arrhythmias 80% ($Z=11.5$, $p<0.0001$), and Dementia 62% ($Z=8.4$, $p<0.001$). The overall increases of these associated diagnoses for total U.S. hospital discharges were a much smaller 28% for Diabetes, 18% for Hypertension, 17% for Arrhythmias, and 15% for Dementia.

Conclusions: The overall number and rate of TBI discharges in the U.S. rose sharply between 2001 and 2007. This occurred at a time when overall hospital discharge rates showed little change. Fall associated TBI discharges rose even more rapidly. TBI hospitalizations with associated diagnoses of Diabetes, Hypertension, Arrhythmias, and Dementia appear to be increasing very rapidly, far more rapidly than in the overall U.S. hospital population. Overall, we are facing a large increase in TBI hospital admissions, lead by fall related TBI. These patients have an increasing number of serious medical conditions.

0145

The Study of APOE Polymorphisms Affecting the Expression of NF- κ B of Astrocytes In the Early Stage Postinjury

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Objectives: To investigate the correlation between apolipoprotein E gene polymorphisms and the expression of NF- κ B of astrocytes in the early stage postinjury.

Method: (1) The CDS region of three APOE alleles was obtained by reverse transcription polymerase chain reaction (RT-PCR), then the recombinant plasmid pEGFP-N1-APOE was constructed and identified by sequencing. (2) Astrocytes were separated from APOE gene-knockout mice, and identified by immunocytochemistry method. The recombinant plasmid was transfected into astrocytes with Lipofectamine 2000. (3) Cell injury models were set up by scarification. RT-PCR was used to detect the expression of NF- κ B mRNA on 12h, 24h and 48h postinjury. Western blot was used to detect the expression of NF- κ B protein as well.

Results: The expression of NF- κ B started to be observed at 12th hour after injury, but there was statistical difference between neither group. The expression increased at the 24th hour postinjury. And compared to the other two group, APOE ϵ 4 transfected astrocytes expressed higher level of NF- κ B ($P<0.05$). At the 48th h after injury, the expression of NF- κ B increased further, and there was statistic difference between APOE ϵ 4 and the other two groups ($P<0.05$).

Conclusions: It suggests that NF- κ B induced early inflammatory response may contribute to deterioration and poor outcome after traumatic brain injury in APOE ϵ 4 carriers.

0146

The Effect of APOE Polymorphisms on the Concentration of Ca²⁺ of Astrocytes In the Early Stage Postinjury

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Objectives: To investigate the correlation between APOE polymorphisms and the concentration of Ca²⁺ of astrocytes in the early stage postinjury.

Method: (1) The CDS region of three APOE alleles was obtained by reverse transcription polymerase chain reaction (RT-PCR), then the recombinant plasmid pEGFP-N1-APOE was constructed and identified by sequencing. (2) Astrocytes were separated from APOE gene-knockout mice, then identified by immunocytochemistry method. The recombinant plasmid was transfected into astrocytes with liposome-mediated method. (3) Cell injury models were set up by scarification. LCSM was used to detect the dynamic changes of intracellular Ca²⁺ on 12h, 24h, 48h and 72h timepoint postinjury.

Results: Compared to the control group, every allele shows significant changes of fluorescence intensity of Ca²⁺ ($P<0.05$). At 12th h after injury, the fluorescence intensity of Ca²⁺ was weak, and there was no statistical difference of fluorescence intensity of Ca²⁺ between each two groups ($P>0.05$). The fluorescence intensity increases progressively. At 24thh, 48thh and 72thh postinjury, the fluorescence intensity of ϵ 4 allele was significantly higher than the other two types ($P<0.05$).

Conclusions: It suggests that intracellular Ca²⁺ overloading may contribute to deterioration and

poor outcome after traumatic brain injury in APOEε4 carriers.

0147

Clinical Guidelines for the Care of Persisting Symptoms after Mild Traumatic Brain Injury

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Objectives: The overall objective was to create a guideline that can be used by healthcare professionals to implement evidence-based, best practice care of individuals who incur a mild traumatic brain injury (mTBI) and experience persisting symptoms. Persisting symptoms are a common complication of mTBI; 10 to 15% of patients will continue to experience significant symptoms beyond the normal recovery period, which can include post-traumatic headache, sleep disturbance, disorders of balance, cognitive impairments, fatigue, and mood disorders. Currently, best practice treatment is not clearly defined for this complex group who may even exhibit worsening of symptoms or emergence of additional symptoms following injury. Therefore, the following clinical questions were asked: Can a management plan be developed to screen for patients at high-risk of persisting symptoms and, once identified, to treat these symptoms?

Method: To achieve this goal, a search for existing clinical practice guidelines (CPGs) including recommendations for the care of mTBI was carried out. Next, a systematic review of the literature evaluating effectiveness of treatments for persistent symptoms was conducted. A search for CPGs and systematic reviews from outside of the TBI field providing guidance on management of the most common persistent symptoms was also completed. An expert consensus conference was held where healthcare professionals representing a wide range of disciplines from across Canada and abroad were brought together to review the existing guidance and evidence and to attempt to develop a comprehensive guideline.

Results: Although several methodologically sound CPGs were identified, only one focused on mTBI and that document primarily dealt with acute management. Thus, there is a clear need for guidance on the care of patients with persisting

symptoms. CPGs from outside of the TBI field were found for the symptom categories: sleep disturbances, fatigue, mood disorders, and cognitive deficits. Although the mTBI evidence base was found to be limited, by adapting recommendations from CPGs addressing TBI or symptoms that commonly persist following mTBI in general, as well as by developing new recommendations based on available evidence and clinical expertise, a clinical guideline was created to ameliorate this practice gap. The recommendations were voted on using a modified delphi technique before and after editing and the guideline received external review by recognized experts and stakeholders.

Conclusions: The guideline is accompanied by a treatment algorithm including a timeframe advising when to provide follow-up and deliver appropriate treatment options as well as numerous resources and tools. A selection of headings under which the recommendations fall include: General Recommendations for the Assessment and Diagnosis of mTBI, General Recommendations for the Management of mTBI, Providing Education Following a mTBI, Assessment and Management of Post-traumatic Headache, Assessment and Management of Persistent Sleep Disorders, Assessment and Management of Persistent Mood Disorders, and Assessment and Management of Persistent Fatigue.

0148

Exploring of cultural and gender differences in concussion reporting in young New Zealand rugby players.

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Objectives: Rugby is a major international sport played widely in New Zealand by both males and females. The game is a contact sport which often results in injuries including concussions. The reporting of a sports concussion to a medical doctor is problematic, and is complicated by the culture surrounding the sport which promotes attitudes of toughness in both males and females. The multicultural composition of New Zealand society sees a large number of players of Māori and Pacific Island heritage playing the game. It might be expected that these players could

bring different attitudes to the reporting of a concussion. Specifically, this study explores the concussion reporting behaviours of young rugby New Zealand rugby players of European (NZE), Māori and Pacific descent and whether males and female players differ in their reporting.

Method: This national survey used a randomised clustered sampling approach targeted to male and female high school rugby players aged 16 and older. The survey questionnaire was designed to investigate the players' knowledge about a concussion and their attitudes and practices in reporting a concussion. Descriptive statistics were computed and univariate logistic regression modelling (odds ratios and 95% confidence intervals) was used to determine if players of different ethnic backgrounds showed different responses in their attitudes to the reporting of a concussion and whether there were differences in males and females.

Results: Data were obtained from 439 players (327 males, 100 female and 12 not specified) which included; 175 players with a New Zealand European, 152 with Māori and 86 with Pacific backgrounds. Players were asked if it was necessary to see a doctor following a concussion and before returning to a game or practice. There was evidence of ethnicity differences in responses to this question ($p=0.026$) with Māori respondents more likely, although not statistically significantly, to endorse seeing a doctor than NZE respondents (1.9, 95%CI 0.7 – 5.1) and Pacific respondents statistically significantly more likely than NZE respondents (14.3, 95%CI 2.1 – 95.5). There was no evidence of difference in odds between females and males ($p=0.953$, odds ratio 1.1, 95%CI 0.1 – 12.3) in their attitudes to the reporting of a concussion.

Conclusions: The data obtained from a representative sample of young players indicate that there is some evidence for an influence of ethnic background in the intention to report a concussion, however the confidence intervals are wide and therefore must be interpreted with caution. Males and females demonstrated a similar attitude to reporting. It is well accepted that most sports concussions go unreported and data from this project provides a preliminary understanding of factors which may influence this health behaviour.

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0150

The relation between Protein Z and cerebral palsy

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Objectives: Cerebral Palsy (CP) is a disease which has a serious impact on children's physical and mental health development, while hypoxic ischemic encephalopathy (HIE) is one of the main causes. In the meantime, Protein Z (PZ) has been more and more reported for its function in both anticoagulation and thrombosis. The objectives of this research were to study the effect of PZ in regulatory mechanism of abnormal anticoagulant system and thrombosis by finding out the variation tendency of PZ concentration during the whole dynamic process of CP, and to provide a theoretical guide in early diagnosis and therapy.

Method: We performed a study by randomly selecting 40 cases of CP children (CP group), 30 cases of HIE children (HIE group), 20 cases of newborns with high risk of CP (umbilical cord group) and 20 control cases of healthy children for each group (control groups). PZ plasma values were detected by enzyme-linked immunosorbent assay (ELISA) in each group (umbilical cord PZ plasma levels in umbilical cord group).

Results: PZ levels in umbilical cord group were significantly higher than those in umbilical cord control group ($P < 0.01$); PZ levels in CP and HIE groups were obviously higher than those in respective control groups ($P < 0.05$); PZ values in HIE group were higher than those in umbilical cord group with statistical significance ($P < 0.05$) and PZ values in CP group were also significantly higher than those in HIE group ($P < 0.05$).

Conclusions: There are close relationships between PZ and CP of each developmental stage. High-risk neonates of CP, HIE and CP children, as different stages of hypoxic ischemic disease, all present higher PZ levels than control children respectively, illustrate that PZ expresses the hypercoagulable state of blood rather than merely a temporary rise as an acute reactive protein. Umbilical cord plasma partially stands for maternal condition and it is accessible as well, maybe we could regard its PZ level as an indicator for early blood coagulant state. The fact that significant higher PZ values in HIE group than those in Umbilical cord group, higher PZ values in CP group than those in HIE group tells us PZ level is the manifestation of the progressive increase of hypoxic ischemic and hypercoagulable state during the entire course of disease, therefore the role of PZ plays as a predictor in cerebral function and cerebral circulation disorder is reasonable, and it

could probably instruct us theoretically in early clinical diagnosis and therapy as well.

0151

Determining the Pain-Related Impairment Rating of Individuals with Mild Traumatic Brain Injury and with Chronic Pain according to the AMA Guides, Fifth Edition

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Objectives: Direct comparative research between chronic pain (CP) and Mild Traumatic Brain Injury (MTBI) have been limited, and post-MTBI outcomes are poorly reported in past literature. Some authors recommend that residual physical issues be assessed along with the more researched cognitive and psychosocial issues in MTBI. This study's objective is to examine the pain-related impairment (PRI) of MTBI patients with CP using Ratings Determining Impairment Associated with Pain (RDIP), a formal assessment of pain disability by the AMA Guides to Evaluation of Permanent Impairment, Fifth Edition. There has been no previous systematic research on the PRI system developed for the Fifth Edition of the AMA Guides, or of any other system for evaluating PRI.

Method: A cross-sectional case series study was undertaken in a referral-based outpatient rehabilitation clinic. 60 outpatient subjects with MTBI completed the Self-Administered Comorbidity Questionnaire (SCQ). SCQ results were used to identify subjects who felt that CP was a significant problem, and 30 subjects (20 men and 10 women) were asked to complete the RDIP. Physical Performance Tests (PPT) scores, consisting of the 6-Minute Walk Test (6MWT), Berg Balance Scale, & Dynamic Gait Index (DGI), were also recorded.

Results: One-half of MTBI outpatients identified significant chronic pain on the SCQ (43.7% combination pain, followed by 23.4% unidentified chronic pain) and were then asked to take the RDIP. A large proportion of the overall impairment was caused by crash-related traffic injuries with several trauma mechanisms. A psychological comorbidity was seen in a majority of the subjects, most commonly due to Affective Disorder. The RDIP consisted of five major items: Pain Severity; Emotional Distress (ED); Activity Interference (AI); Global Pain Behavior; and, Credibility score

for a maximum of 80 (high pain and severe impairment). The RDIP was then broken down into sub-categorization of PRI severity (from no significant impairment to severe). RDIP responses resulted in the following PRI: 0% no significant impairment; 0% mild; 33% moderate; 50% moderately severe; and, 17% severe impairment. The observed trend was a significantly greater effect on AI over ED and a close trend relationship between the total RDIP and low PPT scores.

Conclusions: The majority of the MTBI patients who identified pain as a significant problem, scored in the moderately severe PRI category. The AI/ED ratio in relationship to total RDIP score remained consistent even when the patients were separated based on PRI. There was little variation in their physical performance status. These findings suggest that CP should be considered when interpreting physical and psychosocial difficulties after MTBI and that the pain disability status of MTBI patients, regardless of severity, results in significant loss in health-related quality of life. Further research on the RDIP and its correlation to decreased PPT scores would be beneficial.

0152

ABI/AOD Clinical Consultants in the state of Victoria: the result of State of the art practice between three separate service sectors.

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Objectives: Abstract: Clients with acquired brain injury and alcohol and or other drug issues are often described as complex. This complexity has regularly been described as multiple disadvantage or negative service experiences by these clients. However, since 2001 when the Department of Human Services implemented ABI/AOD Clinicians across the state of Victoria, Australia there has been a significant change. Rather than emphasising the earlier disadvantages this client group have experienced, this paper will highlight how these clinical positions have improved best practice outcomes and solutions. At the very least, these clinical consultants have provided primary and secondary consultations, education, training, direct clinical practice and capacity building referral pathways to a number of AOD clinicians in specific Acquired Brain Injury

services and the Alcohol and Other Drug Service sectors.

Method: N/A

Results: N/A

Conclusions: The service coordination has been examined to reflect referral pathways, encouraging clinicians from both sectors to utilise links to services which have been developed.

0153

Long-term cognitive outcome after neurosurgically treated childhood traumatic brain injury

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Objectives: In the past two decades knowledge has emerged about the relationship between the secondary insults and morbidity and mortality of patients with CTBI. In Sweden, the 'Lund-protocol' for the neurosurgical treatment of severely injured patients was introduced 1992, aiming at controlling intracranial pressure, and the change in treatment protocol also gradually changed the grounds for referral to the neurointensive care unit. Thereafter the mortality of the adult patients was strongly reduced. However, parallel with improved survival rates, psychosocial problems involving work adjustment, marital conflicts, dependence and economy have been reported to increase. In this study we wanted to investigate the long-term cognitive outcome of children with traumatic brain injury and to evaluate if the advancements in the neurosurgical care influence the outcome.

Method: Two cohorts in the Western care health region in Sweden, neurosurgically treated for childhood traumatic brain injury (CTBI), either in 1987–1991 according to an older concept, or 1997–2001 with a stronger emphasis on volume targeted interventions. The participants were subject to an extensive neuropsychological assessment, 13.2 and 6.1 years post injury, respectively. In a between group design, assessment results of the two cohorts, n 18 and n 23, were compared to each other and to controls. Data were analyzed with multivariate analyses of variance.

Results: Long-term cognitive deficits of similar magnitude and character were observed in both groups.

In comparison with the controls, abilities were especially low regarding executive functions, memory functions and verbal IQ. The long-term result of lower verbal IQ and stronger visuospatial IQ is opposite to common cognitive profiles in the early period of recovery, indicating a better recovery of visuospatial intellectual functions. The lower results on verbal intellectual functions on the other hand is thought to be a consequence of diminished brain functions during the ongoing maturation of the frontal and temporal lobe in adolescence. There was a similar difference between visuospatial and verbal memory. A further explanation of the lower verbal result might be found in the difference in the type of tests. The verbal memory task was an implicit learning task, requiring well-functioning strategic abilities depending on intact executive functions, functions that in other executive tests had shown to be impaired. These hypothesis are in accordance with earlier findings describing that the executive control over cognitive processes is often more problematic than deficits of the cognitive processes themselves.

Conclusions: There is a definite need for long-term follow up of cognitive deficits after neurosurgically treated CTBI, also with the newer neurosurgical concept. Verbal learning and the executive control over memory functions should be addressed with interventions aimed at restoration, coping and compensation.

0154

What Constitutes Transition Success? An Investigation into Factors Influencing the Perceptions of Individuals with a TBI Regarding the Transition from Hospital to Home

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Objectives: Previous research has demonstrated that the transition home from hospital and return to community living represents a key period in the rehabilitation continuum for individuals with brain

injury. This bridging phase between hospital and long term community integration is an emotional one characterised by adjustment to changes in life roles and abilities. Other experiences associated with the transition phase include; experiencing difficulty accessing community based services, an increased role of family caregivers and subsequent caregiver strain, reduced participation in meaningful activities, increased feelings of depression and anxiety, financial strain and difficulty accessing the community.

While there is some research investigating the transition experiences of individuals with brain injury, little attention has been given to understanding how individuals perceive the transition phase and what contributes to a more positive experience. This paper aims to:

- (a) Describe how individuals with a TBI perceive the success of the transition from hospital to home and,
- (b) Discuss transition experiences, personal and environmental factors that are associated with the perception of a successful transition from hospital to home.

Method: A prospective longitudinal investigation was conducted with a sample of 102 individuals with a TBI discharged from an acute neurosciences ward and a brain injury rehabilitation unit. Data were collected using a sentinel events questionnaire, EQ-5D, Depression Anxiety Stress Scales (DASS), Sydney Psychosocial Reintegration Measure (SPRS), Mayo-Portland Adaptability Inventory-4 (MPAI-4), Craig Hospital Inventory of Environmental Barriers (CHIEF) and a visual analogue scale of transition success. The measures were administered with participants on four occasions (pre-discharge and 1, 3 and 6 months post discharge). Data analysis included use of multiple regression and random coefficient analysis.

Results: Multiple regression analysis with a preliminary data set indicated that self-ratings of transition success at 6-months post-discharge were significantly associated with the level of psychosocial integration at 1-month post discharge, time taken to become independent in community access, and moving to a more restricted living situation. Greater psychosocial integration and faster return to independent community access were related to positive perceptions of transition. Quality of life and degree of community integration (MPAI-4) were associated with changes in the perception of transition success over time in a preliminary analysis using random effect modelling.

Conclusions: Along with overall levels of psychosocial integration, two key sentinel events were found to

impact upon the perception of transition success. Moving to a more restricted living environment was associated with lower ratings of transition success and gaining independence in community access was associated with higher ratings of transition success. These findings highlight the need to further investigate these key events during the transition from hospital to home following TBI. Further research is also recommended, including other perspectives such as caregivers and using additional methods of investigation such as qualitative research.

0155

Self-managed networks of supports in Australia: Building self and social resources following brain injury

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Objectives: Objective: To determine the impact of psycho-educational, self-managed, six week group program for people with acquired brain injury delivered within multiple communities in Queensland, Australia.

Method: Participants: A prospective cohort of 52 individuals with brain injury aged between 22 years and 79 years of age (Mean = 48 years, SD = 15.31) participated in the study. The impact of the program was measured on three separate occasions (program commencement (Time 1), 3 months post-program (Time 2), and 6 months post-program (Time 3)). Measures: Self-efficacy Scale (adapted), SF-36, Goal Commitment Index, Depression Anxiety and Stress Scale- Short form, Health Coping Scale, Multidimensional Scale of Perceived Social Support, and Health and Social Care Scale.

Results: Results: MANOVA and change score analyses revealed a strong trend towards significance (i.e., $p < .05$) in both increased self resources (i.e., emotional skills, increased ability to manage illness) and increased social resources (i.e., social support) for individuals who participated in the STEPS program, even many years post injury.

Conclusions: Conclusions: Results from this study substantiate the role of a self-managed network of support program in promoting self and social resources following brain injury. However, the findings remind us that without monitoring and maintenance of these resources post-program, any gains made are unlikely to be sustained.

0157

The Stress Coping Process of Patients with Mild Traumatic Brain Injury

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Objectives: Traumatic brain injury (TBI) has been a significant public health problem in Taiwan, with an annual incidence of 138,249, among which mild TBI in the majority. Though most of the patients with MTBI recovered from posttraumatic symptoms in 3~6 months, a miserable 10% patients persistently suffered from a variety of psychosocial problems. Current study adopted the stress-coping model as a framework to figure out posttraumatic adjustment of MTBI patients.

Method: Based on Stress-Coping Model, we proceeded a case study with 2 patients with MTBI. Three aspects of data were collected: 1) interview of stress-coping experiences since the injury; 2) neuropsychological evaluation of memory, processing speed, attention/concentration, and executive functions; and 3) chart review of general health data and TBI related medical records.

According to principles of content analysis, units of 5 stress-coping components, i.e. stressor, coping behavior, appraisal, social support, and belief, identified from the text of interview were counted and categorized in accordance with 5 stages of posttraumatic recovery.

Results:

Case A

Case A is a 19 year-old female college student. No organic lesion was observed on CT scan. Interview data revealed that case A encountered a variety of stressors in different stages of posttraumatic recovery, among which 'physical damage' caused a considerable disturbances of case A. Coping behaviors the case A had used covered several kinds of coping strategies. Neuropsychological evaluation performed on 5th month post-injury revealed normal memory, processing speed, attention/concentration, and executive functions.

Case B

Case B is a 34 year-old male banker. No organic lesion was observed on CT scan. Interview data revealed that case B encountered stressors of different subjects, among them 'Symptom recurrence' was a special and important one for case B's long-term status of adjustment. Case B applied various kinds of coping strategies to handle with the

stressors. Neuropsychological evaluation performed on 10th month post-injury revealed normal memory, processing speed, attention/concentration, and executive functions.

Conclusions: Four common and 2 differences aspects of stress coping process were derived. Furthermore, two levels of stress-coping processes were elaborated, i.e. level one, "coping with symptoms and other related stressors", and level two, "making meaning out of head injury experience". In detail, the latter contains three steps: 1) passive identification of stress situation, 2) active identification through gathering information and forming interpretation, and 3) forming internal meanings. During the post-injured period, the 2 level processes might interact, and effect on the patient's status of posttraumatic adjustment. In addition, factors such as "patterns of physical damage and cognitive deficit" and "social support" might also play important roles in these processes.

0158

Prehospital emergency care for severe traffic craniocerebral injuries and prognoses: an analysis of 1107 cases

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Objectives: To analyze the effect of prehospital emergency care intervals on severe traffic craniocerebral injuries.

Method: Severe traffic craniocerebral injury cases were collected and screened according to a survey form designed on March 2008 and was approved by Experts Association of Neurosurgery in China. The clinical epidemiological survey was launched on April 4 2008 with more than 60 participating hospitals nationwide. Survey respondents were clinicians involved in emergency treatments. The forms were filled out by the clinicians in a uniform manner, checked by department directors and signed, and kept in both printed and electronic forms. The data were screened carefully to exclude any ineligible cases, selected based on Glasgow coma scores lower than eight, and analyzed following guidelines specified in the form. The data in the survey forms were analyzed with chi-square tests

and Spearman correlation analyses (SPSS 13.0, SPSS, Chicago, IL, USA).

Results: Mortality and disability increased with increases in both the response interval and the field management interval. The total prehospital interval may be an indicator of the rapidity of the emergency response, the traffic delay of the care service, accuracy of the care, and therefore an effective prognostic factor.

Conclusions: To improve the care quality following severe traffic craniocerebral injuries, prehospital intervals should be minimized.

0159

Interpretation of magnetic resonance imaging in the chronic phase of traumatic brain injury

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Objectives: After the acute stage of traumatic brain injury (TBI), MRI is the imaging method of choice and its findings may be of great importance for differential diagnosis, treatment decisions, outcome prediction, and medico-legal purposes.

The accuracy of residents' readings of MRI studies has been shown to improve with growing experience. We found no studies over the accuracy of consultant neuroradiologists' head MRI reports, and in fact in many studies the report of one neuroradiologist has been the reference diagnosis. Regarding CT of acute TBI, we have recently shown that there is a marked variation even between the most experienced readers in the detection of brain injury findings.

Our aim was to study eventual differences (in quantity and quality) in detecting the late stage TBI findings in MRI between two neuroradiologists.

Method: Randomly selected 89 cranial MRI-examinations from patients with clinically evident TBI and 11 controls were reviewed independently by two neuroradiologists: one with 14 years of experience within the subspecialty (R1), and another with recent completion of subspecialty training (R2). All examinations were performed on 1.5 T MR-scanners and included T2, gradient echo (T2*) and FLAIR sequences. Eventual other available sequences were also reviewed.

The findings were recorded using classifications of the nature of the finding and the location and side of the injury. The classes used were: brain contusion, subdural effusion and traumatic axonal injury (TAI).

TAI included subclasses of spot-like haemorrhage, spot-like hyperintensities and localized atrophy. The readers also stated their view of TAI being evident, possible or absent.

Results: Altogether 634 different findings in different locations were reported, R1 reported 370 findings and R2 264. The most common type of finding was white matter hyperintensities.

In 51 TBI-patients, TAI was reported being evident or possible, 41 by R1 and 40 by R2. However, only 30 of these concerned the same patients, so there was consensus over whether TAI is present or not in 76%.

R1 reported slightly more contusion findings but both found spot-like haemorrhages evenly. The most striking difference was in reporting of localized atrophy, especially in the frontal lobe. R1 reported atrophy in 51/178 (29%) frontal lobes, whereas R2 in 14/178 (8%). Altogether R1 reported atrophy in 98 locations and R2 in 33 locations.

Conclusions: The interpretation of TBI findings in late-stage MRI is difficult, yielding significant variability also between specialists in neuroradiology. This may endanger correct diagnostics and lead to false treatment decisions and medico-legal problems. Detecting atrophy seems to be the most demanding task while interpreting images of chronic TBI. Standardized quantitative imaging programs should be developed and the advances in MRI technology carefully evaluated to improve radiological TBI diagnosis.

0161

Late Mortality and Vocational Outcome of Patients with Traumatic Brain Injury: A 30-Year Follow-up Study

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Objectives: The aim of the study was to evaluate major risk factors for early retirement and late mortality in patients with traumatic brain injury (TBI).

Method: The study group included 192 TBI patients. Cognitive testing was carried out on the average two years after the injury (at mean age of 39.0 years), during the years 1966–1972. The severity of TBI was assessed retrospectively according to the duration of posttraumatic amnesia. Cox's regression and logistic regression analyses were used, and the survival of the patients was compared with the

general population using standardized mortality ratio (SMR). General cognitive decline was measured using the Mild Deterioration Battery.

Results: During a follow-up of three decades, 39.1% patients had died, 42.8% patients had retired soon after TBI, 46.2% retired prematurely or changed to less demanding jobs with periods of unemployment, and 11.0% completed a normal working career. Survival was significantly associated with age ($p < 0.001$) and vocational outcome ($p = 0.003$). Vocational outcome was associated with age ($p = 0.010$), severity of injury ($p < 0.001$), cognitive impairment ($p = 0.010$), later TBIs ($p = 0.007$), and alcohol abuse ($p = 0.015$). Mortality in the younger patient group (age < 39 years) was higher compared with the general population (SMR 4.50).

Conclusions: Normal working career seems to be rare after TBI and the working ability is compromised by age-, injury- and lifestyle-related factors. The mortality of the younger patients is high which should be considered when planning the care after TBI.

0162

Quantitative Analyses of Cortical Neuronal Population Changes Correlated with Severity of TBI

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Objectives: Magnetic Resonance Imaging provides evidence for loss of both white and grey matter, in terms of tissue volume, from the cerebral hemispheres after human traumatic brain injury (TBI). However, quantitative histopathological data for changes in number of cortical neurons is lacking.

Method: From the archive of the Department of Neuropathology at Glasgow, the cerebral cortex of 48 patients was investigated using stereology. Patients had survived 3 months after TBI and were classified using the Glasgow Outcome Scale (GOS) as follows; Moderately Disabled (MD, $n = 13$), Severely Disabled (SD, $n = 12$) and Vegetative State (VS, $n = 12$), and controls. Some patients from the archive were diagnosed with Diffuse Axonal Injury (DAI) post-mortem. Comparisons of changes in cortical neuron population across GOS groups between DAI and non-DAI patients were undertaken using Effect Size Analyses.

The hypotheses tested were that thinning of the cerebral cortex occurred after TBI, changes in thickness of cortical layers in Brodmann Area (BA)

11, BA 10, BA 24a and BA 4 differed, and different changes occurred for neuronal number, their size and nearest neighbour index (NNI) across GOS groups.

Results: There was a greater loss of large pyramidal and large non-pyramidal neurons with greater severity of the GOS from all four cortical regions, and the greatest loss of neurons occurred from the prefrontal cortex of DAI patients. There were different changes of the numbers of medium and small pyramidal and non-pyramidal neurons between different cortical regions and between DAI and non-DAI patients. Generally, a decrease in the somatic diameter of pyramidal and non-pyramidal neurons was associated with a more severe GOS. However, in the motor cortex an increased diameter of medium pyramidal neurons and small non-pyramidal cells occurred with a more severe GOS. Pyramidal and non-pyramidal neurons did not follow a Poisson distribution within the neuropil of control patients. Pyramidal neurons were usually scattered while medium and small non-pyramidal neurons were clustered. An increased spacing usually occurred across GOS groups.

Conclusions: It is concluded that loss of cortical pyramidal and non-pyramidal neurons may provide a structural explanation for the reduced executive and integrative capability of patients after traumatic head injury.

0163

Factors Influencing Long-Term Outcome of Operatively Treated Patients with Acute Subdural Hematoma

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Objectives: Traumatic acute subdural hematoma (aSDH) is a devastating injury. The goal of this paper was to investigate which factors contribute to the one-year outcomes of patients who required surgery for aSDH.

Method: Between 01/2001 and 12/2005 13 European centers enrolled patients with severe TBI (= Glasgow Coma Scale < 9). Only patients who survived at least until admission to the intensive care unit (ICU) were enrolled. Data on accident, pre-hospital treatment, hospital treatment, and outcomes (ICU, 3, 6, 12

months) was collected prospectively using a web-based database. Data sets of all patients who had had an aSDH requiring surgery were retrieved from the database. The Glasgow Outcome Scale (GOS) at 12 months after trauma was used to classify the patients into 3 groups: “good” (GOS scores 5–4), “poor” (GOS scores 3–2), and “dead” (GOS score 1). Data is presented as median and interquartile range or as proportions with 95% confidence interval (CI). Statistical analysis was performed with the open source statistical package “R”. Univariate analyses were used to identify differences between the three groups of patients. Relevant data was then used as covariates in logistic regression models. The results are given as odds ratio (OR) and CI. A p-value of <0.05 was considered statistically significant.

Results: 304 (26%) of the 1172 patients in the database had aSDH requiring surgery. Of these, 30% achieved good outcome, 10% poor outcome, and 60% had died at 12 months after trauma. Of those who died, 85% died on the ICU, 14% died on the ward, and 1% died after hospital discharge. The majority of patients were male. The most common injuries were fall <3m followed by motor vehicle accidents. In the univariate analyses, the following significant differences between the 3 groups (good/poor/dead) were found: median age (46 [30–58]/60 [43–64]/61 [38–69]), median GCS scores (7 [5–8]/4 [3–5]/4 [3–5]), proportion of patients with normal pupils (53 [43–64]/31 [14–48]/31 [24–38]), and median time to surgery (in minutes: 60 [40–90]/110 [60–137]/120 [60–233]). In the multivariate analysis age (OR 0.96, CI 0.95–0.99), GCS score (OR 1.43, CI 1.25–1.63), midline shift >15 mm (OR 0.20, CI 0.06–0.73), and direct transfer (OR 1.93, CI 1.02–3.66) to the center were the factors that significantly influenced good outcome at 12 months; GCS score (OR 1.30, CI 1.15–1.46) and midline shift <5 mm (OR 3.49, CI 1.06–11.44) were the factors that significantly influenced survival.

Conclusions: Morbidity and mortality after aSDH are mostly influenced by age and trauma severity as reflected by GCS scores and midline shift. The only treatment factor that significantly improved the odds for good recovery was direct transfer to a specialized neurotrauma center.

0164

Community Music Therapy in Post-Acute Rehabilitation Following Brain Injury

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Objectives: Negative affect states such as depression, boredom, loneliness and worthlessness have been reported to be the most common post brain injury emotional reactions. It was hypothesized that the greatest benefits for clients involved in Music Therapy would fall within the psychosocial realm. Questions were considered as to the client’s perception of the experience and whether it was possible to identify the value of musical expression and its emotional consequence within a wider understanding of Music Therapy as a rehabilitative modality.

Method: The clients engaged in at least weekly Music Therapy sessions encompassing an array of musical activities including singing, improvisation, songwriting, recording, rehearsing and live community performance. This multi-level experience was approached from a Community Music Therapy model, defined as a holistic understanding of music that leads people both inward in exploration of their inner lives as well as outward toward participation and connection within community. The aim is to assist clients in accessing a variety of situations and accompanying them as they move between traditional therapy approaches and the wider social contexts typically involved in music making.

Results: Fifteen original client songs that were recorded and, in most cases, performed live, were analyzed for dominant thematic content. The songs were found to organize into the following categories: 1. Processing/Integration of Trauma; 2. Teaching Others (about experiences of disability and creating a better world); 3. Self-Reflection; 4. Spirituality and Love. Additionally, a series of twenty-three personal interviews and written reflections by the participants following the completion of various musical projects were analyzed. The clients personal statements revealed a self-perception of high level functionality within certain generally accepted areas of deficit common in brain injury: 1. Self-Esteem; 2. Motivation; 3. Self-Expression; 4. Collaboration. Since these qualities were reported by the clients to have been manifested within successful completion of creative musical projects, any benefit either derived or perceived by the client could be considered both 1. The direct result of engagement in an active musical process and; 2. Intrinsic to the creative musical experience.

Conclusions: In this process of identification with one’s own creative power, the rehabilitative intent is to begin to shift a shattered self-image to one of self-acceptance. As clients increasingly feel productive, validated, competent and aware of progress, disability can begin to be redefined as only one aspect in a multi-dimensional sense of self rather than having one’s self and life defined by disability.

The dominant message is that being an individual with a disability does not preclude having active, creative and interesting experiences in life and it can be proposed that the client's creative work represents a striving towards a renewed way to cope with their changed self-image and daily lives.

0165

The influence of apolipoprotein E polymorphism on the electrical activity of brain after mild/moderate traumatic brain injury

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Objectives: To investigate the influence of apolipoprotein E gene (APOE) polymorphism on the electrical activity of brain at the acute stage of mild/moderate traumatic brain injury.

Method: The clinical data of 112 patients with mild/moderate traumatic brain injury were collected and the APOE genotype was identified by polymerase chain reaction-restriction fragment length polymorphism (PCR-RFLP). The electrical activity of brain in every patient was recorded by electroencephalogram for 2 times within a week after injury. Qualitative and quantitative methods were used to determine the variations of electrical activity of brain.

Results: Among 112 patients, the distributions of APOE genotypes and alleles matched Haldy-Weinberg Law. 12 out of 22 patients with APOE ϵ 4 (54.54%) presented with deteriorated electroencephalogram, which was significantly higher than that of patients without APOE ϵ 4 (16 of 90 patients, 17.78%, $P=0.000$). Comparison of the first and second electroencephalograms demonstrated that the slow waves in patients with APOE ϵ 4 significantly increased ($P=0.0098$), while the slow waves in cases with APOE ϵ 2 and APOE ϵ 3 decreased ($P<0.05$). And the reduction of slow waves in APOE ϵ 2 carriers was more obvious than APOE ϵ 3 carriers ($P=0.0249$). Logistic regression analyses showed that APOE ϵ 4 was a risk factor to electroencephalogram aggravation after traumatic brain injury.

Conclusions: APOE ϵ 4 is a risk factor to electroencephalogram aggravation during acute stage after mild/moderate traumatic brain injury. However, APOE ϵ 2 seems beneficial for the recovery of electrical activity of brain.

0166

Return to work after acquired brain injury: A systematic review

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Objectives: Acquired brain injury (ABI) is known as one of the most disabling diseases, affecting neurological, psychiatric and cognitive functions and making therefore return to work (RTW) difficult. However, being employed is important for most people. Objective of the study was to investigate how many people return to work after ABI due to traumatic or non-traumatic causes and to provide insight into the prognostic and non-prognostic factors of RTW in people with ABI who were working before injury.

Method: A systematic literature search (1992–2008) in the Pubmed, EMBASE, CINAHL and PsycINFO databases was performed. The search strategy consisted of several terms denoting brain injury, return to work and prognostic factors. An overall estimation of % RTW one and two years post-injury was calculated by data pooling. Evidence was classified as strong (positive, negative or no), weak, or inconsistent.

Results: 35–60% of the people with non-traumatic ABI and 30–65% of the people with traumatic ABI returned to work. The pooled overall estimate was 39.3% RTW after two years of injury for people with non-traumatic ABI. For people with traumatic ABI the pooled overall estimate was 40.7% RTW after one year and 40.6% RTW after two years. Strong evidence was found that 'gender' and 'anatomic location' were not associated with RTW after non-traumatic ABI, and that both 'injury severity' (classified by the Glasgow Coma Scale) and 'suffering from depression' or 'anxiety' were not associated with RTW after traumatic ABI. In addition strong evidence was found for the 'inpatient length of stay' as a negative prognostic indicator after traumatic ABI: Subjects that had a longer inpatient hospital and rehabilitation stay had a reduced chance of returning to work. As possible indicators for vocational therapy weak evidence was found for the three trainable or treatable factors 'ability to perform activities of daily living' (after non-traumatic ABI),

‘residual physical deficits/higher disability level’, and ‘number of associated injuries’ (both after traumatic ABI).

Conclusions: It can be concluded that two-fifths of the subjects with non-traumatic or traumatic ABI returned to work within two years post-injury. Although many factors were investigated, limited evidence for the prognostic value of the investigated variables was found. It is recommended to focus in rehabilitation on the factors for which weak evidence was found but that are trainable or treatable with the goal of improving the process of vocational rehabilitation.

0167

Early vocational rehabilitation after acquired brain injury

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Objectives: To describe a protocol for early vocational rehabilitation (EVR) that can be used during the rehabilitation process of people with acquired brain injury (ABI).

Method: The protocol of EVR is meant as a process guideline to focus systematically on return to work in an early stage of (inpatient or outpatient) rehabilitation. It was developed based on the experiences and knowledge resulting from a promising project that was run in the Netherlands and Belgium to guide people with ABI back to work. The protocol was designed existing of six steps. All disciplines of the rehabilitation team are involved in the process of EVR, making it possible to start multi-disciplinary training of specific working skills early after acquiring brain injury or receiving rehabilitation.

Results: The protocol exists of the following steps:

- (1) The working situation and goals concerning work of the patient are explored by the (rehabilitation) physician and the vocational rehabilitation specialist within the first three weeks of the rehabilitation process;

- (2) Based on the exploration the rehabilitation team decides whether returning to work could be possible;
- (3) If work could be possible, the vocational rehabilitation specialist visits the employer and contacts the occupational physician. During the visit the employer is informed about ABI and an overview of the job requirements of the patient is made;
- (4) The rehabilitation team investigates which of these job requirements can be fulfilled by the patient and a decision is made about the possibilities to return to the former job;
- (5) If return to the former job seems to be possible (with or without adaptations), goals for vocational rehabilitation were set by each relevant caregiver. (Cognitive) work samples are used during the training. If necessary an overview of the requirements of an alternative job is made. The capabilities of the patient and the goals for vocational rehabilitation are set and discussed every twelve weeks. The duration of treatment according to EVR depends on the situation of each individual patient;
- (6) As soon as EVR stops (because the patient returned to work completely, is discharged from rehabilitation or is not able to work at all) all relevant information is assigned to the employer and occupational physician and, if necessary, appointments about further treatment or (job)-coaching are made.

Conclusions: A protocol to focus systematically on return to work in an early stage of rehabilitation after ABI has been developed. Future studies will be necessary to provide insight into the feasibility and effectiveness of the protocol.

0168

Does the Right Ventromedial Prefrontal Cortex Modulate the Effect of Emotion on Moral Judgment?

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Objectives: Although there is little doubt about the reliance of morality on various mechanisms, there is almost no consensus over the type of their relations. In this way, the importance of reasoning and feeling

in human morality was chiefly concerned; however the neural basis of these introspectively different components of moral decisions is hotly debated. This study was aimed to investigate any possible effect of right ventromedial prefrontal cortex (rVMPC) on modulatory effect of emotion on moral judgments.

Method: A sample of present study included 6 patients with adult-onset brain damages and 6 healthy individuals. Volunteers were eligible to enroll in this research if they had focal and stable brain damage to VMPC. The site of the lesion was ascertained by acquiring MRI. All patients had right encephalomalacia due to surgery after trauma and tumor resection. The overlap of lesions calculated by the sum of lesions which the most extensive suffered region overlapped across the six patients was the rVMPC, in particular BA 10. The time elapsing between their injuries and participating in this research ranged from 1 to 20 years to allow the potential changes to become manifest. Also healthy subjects were matched for age and sex distribution. All participants gave their written consent to participate in this study.

Two different computerized tasks were embedded in a 5 stages procedure applied in the current study. One task was to assess the Moral Judgment (MJ) and the other one was for Emotional Induction (EI). MJ part was composed of 3 stages while emotional inductions were presented two times between the MJ stages sequentially. The moral judgment task consisted of 15 moral dilemmas taken from Greene et al.'s work (2001). The first stage of EI task included neutral pictures whereas the second one was composed of negative evocative pictures. In EI task, 14 neutral and 24 negative evocative pictures from International Affective Picture System (IAPS) were selected.

Results: There were not significant differences between groups on response times to moral judgments before and after negative EI as well as the proportion of utilitarian responses. Data from self-reporting of emotional states demonstrated that negative emotions impressed participants' emotional states more than did neutral emotions.

Conclusions: Our results did not confirm proposed influences of rVMPC damage on the effects of emotions on moral decision making. There are at least 3 possibilities for this finding: 1. Plasticity of the brain and also the social learning compensate the impaired function by the other areas; 2. It seems that patients with unilateral damage had not any defects in social perspective-taking, self-focused and self-conscious emotion to prevent acting against the rule besides hypothesis about the laterality of these functions in the brain; 3.

Our pilot studies highlighted cultural properties of moral judgment which it seems that not only the cognitive structure but also other social and cultural mechanisms intermediate moral judgment and had an influence on brain reorganization following the damage.

0169

Objective and Subjective Assessment of Mental Fatigue After a Traumatic Brain Injury

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Objectives: Mental fatigue is a common symptom after both mild traumatic brain injury (MTBI) and more severe traumatic brain injury (TBI). It is characterized by subjective concentration and memory difficulties as well as increased fatigability after mental activities, such as paying attention to conversations and reading. Mental activities during the day results in depletion of energy, and it can take days to recover. For most individuals the problem disappears within a year after the injury, but for some, mental fatigue becomes a chronic problem that affects daily life.

Fatigue is usually assessed as a subjective problem with self-report questionnaires and it has been difficult to relate to objective assessment. The aim of this project was to find better ways to determine mental fatigue. Both subjective and objective measurements were used with the intention of more clearly identifying items associated with mental fatigue. A new self-assessment scale was employed for the subjective rating of mental fatigue and related symptoms in combination with objective tests of information processing speed, working memory and divided attention.

Method: A new self-assessment scale was constructed, with the aim of distinguishing between fatigue in common and mental fatigue. The scale developed was based on common activities and related the estimation to intensity, frequency and duration with exemplified alternatives. The intention was to make the scale more consistent between individuals and also between ratings for the same individual. Subjects reporting mental fatigue for 6 months or more after MTBI or TBI were assessed for subjective mental fatigue, information processing speed, working memory and attention and were compared with controls.

Results: A significant correlation was found between the items from the self-assessment scale (24-hour variation not included) and also an adequate internal consistency with a Cronbach's alpha of 0.944. The MTBI and TBI groups reported a significantly higher total sum score compared to controls, and MTBI working full time reported a lower total sum score than MTBI on sick leave (ANCOVA, $F=79.80$, $p < 0.001$). The individual items in the self-assessment scale showed that the three groups with brain injury had significantly higher scores for all questions compared to the healthy controls. This indicates that mental fatigue also includes other relevant symptoms which are either primary or secondary to the problem. A significantly decreased information processing speed (digit symbol-coding, reading speed, trail making test) was found in those on sick leave due to MTBI or TBI, compared to controls. Divided attention was affected to a lesser extent. A significant correlation appeared for total sum score and digit symbol-coding ($r = -0.59$).

Conclusions: After a traumatic brain injury information processing speed is suggested the most important cognitive predictor of mental fatigue and related items.

0170

Exploring the content of physiotherapy (PT) interventions for children and youth with ABI: Development and validation of a rating instrument

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Objectives: Acquired brain injuries (ABI) in children and youth often result in physical impairments, activity limitations and participation restrictions requiring PT intervention. In this heterogeneous population, there are few best practice guidelines to direct the provision of PT services. One key issue underlying this gap is that the content and focus of 'usual' PT intervention strategies for children and youth in the early stages of recovery from moderate and severe ABI have not been well-described. The purpose of this research was to develop and validate an observer-rated instrument to document and quantify therapist and client activities and verbalizations during PT intervention sessions.

Method: An initial list of potential items was generated through a review of the literature and

observation of physiotherapy intervention sessions for this population. A convenience sample of seven researcher/academic experts participated in a face validation process to confirm comprehensiveness of the items and rating scheme that would be tested in the pilot instrument. Six 30–60 minute PT sessions with children and youth with ABI and physiotherapists in the Brain Injury Rehabilitation Team were videotaped at a children's rehabilitation centre. Videotapes were used within a content validation process in which 12 physiotherapists with pediatric ABI experience responded to a questionnaire evaluating feasibility and importance of items. Subsequently, the physiotherapists participated in a focus group in which rating of the PT session videos was done to test the instrument. The final instrument was constructed from this feedback.

Results: The Acquired Brain Injury Physiotherapy Session Rating Instrument (ABI-PSRI) is a 25-item instrument in which a trained rater uses a 5-point Likert scale to score the extent to which intervention strategies were observed during a videotaped PT session. Given that rating of the PSRI is completed following videotape viewing, a worksheet is used while watching the videotape to guide the rater's attention towards items of relevance to the scale; for example, the number of practice trial repetitions and the use of physical demonstration or modeling. This worksheet also allows the rater to describe each of the activities undertaken during the session.

Conclusions: The ABI-PSRI documents and quantifies physiotherapy intervention strategies. A study to determine inter- and intra-rater reliability of the ABI-PSRI is currently underway. The goal of this instrument is to enhance our understanding of PT interventions with this complex population. In the future, a greater understanding and delineation of the components of comparative 'usual' therapy will enhance the quality of future trials investigating the effectiveness of new PT interventions for children and youth with ABI.

0171

Community Integration Following TBI and the ICF: An examination of the Community Integration Questionnaire and the Reintegration to Normal Living Index.

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Objectives: Introduction/Objectives: The International Classification of Functioning, Disability and Health (ICF) provides a framework for the standardized assessment and classification of functioning and participation in everyday activities. The purpose of the present study is to i) examine whether the content of existing community integration measures commonly used following traumatic brain injury (TBI) is represented in the ICF and ii) determine if the ICF may be reasonably used as a common framework within which such measurement tools may be compared.

Method: Method: Based on the results of a previously published review, the Community Integration Questionnaire (CIQ) and the Reintegration to Normal Living Index (RNLI) were selected as commonly-used instruments representative of community integration assessment. Two independent raters coded items from the CIQ and the RNLI to the ICF according to established linking rules. Discrepancies were resolved through discussion and inter-rater agreement was determined by calculating percentage agreements.

Results: Results: A total of 49 concepts were identified from the 26 items included on the two instruments. Inter-rater agreement was observed for 96%, 92%, and 86% of all concepts linked to the first, second, and third levels of the ICF, respectively. All items were successfully linked and discrepancies between raters easily resolved. The CIQ was linked to 22 distinct codes, representing 6 of the Activities and Participation chapters as well as 1 Body Functions chapter. The RNLI was linked to 22 codes in 6 of the Activities and Participation chapters, in addition to one item coded as a personal factor. The most common assessment areas in the CIQ were domestic life, community, social and civic life (recreation and leisure) and major life areas (economic, work and employment and school/training); whereas, mobility (moving around), community, social and civic life (recreation and leisure) and interpersonal relationships were areas of focus within the RNLI.

Conclusions: Conclusion: The concepts related to community integration contained within the CIQ and RNLI could be framed within the ICF by linking each identified concept to corresponding ICF codes. In so doing, it was possible to compare directly differences in operationalization of this important construct. It should be noted that while both instruments assess community integration, the CIQ provides an objective assessment of behaviours or activities thought to be indicative of integration.

The RNLI provides a subjective assessment of community integration from the perspective of the individual. Unfortunately, there is no provision for the subjective dimension of performance within the ICF thereby limiting between-scale comparisons to identified performance-based concepts.

0172

Discharge against medical advice after traumatic brain injury: Is intentional injury a predictor?

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Objectives: Discharges against medical advice (DAMA) have consistently been reported as causing worse functional outcomes and frequent hospital readmissions and frustrate clinicians in the provision of needed care. However, little is known about DAMA of patients with traumatic brain injury (TBI). This study aimed to develop a risk profile of DAMA patients in the TBI population, to examine factors associated with DAMA occurrence, and to examine specifically whether injury intention (unintentional injury versus intentional injury) is a significant predictor of DAMA.

Method: A retrospective cohort study was conducted using hospital discharge data obtained from the Minimal Data Set (MDS) of the Ontario Trauma Registry (OTR) for the years of 1993/94 and 2000/01. Participants included in this study had a history of TBI defined by the ICD-9-CM codes 800–801 and 850–854, and were between 15–64 years of age. Discharge outcomes were categorized as regular discharge or as DAMA.

Results: The MDS review yielded 15,684 cases of TBI with an average length of stay of 2.7 days. Of these, 446 (2.84%) had recorded DAMA events. Thus, approximately 1 in 35 hospital discharges of TBI patients in Ontario were against medical advice. DAMA was significantly greater in those with intentional TBI compared to unintentional TBI. Of the intentional injuries, the adjusted odds ratios (aOR) of DAMA for self-inflicted TBI and other-inflicted TBI were aOR 1.97 (CI: 1.36–2.84) and aOR 2.00 (CI: 1.53–2.62), respectively. There was a 1.9–2.4 times greater risk of being discharged against medical advice in age groups between 25–54 years than in the oldest age group of 55–64 years. DAMA

was also associated with a history of alcohol/drug abuse (aOR = 3.50, CI : 2.85 – 4.30).

Conclusions: TBI patients who leave hospital against medical advice are a high-risk population. This study also suggests that injury intention is an important independent factor to consider when modeling DAMA. Early identification of patients with intentional TBI could allow implementation of better preventative strategies, thus improving health outcomes and enhancing healthcare delivery.

0173

Maturation related changes may explain a range specific response in the rat model to shock wave induced neurotrauma

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Objectives: The mechanism for shock wave induced neurotrauma has been a matter of debate among researchers in the field of blast related injury. Multiple hypotheses of the mechanism have been suggested, while all have some evidence to suggest these, none have yet been proven. Our research has shown that rats subjected to a specific band of pressures (17PSI/119kPa) demonstrate significant alterations (MRI, biomarkers, cognitive performance, histology) as compared to pressures above and below that threshold. Thus, we conducted this study to uncover a potential answer for this question of a range-specific brain injury mechanism.

Method: Male Sprague Dawley rats (n = 8) of various ages and weights were subjected to a repeated number of pressure exposures at different intensities ranging from 14 to 40PSI (96.53 to 275.8kPa). The rats were instrumented with a fiber optic pressure sensor sealed inside the brain to monitor the changes in intracranial pressure as a response to shock wave transmission. Shock waves were generated using a compressed helium shock tube at Wayne State University; following the battery of exposures the rats were sacrificed. Four rats, including the oldest and youngest, were subjected to a micro CT scan to analyze the skull thickness at different regions in the skull case.

Results: The data demonstrated that at a specific range of pressures, the rat's skull would achieve a resonant state for a time frame of 1–2 ms or longer depending on the animal and pressure. The

youngest and lightest rats would respond to the lowest pressures where the oldest and heaviest rats would resonate at the greatest pressures. The mid range rats, an approximate of our earlier studies tended to show the greatest response approximating 15–20 PSI (105–140 kPa) range. The results of the CT depict a direct correlation of rat age/development and skull thickness. It was observed that as the rat becomes older the frequency of the resonance decreased but the amplitude increased. The older rats achieved greater intracranial pressures when compared to the younger rats when subjected to the same incident pressures. Additionally while analyzing the geometry of the skull it was noted that there were folds of bone on the lateral surfaces of the skull while the superior aspect did not. This leads to the possibility that the top of the skull is acting as a vibrating membrane and allowing for the propagation of waves into the intracranial contents. We expect that this effect may be more severe when this membrane/skull achieves resonant characteristics.

Conclusions: The data suggests that the response of the rat to shock related impact is a function of the rat's age, weight, and skull thickness. Therefore stage of development of the rat needs to be greatly considered among any researcher undertaking shock related neurotrauma research.

0174

Rehabilitation Outcomes after Intentional Traumatic Brain Injury: Functional Changes and Discharge Destinations

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Objectives: Traumatic brain injury (TBI) due to violence is a major public health issue; a recent report by the Canadian Institute for Health Information (CIHI) indicates that intentional TBI is increasing among young adults. Our previous study was the first epidemiological study for intentional TBI. However, there are no population-based Canadian studies addressing functional outcomes in post-acute settings. This study aimed to investigate functional changes and discharge destinations of intentional TBI patients compared to unintentional TBI patients.

Method: Prospective cohort study utilizing population based acute care and inpatient rehabilitation

records: the Discharge Abstract Dataset (DAD) and the National Rehabilitation Reporting System (NRS) from the Canadian Institute for Health Information (CIHI). All patients in the dataset were receiving in-patient rehabilitation services across Canada during the fiscal years 2001–2006. The main outcomes measured were: absolute Functional Independence Measure (FIM) gains in motor and cognitive subscales, relative FIM gains in motor and cognitive subscales using Montebello Rehabilitation Factor Scores (MRFS), and discharge destinations (home versus others, home with service versus home without service).

Results: People with intentional TBI had significantly lower motor FIM gain and cognitive MRFS in univariate analyses ($p=0.010$, $p=0.039$ respectively) at discharge. Intentional TBI was also associated with lower cognitive MRFS, while controlling for age, gender, alcohol/drug abuse history and other demographic and clinical variables. These people were less likely to be discharged home, controlling for other independent variables.

Conclusions: People with intentional TBI are a distinct population in the rehabilitation setting in Canada. During in-patient rehabilitation, focusing on effective changes in cognitive functions rather than in motor functions would be more applicable to this population. Different discharge destinations would also imply that more careful discharge planning should be developed.

0175

Neurorehabilitation of the Mild to Moderate Brain Injury Survivor

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Objectives: The National Institutes of Health estimate that there are more than 2 million individuals that sustain Traumatic Brain Injuries (TBIs) in the United States each year. TBIs, regardless of severity, can result in cognitive, emotional, and physiological deficits. Individuals that function at a high level following TBI present an especially challenging problem for the rehabilitation team. It is not unusual for these individuals to become depressed and frustrated at their inability to function at their pre-injury level, while at the same time denying any cognitive impairment. Additionally, when admitted to a residential treatment facility, the TBI survivors that function at a high level resent being placed alongside TBI survivors with greater cognitive,

emotional and physical impairments. We will present a detailed, multidisciplinary program for treating adult survivors of TBI that function at a high level, but who have significant deficits in executive skills and have emotional and behavioral challenges.

Method: The history for treatment of adult survivors of TBI with high level cognitive deficits is explored with respect to both the survivor and the survivor's family. Peer reviewed literature of the treatment of these survivors combined with our clinical experience was used to derive a unique treatment program. This program used the format of a "university" curriculum uniquely crafted to fit the needs of survivors.

Results: A complete, unique multidisciplinary program for residential treatment of adult survivors with traumatic brain injury was developed. Individuals that had significant neuro-cognitive deficits which interfered with independent living were engaged in this program long term. Cognitive testing was done pre treatment and post treatment.

Conclusions: The strategy and goals of rehabilitation must pivot around the axis of self-identity. In defining and establishing true self-identity, one finds the keys to guide satisfying work and establish meaning for the living self. The tools for living are unique, and once lost, they need replacing. Providing a person to assist an individual with a brain injury and providing a structured curriculum will help that individual step beyond his or her limitations.

0176

ICF based content comparison of the most utilized measurement instruments used in Traumatic Brain Injury research.

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Objectives: To identify using an evidence based approach which are the most frequently used measurement scales reported in published studies focusing on Traumatic Brain Injury (TBI) and to analyze the ICF concepts contained in them. By doing so, we hope to assist clinicians working in the field, to choose better measures base on a conceptual decision making framework.

Method: A systematic literature review was conducted after developing an electronic search strategy between 2002 and 2007 (Medline, EMBASE and PsycINFO). The most frequent measuring instruments were extracted and meaningful concepts were identified and linked to the ICF. Duplicates and four level categories were excluded.

Results: 1089 papers met the initial criteria. After doing an abstract check, 193 papers fulfilled the eligibility criteria. The frequency analysis showed that FIM, DRS, CIQ, TMTa/b, GOS and WECHSLER were the most frequent scales reported in studies dealing with TBI. 212 concepts based on the ICF were identified. 24% were linked to “body functions” whereas the great majority (72.6%) were linked to “activities and participation”. Almost all chapters from “body functions” and “activities and participation” were represented after the analysis showing the broad areas of impairment after TBI.

Conclusions: This study concludes that ICF provides a useful tool for identifying concepts contained in measurement instruments used in TBI, many of these measures integrate a variety of different ICF concepts. Clinicians should find this data analysis helpful in choosing the right scale in order to address a specific ICF item when making decisions about the most appropriate measuring instrument for their clinical practice and/or research. This study is a minor part of a big project in order to develop the ICF Core Sets for TBI.

0177

Computerized web-based neuropsychological assessment of cognitive control using the Sevilla Neuropsychological Test Battery (SNB) demonstrates activation in superior dorsolateral prefrontal cortex (DLPFC)

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Objectives: The purpose of this study is to establish the relationship between the hemodynamic response in dorsolateral prefrontal cortex (DLPFC) and individual differences in cognitive control, as assessed by the Sevilla Neuropsychological Test Battery (SNB). DLPFC plays a crucial role in maintaining information on-line while it is processed. Functional neuroimaging studies have shown that DLPFC activation is stronger when subjects

are required to process conflict information, as presented in the classic Stroop paradigm, where a prepotent response must be overridden in order to accomplish the tasks. Patients with DLPFC lesions show deficits in tasks that demand intact cognitive control. However, little is known about individual differences in cognitive control and its neural correlates.

Method: Twenty-five healthy volunteers were studied using functional near infrared spectroscopy (fNIRS) while performing a modified Stroop paradigm. A matched non-conflict task was used to control possible effects of sustained attention or task language demands. Mean concentration levels of oxygenated haemoglobin (oxy-Hb) were correlated with behavioural performance (reaction time) in the conflict task.

Results: Subjects showed higher reaction times in the Stroop task (conflict task) than in the control task. Those with shorter reaction times had higher levels of oxy-Hb concentration in superior DLPFC. This correlation was not observed in the control task.

Conclusions: Our results are the first to show a positive correlation between behavioural performance and oxy-Hb levels in superior DLPFC using the Sevilla Neuropsychological Test Battery (SNB). These results suggest that the availability of oxygen in the superior DLPFC, possibly linked to an increase in metabolism, may be related to attention level and effectiveness of cognitive control. The conclusions drawn from this study could improve cognitive control assessment of patients with frontal cortex lesions.

0178

Computerized web-based neuropsychological assessment of memory and learning processes using the Sevilla Neuropsychological Test Battery (SNB) found activation in frontal cortex

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Objectives: Learning produces neuroanatomical and neurophysiological changes. The computerized web-based Sevilla Neuropsychological Test Battery (SNB) examines memory and verbal learning in patients as well as in healthy individuals. This study investigates the effect of efficient verbal learning on PFC, and associated neurophysiological effects,

using a high temporal resolution neuroimaging technique called functional near-infrared spectroscopy (fNIRS).

Method: We focus on the physiological effects of learning and working memory using an adaptation of Luria's Memory Word-Task (LMWT). Thirteen healthy, right-handed volunteers, mean age = 25.91 (range = 23 to 43), participated in the current study. We use fNIRS to assess the hemodynamic response of PFC while subjects complete the LMWT, adapted to our neuroimaging protocol research. Changes in oxygenated haemoglobin (oxy-Hb) and deoxygenated haemoglobin (deoxy-Hb) were recorded and analysed. A subject performance recalling the maximum number of words was considered effective learning.

Results: Percentage of subjects who recalled the complete word list varied across trials ($p < 0.0001$). Only 7.69% recalled 10 words in the first trial, whereas 76.9% recalled the complete word list in the 5th trial. All subjects recalled the 10 words in the 10th trial. fNIRS results showed significant increase in oxy-Hb and decrease in deoxy-Hb during the first half of the learning task, when subjects could not recall the complete word list. Conversely, significant decrease in oxy-Hb and increase in deoxy-Hb were found when subjects learned the complete word list.

Conclusions: Our findings show that memory and efficient verbal learning is mediated by the neural repetition suppression (NRS) mechanism. This mechanism facilitates automatic cortical deactivation in dorsolateral PFC once learning is successfully completed. SNB is confirmed as a reliable tool for assessing memory mechanisms (volume, contamination, mnemonic gain, primacy/recency) associated with frontal cortices.

0179

S-Nitrosoglutathione Reduces Neurovascular Injury in a Rat Model of Experimental Traumatic Brain Injury

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Objectives: Traumatic brain injury (TBI) is a major cause of serious morbidity in young adults. This complex pathological condition is characterized by significant blood brain barrier (BBB) disruption

that stems from cerebral ischemia, inflammation, and reactive oxygen. nitrogen species in the traumatic penumbra of the injured brain. Once traumatic injury has occurred, combating these exacerbations is the keystone of an effective TBI therapy. Nitric oxide (NO) has been shown to maintain not only integrity of BBB but also inhibit the mechanisms of secondary injury following trauma. Therefore, we tested whether NO modulator S-nitrosoglutathione (GSNO) shows efficacy in a rat model of experimental TBI.

Method: TBI was induced by controlled cortical impact (CCI) in adult male rats. GSNO (50 µg/kg body weight) was administered at two hours after CCI. GSNO-treated injured animals (CCI + GSNO group) were compared with vehicle-treated injured animals (CCI + VEH group) in terms of tissue histology, BBB leakage, edema, inflammation, cell death, and neurological dysfunctions.

Results: Treatment of the TBI animals with GSNO maintained the integrity of BBB as evidenced by decreased Evan's blue extravasation across brain, infiltration/activation of macrophages (ED1 positive cells), and reduced expression of ICAM-1 and MMP-9. The GSNO treatment also restored CCI-mediated reduced expression of BBB integrity proteins ZO-1 and occludin. GSNO-mediated improvement in tissue histology shown by reduction of lesion size and decreased loss of both myelin (measured by LFB staining) and neurons (assayed by TUNEL) further supports the efficacy of GSNO therapy. GSNO-mediated reduced expression of iNOS in macrophages as well as decreased neuronal cell death may be responsible for the histological improvement and reduced exacerbations. In addition to these biochemical and histological improvements, GSNO-treated injured animals recovered neurobehavioral functions as evaluated by the rotarod task and neurological score measurements.

Conclusions: GSNO is a suitable candidate to be investigated in humans after TBI because it not only protects the traumatic penumbra from secondary injury and improves overall tissue structure but also maintains the integrity of BBB and reduces neurologic deficits following CCI in a rat model of experimental TBI.

0180

The pulmonary physiological response from repeated shock wave induced trauma and its relationship with cognitive deficits in the rat model

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Objectives: The mechanism of brain injury for animals exposed to a shock wave induced environment raises the question of how the shock wave is transmitted to the brain; whether a direct wave propagation through the skull or a rapid compression of the thorax and subsequent wave transmission to the central nervous system. In this report the physiological response of rats to shock wave exposure, which was representative of lung/vagal reflex injury was compared to the spatial orientation skills of the rat which has been associated with injuries related to blast.

Method: Rats were subjected to shock waves at various intensities (0, 8, 17, and 25 PSI; 0, 55, 117, and 172 kPa) for three exposures. The timing in between exposures was also controlled for (15 min, 3, or 24 hrs). Physiological measurements were recorded using an external pulse oximeter designed for rodents. Heart rate, breath rate, and oxygen saturation were among such measurements. The rats were then cognitively tested using the Morris maze test at four different time points following the final exposure (3, 24, 48, and 72 hours). Cognitive data was collected using motion capture and variables such as distance swam, time to target, velocity, and time spent swimming along the wall were reported.

Results: Rats exposed to three (25 PSI/172kPa) shock waves with a 15 minute time in between exposures suffered the greatest physiological damage for heart rate related effects. Breath distention and Oxygen saturation effects were mostly associated with (17 PSI/119kPa). When compared to the oxygen saturation and heart rate the 3 hour repeats showed a greater response when compared to the 24 repeats, while the pulse distention was shown to have greater effects.

During the 15 minute and 3 hour time points, it was shown that the rat was unable to identify the target and therefore spent much greater amount of time circling around the edge of the tank. This was mostly associated with the (17 PSI/119kPa) exposure. Although some trends were seen for the (25 PSI/155kPa) pressure at the 24 hour repeat regions. Other trends were noted in latency and distance but overall major trends were not apparent.

Conclusions: This research indicates that the physiological response immediately following exposure to a shock wave does not necessarily predict cognitive performance in the rodent. It was demonstrated that as the exposure intensity and frequency between exposures increases, not all responses are linear. The cognitive performance

was most effected in the moderate pressure level (17 PSI/119kPa) for some but not all measurements of performance. Therefore this research suggests that physiological damage related to lung damage/vagal reflex injury needs to be further investigated with cognitive performance associated with spatial orientation as addressed by the Morris water maze.

0181

Acute early detection of brain hematomas in patients with TBI using the Infrascanner

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Objectives: In patients with traumatic brain injury (TBI), the early identification and treatment of intracranial hematomas is fundamental to successful treatment. The present study examines the Infrascanner as a medical screening tool for in situ detection of the presence of brain hematomas in patients who suffer a head injury.

Method: Thirty-five TBI patients, aged 17 to 76 (M = 47.6), admitted to the neurosurgical intensive care unit (ICU) and the observation unit of a University Hospital in a Level 1 trauma center participated in this study. The Infrascanner™ NIRS device (InfraScan, Inc., Philadelphia, PA) uses near infrared light measurements to calculate optical density in brain regions.

Results: Infrascanner results show a sensitivity of 89.5% and specificity of 81.2%. The PPV was 85% and the NPV was 86.7%. The device detected 90% of extra-axial hematomas and 88.9% of intra-axial hematomas. Infrascanner detected 93.3% of non-surgical hematomas (less than 25 mL). PPV for this classification was 82.3%. Sensitivity of 87.5% was found when the Infrascanner exam was performed within the first 12 hours after trauma, whereas 90.1% sensitivity was found for those taken after 12 hours post-trauma.

Conclusions: This study demonstrates that the Infrascanner is a useful tool in situ for the initial examination and screening of head-injured patients, can be used as an adjunct to CT scans or used when a CT scan is not available, and may allow earlier

treatment and reduced secondary injury caused by present and delayed hematomas.

0182

Blast related mild brain injury and PTSD: two distinct disorders

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Objectives: A significant number of soldiers deployed to Afghanistan and Iraq return with persistent post-concussion symptoms, often overlapping with signs of post-traumatic stress disorder (PTSD). A controversy exists as to whether post-traumatic stress disorder (PTSD) is a disorder in its own right or invariably results from traumatic brain injury (TBI). *Method:* The present study provides a quantitative and qualitative review using genetic, neuropsychological, endocrinological and neuroimaging data to help differentiate between these disorders. Published articles identified through electronic and manual searches served as data sources. Participants in the analyzed studies included subjects with PTSD and patients with mild to severe TBI. Quantitative and qualitative methods were used to evaluate the studies that met inclusion criteria

Results: We found evidence that PTSD is an illness associated with specific genetic antecedents and neuroimaging findings. These include polymorphisms involving serotonin transporter 5-HTTLPR. Several genes involved in glucocorticoid signaling are differentially expressed among those with current PTSD. Patients with PTSD also show abnormal findings in structural and functional imaging but do not have the characteristic changes seen in TBI, namely multiple localized lesions and diffused axonal injury. Patients with PTSD have a smaller hippocampal volume than normal subjects covarying with PTSD severity and abnormalities in multiple frontal-limbic system structures. Different Hypothalamic Pituitary Adrenal (HPA) axis alteration is associated with the risk of developing PTSD and may be altered prior to exposure to a trauma. Hypocortisolism in PTSD occurs in the context of increased sensitivity of the HPA axis to negative glucocorticoid feedback. Memory deficits link chronic exposure to hypercortisolemia to impaired attention-dependent working memory and delayed recall process (León-Carrion, Atutxa, Mangas, et al., 2009). Patients with PTSD exhibit a broad range of memory problems, including memory and declarative memory gaps, attention and executive function

deficits, trauma-related intrusive memories and emotional hyperreactivity.

Conclusions: PTSD is a genuine condition produced by an abnormal genetic response to threat which affects brain structure and function. Some of the most severe cases of PTSD occur in the absence of physical damage to the head, and most cases occur under similar conditions. Despite the controversy regarding post traumatic amnesia protecting against PTSD, it cannot be denied that head trauma and PTSD, which often occur in traumatic circumstances, may coexist, yet the two disorders are distinct.

0183

Cognitive Behavioural Therapy for Persistent PCS: Preliminary Results from a Randomised Control Trial

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Objectives: Whilst the nature of persistent postconcussional symptoms (PCS) continues to provoke debate, research around treatment remains limited. Psychological interventions have largely been focussed on prophylaxis after mild traumatic brain injury (MTBI), typically involving brief psycho-educational approaches in the first few days after injury. Although the results of these early intervention studies are broadly positive, individuals with persistent symptoms have traditionally been seen as "difficult" to treat.

Nonetheless, a number of biopsychosocial models for persistent symptoms have been presented (e.g. Lishman, 1988; Kay, 1993; Wood, 2004), which emphasise that individuals may find themselves in a variety of vicious cycles that maintain postconcussional symptoms over time. Cognitive-behavioural therapy (CBT) appears well-placed to address many of these issues, both in addressing significant co-morbid or overlapping psychiatric diagnoses, and in more idiosyncratic modifications tailored to PCS. *Method:* CBT for persistent PCS was evaluated in a pilot randomised waiting list-controlled trial (ISRCTN 49540320). Individuals were identified from two out-patient brain injury services in north and south London in the UK. After an initial assessment (typically including both neuropsychiatric and neuropsychological components) individuals with persistent postconcussional symptoms were

randomised between an active treatment arm (consisting of 12 sessions of cognitive behavioural therapy) and a four month waiting-list control group. Symptoms were required to meet ICD-10 criteria for postconcussional disorder, and to have been present for at least six months post-injury. Individuals were also required to have sustained an injury meeting at least ACRM criteria for MTBI, although individuals with more severe injuries (e.g. posttraumatic amnesias longer than 24 hours) were not excluded.

Outcomes were assessed using a number of self-report questionnaires. Primary outcome measures focussed on more general postconcussional symptoms (RPQ) and quality of life (BICRO; QOLAS). Secondary outcome measures included indices of anxiety and depression (HADS), PTSD (IES-R), fatigue (CIS-20R) and irritability (STAXI-2).

Results: 46 individuals (25 men, 21 women) were seen as part of the trial. The majority (52%) had sustained mild TBIs with posttraumatic amnesia of less than 24 hours. A significant number were experiencing chronic symptoms: 46% had sustained their injuries at least 2 years before entering the trial. 72% had been or were involved in ongoing medicolegal claims.

Preliminary results from the T1 (baseline) and T2 (post-treatment for the active treatment group, post-waiting list for the control) outcome measures will be reported from the end of this phase of the trial (anticipated to be November 2009).

Conclusions: [n/a].

0184

Severe neurocognitive disorders: the disrupted content of consciousness

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Objectives: The term disorder of consciousness (DOC) is currently used to describe states where both wakefulness and awareness are impaired due to structural and functional damage or to malfunction in a wide variety of brain areas. DOC refers mainly to individuals in vegetative state (VS) or minimally conscious state (MCS). However, no studies have tested whether brain areas are relevant in patients that are aware but have a clear disruption and

deterioration of their consciousness content. Severe neurocognitive disorder (SND) represents the upper boundary of MCS. The objective of this study is to characterize behavior, EEG power spectra and EEG coherence of patients with SND.

Method: Sixteen non-acute traumatic brain injury patients participated. SND behavioral characteristics included functional interactive communication (the ability to answer basic yes/no questions regarding personal or environmental orientation), or functional use of objects (demonstrating the ability to appropriately use or discriminate among objects). SND patients can be assessed using a routine neuropsychological assessment (Seville Computerized Test Battery, Leon-Carrion, 2002), whereas impairments in MCS patients are not accessible through routine neuropsychological testing. Participants underwent a three-scale assessment used by clinicians to evaluate low-level brain-injured patients. We studied EEG power spectra, coherence, and LORETA sources at rest for SND group patients and compared the results to those of a MCS patient group.

Results: Our results show a clear clinical and neurophysiological characterization of patients with SND: severe deterioration of memory structures and/or processes, and of other neurocognitive functions such as attention, language, motor, recognition, imagery and/or executive functioning. EEG power spectra and coherence data show that SND patients have more coherent activity between frontal and other brain regions and more consistency in beta, alpha, and theta bands.

Conclusions: Our data suggests that SND has better preservation and integration between different brain regions, whereas MCS shows a deafferentation/deafferentation within cortical brain networks.

0185

Can patients with acquired brain injury (ABI) maintain social cognition?

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Objectives: Social and theory of mind (ToM) deficits are common in patients with acquired brain injury (ABI). Understanding socially relevant cues and recovering the ability to maintain social cognition are fundamental to the rehabilitation process of these patients. However, this process could benefit from

increased knowledge on the extent of these impairments in this clinical population and the tools needed for patient assessment and rehabilitation. The neurocognitive processes and neural bases underlying these social deficits must receive further investigation. We provide a quantitative review (using meta-analytic methods) on social, cognitive and ToM deficits in patients with ABI, and present findings that could be useful for clinicians.

Method: This research reviews 26 studies comparing the performance of ABI patients with healthy controls in four of the most widely-used tasks to assess social performance: first-order belief task, second-order belief task, understanding indirect speech (IS) (which includes metaphor, irony, sarcasm, and lie understanding), and social faux pas. We assess the impact of a number of clinical and demographic variables on social cognition deficits found in ABI.

Results: Patients with ABI show moderate to large impairment in social understanding tasks compared to matched healthy controls. Severe impairment appears in more advanced tasks where understanding socially relevant clues demands more executive abilities and emotional processing (faux pas and understanding IS tasks). In these high-level social tasks, patients with frontal lobe and right hemisphere damage show a large impairment when compared to patients with posterior or left-sided lesions.

Conclusions: Our results provide significant quantitative evidence of the severity of social cognition deficits in the ABI population, and identify clinical and task-related variables associated with these deficits. Basic and clinical implications are discussed: the role of prefrontal cortex and parieto-temporal regions in social cognition, tools for assessing social impairment in the ABI population, and neurocognitive processes underlying acquired social deficits.

0186

Executive control training to enhance frontal plasticity in traumatic brain injury

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Objectives: Executive control deficits manifested by impairments in reasoning and abstraction have devastating effects on daily function, including vocational and social integration. Despite the importance of executive control functions in daily lives,

traumatic brain injury (TBI) rehabilitation protocols do not address this issue (Cicerone et al., 2005; Park & Ingles, 2001). Moreover, cognitive therapies lack theoretical foundation which can serve to guide treatment development (D'Esposito & Gazzaley, 2006). This study addresses the void in theoretically guided training programs of executive control functions in adults with TBI. Extensive research by Chapman and colleagues has led to a newly defined and theoretically driven gist-based strategic reasoning training protocol that could potentially improve executive control functions in adults with TBI. Gist-reasoning, considered essential to everyday life, involves synthesizing core meaning(s) from incoming information, including newspaper articles, conversations, books, or television programs, to mention a few (Chapman et al., 2004, 2006). We integrated aspects of Functional Integration Framework (Chen, Abrams, & D'Esposito, 2006) to take advantage of goal-directed tasks into our gist-training protocol. The goal of the study is to examine the effects of gist-protocol in (a) trained area of abstraction ability, (b) generalization to untrained domains measured by frontal-mediated measures of executive control, (c) daily function, and (d) long-term maintenance of trained and untrained executive control functions.

Method: Twenty four participants with TBI between the ages of 20–65, functioning at a moderate level at the time of assessment were recruited for the study. Participants were randomly assigned to one of the two protocols (a) Gist-based (experimental) and (b) information-based (control). The gist protocol adopted a hierarchical approach of strategic attention, integrated reasoning, and elaborated reasoning to enhance gist-reasoning. The control protocol provided information on brain anatomy, brain functioning, and cognitive changes following a TBI. Both the protocols included 12 group sessions (1.5 hrs each) conducted over 8 weeks. Each group session consisted of four participants and two trained clinicians. Participants in both the experimental and control protocols were comparable in age, education, severity of injury (moderate-severe), and level of functioning at the time of assessment. Outcomes of both protocols were determined by standardized cognitive and functional measures.

Results: Post-training effects on gist-reasoning measures were significantly higher in the gist protocol as compared to the control group on. The gist-training effects were also generalized to untrained cognitive domains of inhibition and working memory, which in turn improved daily function. Six-month follow-up indicates maintenance of executive control function in majority (9 out of 12) of the gist-group participants. The research study is ongoing and we expect to collect more data in the next few months.

Conclusions: The gist program appears to enhance frontal lobe mediated executive functions that translate into functional gains. Evidence of long-term maintenance of executive control function lays ground for investigation of neural changes associated with the gist training program.

0187

An Exploratory Examination of Political Empowerment and Voting among Individuals with TBI

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Objectives: Voting is one of the most basic rights in any democracy. Every vote counts and every voice must be heard. Voter participation rates among people with disabilities have been lower than among the general population. Scholars argue that people with cognitive and communication impairments, such as those that arise from TBI, are particularly vulnerable to possible disenfranchisement from voting. However, there is no empirical data on the experiences of voting and political participation among Americans with TBI. This National Institutes of Health sponsored study is the first research to report on the experiences of voting and political participation among those with TBI.

Method: We used a community-based participatory research (CBPR) approach to assess the experience of voting among individuals with TBI and their caregivers and family members during the November 2007 and May 2007 General Election, and the November 2008 Presidential Election in North Carolina, USA. We conducted 55 in-depth interviews with people with TBI and 27 interviews with spouses, caregivers, and healthcare and community providers of people with TBI to discuss their experiences with political participation or voting. 63% of participants had voted in the most recent election, and we shadowed and observed

them at the polls. Data was coded using a rigorous multi-step grounded theory process by a research team consisting of experts in disability and voting; people with TBI; and family members and healthcare providers of people with TBI.

Results: Our data suggest that people with TBI vote for some of the same reasons as people without TBI – to be contributing members of society in a way that takes an active role in shaping the future of our country. However, for people with TBI voting represents a way to regain the voice and identity lost after the injury. Thus, by voting people with TBI are affirming their identity as contributing members of our society. However, unlike people without TBI, voting can require extra resources (time, effort, transportation). Often, those with TBI note challenges remembering to vote, preparing to vote, to research candidates, and to arrange for transportation to the polls. Once in the polls, some individuals note challenges navigating the polls and the ballot, and difficulty with memory involving who to vote for. However, voting also represents an opportunity to regain a sense of control. In addition, voting gives voice to people with TBI who may have difficulty in communicating or expressing their views.

Conclusions: Our data suggest strategies for reducing possible experiences of disenfranchisement from voting among persons with TBI: provide people with a sample practice ballot and voting machine ahead of time; help people understand the candidates and their positions; provide a special voting area with more space and time for people with disabilities and with larger, clearer ballots; provide transportation to the polls; help people make decisions between candidates; remind people to vote; and encourage and welcome people with TBI to the polls. Our research indicates that study participants view voting as a means of exercising our rights as members of society, and thus, serves as acknowledgement of societal inclusion. Every citizen has the right to vote—including citizens who have impairments due to accidents or injuries. That right to vote includes receiving assistance in voting, when a person has physical or cognitive impairments that make voting difficult or less likely. Voting is a way for all citizens to take an active role in their future and in the future of our country. Voting represents voice, expression of opinions and choices. It is both a privilege and a right of citizenship. People with TBI vote in lower numbers than non-TBI citizens because of physical and cognitive deficits resulting from the injury, extra effort required to understand the process and make decisions between candidates, and difficulties getting to and navigating the polls. People with TBI are more likely to vote if they are provided with assistance in these areas.

0188

Application of the Systemic Falls Investigative Method (SFIM) to Identify Systemic Causes of Falls and Re-injury in a Residential Brain Injury Program – Pilot Project

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Objectives: Re-injury among individuals with acquired brain injury (ABI) is frequent and often caused by a fall. The purpose of this pilot project was to investigate the potential of implementing the Systemic Falls Investigative Method (SFIM) in a community-based brain injury program in Ontario. The objectives were to identify systemic causes of falls, identify a team of stakeholders within the agency that will work on re-injury prevention, communicate exposed safety deficiencies to this team, and identify facilitators and barriers to SFIM implementation and uptake of results by the organization.

Method: A prospective case series study design was applied where five consecutive falls of high-risk fallers were selected for in-depth investigations. Content analysis was employed to identify patterns of safety deficiencies within four predetermined levels of the Swiss Cheese Accident Causation Model. A group of 22 stakeholders in the organization were presented with final reports. They discussed findings and provided feedback on implementation, outcomes and potential for safety intervention.

Results: Investigations identified various unsafe acts and unsafe decisions of participants as well as staff, numerous preconditions for unsafe acts, and several supervisory and organizational safety deficiencies that contributed to the occurrence of falls. The SFIM investigative process was perceived as simple and easy to understand. The implementation was facilitated by an ongoing accreditation process, openness of the administration to participate in the research project, the vigilance and dedication of a veteran physical therapist, availability of an already trained external SFIM investigator, and funding support from Ontario Neurotrauma Foundation (Canada). There were no specific barriers identified with SFIM implementation, but it was recommended that “embedded” SFIM investigators would be beneficial, especially for taking responsibility with the follow-up and contribution to prevention strategies.

Conclusions: In this project the SFIM demonstrated great potential to improve organizational safety by identifying contributors to adverse events. Results show that any falls prevention program, targeting persons living with acquired brain injury (ABI), must be individualized but also must address the entire system within which a survivor operates. Application of SFIM in ABI rehabilitation could provide a model for re-injury prevention that can be implemented nationally and internationally.

0189

Living at Home after Brain Injury: Comparing Outcomes of Two Models of Community Service

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Objectives: This study compared outcomes for persons with acquired brain injury (ABI) living in and around two small cities in Ontario, Canada who were receiving publicly-funded community services. In one city, a coordinated interdisciplinary team provided services exclusively to ABI clients, and in the second city, a case manager assigned contracted service providers to ABI clients according to their needs. The case manager and providers worked with a broad spectrum of clients, and were not specialized in ABI.

Method: Independent interviewers met with clients and designated family members in their homes every 12 months for two years using standardized rating scales and self-report measures. Outcome measures include client functioning (Mayo-Portland Adaptability Index and Disability Rating Scale), community integration (Community Integration Questionnaire and Community Integration Measure), health-related quality of life (SF36v2), family burden (Burden Assessment Scale), and the client/family Satisfaction with Services Scale.

Results: One-year follow-up data (N=64) showed that ABI Team clients had better health status (p < 0.05) and community integration (p < 0.01) when compared to baseline, and were more satisfied with services provided compared to the Generic Service clients (p < 0.01). Generic Service clients showed decreased functioning (p < 0.01) when compared to baseline. Two-year follow-up data (N=36) showed that ABI Team clients had increased community integration (p < 0.01),

maintained their improved health status, and reduced family burden ($p < 0.01$); Generic Service clients showed greater disability ($p < 0.05$) when compared to baseline and 1-year follow-up data. Families of both client groups showed increased satisfaction with services from Year 1 to Year 2 ($p < 0.05$), and ABI Team clients reported increased satisfaction with services from Year 1 to Year 2 ($p < 0.05$). A greater number of ABI Team clients received professional therapies and a greater number of Generic Services clients received nursing, dietary, and personal support services. When services were received, the ABI Team clients typically had a greater number of service contacts than the Generic Service clients.

Conclusions: Two-year follow-up data showed that a specialized community interdisciplinary team helped ABI clients improve their health status, and increase their community integration. Generic services maintained ABI clients in the community, but they became more disabled over time.

0190

Irritability and Traumatic Brain Injury: A Community-based Participatory Research Exploration

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Objectives: This Community-based participatory research (CBPR) study, funded through the National Institute on Disability and Rehabilitation Research, sought to understand the experience of post-traumatic irritability among people with traumatic brain injury (TBI; $n = 13$), caregivers and family members of people with TBI ($n = 7$), and TBI healthcare providers ($n = 14$). Our aim was to understand the experience of irritability in TBI from all perspectives, and, specifically, to define irritability, to understand how irritability in people with TBI differs from irritability as experienced with people without TBI, to understand the triggers for irritability, and to understand how people with TBI and their significant others can cope with and prevent irritability.

Method: Five different participatory focus groups meeting monthly for 10 months discussed the role of post-traumatic irritability on issues such as family and social support, environmental barriers and communication. Meetings were recorded digitally, transcribed and coded. Our grounded theory analysis of over 1500 pages of data, and a member check of study participants, validated our findings.

Results: Analysis of the data suggest a four dimensional model of post-traumatic irritability: physiological damage from the brain injury (especially in areas of self-regulation and impulse control); cognition (self-talk and ways of seeing the world); relational issues (power dynamics and interpersonal and family system communication); and environment (including environmental stimuli, time management, disruptions and routines, and cultural expectations). Additionally, our data suggest that one's spouse's irritability is generated from the other spouse's irritability. Further, our data analysis suggested that irritability and TBI cannot be separated; nor can definitions, experiences, triggers, coping, and prevention. Data suggest that the experiences of TBI and irritability overlap, and the causes and coping with irritability seem to frequently be two sides of the same coin.

Conclusions: Post-traumatic irritability among people with TBI is a complex construct. Community-based Participatory Research is useful in exploring post-traumatic irritability and aggression among persons with TBI, caregiver and family members. Our research suggests that diminished affect recognition and decreased communication and regulation of emotions resulting from the brain injury interact with negative self-talk and negative thoughts, interpersonal interactions, and environmental stimuli in ways that trigger varying degrees of irritability, frustration, moodiness, and anger. And of course, irritability, or the threat of irritability, negatively affects spousal communication. This research leads to suggested interventions for both people with TBI and their spouses to teach them how to compensate for these multi-dimensional losses.

0191

Recovery from sports-related concussion in a pediatric population

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Objectives: Sports-related concussion is common in children who participate in organized sports. While the most common cognitive sequelae of concussion are similar for children and adults, the breadth of consequences to children remains largely unknown. The primary goal of the study is to document both acute and long-term recovery following sports-related concussion in male and female children 10–14 years old.

Method: The current study utilizes a longitudinal, prospective design with competitive youth hockey players. This provides the rare opportunity to obtain pre-injury data on youth behavioural characteristics and cognitive and physical functioning and relate this to outcome following injury. To date, baseline data on 100 boys and 25 girls across two years have been collected on a battery of cognitive, motor and visuo-motor tasks as well as the Post-concussion Symptoms Scale – Revised (PCS). Youth who sustain a concussion complete the measures across repeated follow-up sessions until symptoms have fully resolved.

Results: A total of 11 boys (but no girls) have sustained a concussion since the onset of the study, including one boy who sustained 3 injuries across the two years. In total, 14 concussions have been documented, with an incidence rate of 11.5%. Despite all injuries being classified as ‘mild’ according to typical indices such as loss of consciousness (LOC) and post-traumatic amnesia (PTA), recovery (defined as a return to a score ≤ 6 on the PCS scale) ranged widely from 1 to 38 days post-concussion. Only one participant reported LOC and/or PTA that lasted for a few minutes. All participants demonstrated poorer cognitive performance compared to pre-injury baseline levels of performance on several neuropsychological measures when tested upon full symptom resolution. For example, 9 out of 14 follow-up testing sessions revealed clinically significant (according to a reliable change index calculation) decreases on auditory verbal learning and memory performance compared to pre-injury baseline functioning.

Conclusions: The results of the current study suggest that, as in youth and adults, injury severity classified according to brief LOC and presence of PTA is a poor predictor of recovery and should not be used in lieu of in-depth assessment and follow-up for the pediatric population. The Post-concussion

Symptom Scale - Revised (see Zurich concussion consensus document) should be included to assess the injury in addition to LOC and PTA and should be used in follow-up to monitor recovery until symptoms have abated or completely resolved.

0192

The development of a prediction model for the outcome following mild traumatic brain injury: The use of serum biomarkers

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Objectives: Mild traumatic brain injury (mTBI) is one of the most common injuries affecting people worldwide. Although most patients with mTBI recover to their previous level of functioning, some are at an increased risk for developing problems with concentration, behavior and physical function. It is important to diagnose mTBI as soon as possible, to limit the risk of developing these problems. However, mTBI can be difficult to diagnose in all patients using current clinical tools. Several studies have suggested that specific markers in the blood may be used to identify mTBI. The purpose of this study was to examine whether the use of a simple screening tool, the Galveston Orientation and Amnesia Test (GOAT) in conjunction with the measurement of serum biomarkers (S100 calcium binding protein B [S100B], Neuron-Specific Enolase [NSE]) in patients with mTBI, who were evaluated within four hours of their injury in an emergency department (ED), would reliably and accurately predict patients who could be discharged from ongoing medical care related to brain injury at 6 week post-injury.

Method: In this prospective cohort study patients arriving to the ED with a suspected mTBI were screened for the following inclusion criteria: non-penetrating mTBI; arrival to the ED within 4 hours of the injury; 18–65 years of age. Patients with recent alcohol or substance use were excluded. After providing informed consent the patients were administered the GOAT and a blood sample was collected for biomarker testing. The Rivermead Post-concussion Symptoms Questionnaire (RPQ) was administered by telephone three days post-enrollment into the study. Participants returned to the out-patient Head injury clinic for further

assessments at 1 week (7–14 days), 6 weeks (42–49 days) and 12 weeks (84–91 days) post-enrollment as deemed necessary by their treating physician. The following assessments were completed at these visits: RPQ, Balance Error Scoring System (BESS), Controlled Oral Word Association Test (COWAT), Symbol Digit Modalities Test, Trials B, Rey Auditory Verbal Learning TestR.

Results: A total of 135 patients were enrolled into the study (mean age, 39.9 years; 62% male). At the time of enrollment into the study the mean Glasgow Coma Score was 14.9 and the mean GOAT score was 91.2. Elevated levels of S100B and NSE were observed for 53% and 58% of the cases, respectively. These data have been used to develop a prediction model of outcome following mTBI at 1-, 6-, and 12-weeks post-injury.

Conclusions: Preliminary results indicate that a simple screening tool in conjunction with the measurement of serum biomarker levels could be used as an adjunct tool in an ED setting to assist in predicting outcome following mTBI.

0193

Tactile Defensive Behavior on a Rehabilitation Unit Following Moderate to Severe Closed Head Injury

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Objectives: Tactile Defensive Behavior (TDB) in patients following moderate to severe brain injury manifests as severe avoidance or agitated behavior when approached or touched. In the acute rehabilitation center such behavior can be a challenge for therapeutic intervention as well as for routine care and hygiene. TDB in its most extreme presentation is associated with long length of stays in the rehabilitation center and decreased level of functional independence at discharge. The objective of this case report is to raise awareness and to generate discussion of this clinical phenomenon.

Method: Four individuals with prominent TDB who were admitted to a specialized brain injury rehabilitation program after closed head injury are presented. Injury type, severity and location of injury are described as well as effects of pharmacologic interventions on symptoms.

Results: All subjects were admitted to a regional trauma center after a motor vehicle accident with a Glasgow Coma Score of less than 6. Two of three

subjects were transferred to the rehabilitation center in a vegetative state from which they later emerged and began to exhibit TDB symptoms. Neuroimaging findings shared between patients included bilateral frontal contusions, diffuse axonal injury (DAI), and a predominance of right sided hemorrhagic lesions. Two of the patients were noted to have anterior corpus callosum injury. Mean length of stay in the rehabilitation center was 156 days. Patient 1 was treated with buspirone and valproic acid (VPA). VPA was effective in reducing TDB. After discharge VPA was weaned off of Patient 1 and symptoms returned. TDB resolved after reinstatement of VPA. Patient 2 was treated with sertraline with a modest reduction in TDB. Patient 3 was treated with sertraline then buspirone with a modest reduction in symptoms. Patient 4 was treated with VPA with a modest reduction in TDB. Patient 1 was discharged home and Patient 2 transferred to another rehab center. Patient 3 and 4 were discharged to long term nursing facilities.

Conclusions: TBD following brain injury is not well described in the TBI literature. In the 1950s Deny-Brown described avoidance motor tropisms in primates after lesions to nondominant parietal lobes. A patient with TDB is a particular challenge in the rehabilitation setting. The full blown clinical picture of TDB may represent the far end of a spectrum of behavior in the patient emerging from moderate to severe brain injury. Patients with less extreme forms of TDB may be considered going through typical motor restless agitation of RLAS IV. Further work is needed to gather a larger cohort of patients and to develop a validated scale to measure TDB in patients with brain injury. Such objective criteria will allow appropriate study design to evaluate effective treatments which would reduce length of hospitalizations and improve outcomes.

0194

Cognitive rehabilitation outcomes following anoxic brain injury: A case-controlled comparison with traumatic brain injury

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Objectives: Background and Rationale: Anoxic brain injury (AnBI) is a gross deterioration in brain function due to inadequate oxygenation of brain cells resulting from a variety of emergencies such as

seizures, near drowning, and cardiac arrest
1. Clinical outcome is dependent on the degree and duration of oxygen deprivation. Cognitive deficits in memory and attention are common, while motor impairments include problems with gait and involuntary movement
2. Following discharge from acute care, individuals with AnBI are often admitted to a rehabilitation program to address these deficits. Previous research on rehabilitation outcomes is limited compared with published data on traumatic brain injury (TBI) survivors.

Objectives: (1) To examine the differences in the cognitive recovery of AnBI patients compared to matched TBI controls using neuropsychological assessment data; and (2) to explore between-group differences in the relationship between neuropsychological measures and functional outcomes at rehabilitation discharge.

Method: Design: Retrospective, matched case-controlled design.

Setting: Inpatient rehab unit with a multidisciplinary clinical team (PT, OT, SLP, SW, RT, Nursing, and Physiatry).

Methods: 10 patients with primary diagnosis of AnBI patients were matched to 10 TBI controls within the same period of time on age (+6 years), acute care length of stay (+11 days), and FIMTM scores (+12). Baseline data also included demographic variables.

Main Outcome Measures: Neuropsychological Tests (14 Tests), Functional Independence Measure (FIMTM), and Disability Rating Scale (DRS)

Results: No significant difference in demographics for AnBI vs. TBI. Language communication and mental speed were significantly lower ($p < 0.05$) for patients with AnBI. AnBI patients had significant correlations between SDMT Oral and FIM, and WMS-III Logical Memory I and DRS. For the TBI group, Block Design, MAE Token Test, Spatial Span Backwards, and COWA were all significantly correlated with FIM.

Conclusions: AnBI patients recover cognitive function at a slower rate than TBI patients. Focused rehabilitation strategies in cognitive domains for longer periods of time at a greater intensity may optimize rehabilitation care post AnBI.

0195

Osteoplastic Decompressive Craniotomy – an Alternative to Decompressive Craniectomy in Head Injury Patients

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Objectives: Decompressive craniectomy is a standard neurosurgical intervention in the therapy of post-traumatic intracranial hypertension. When the degree of intradural mass lesion does not require the removal of the bone flap, we perform osteoplastic decompressive craniotomy (ODC).

Method: Decompression during ODC is achieved using duraplasty and the possibility of elevation of the unfixed bone plate by the cerebral tissue expansion. After the disappearance of oedema, the free bone flap returns to its original position and is reattached. The risk of bone depression is eliminated by an oblique incision using a Gigli saw.

Over a 10-year period (1999 to 2008) 64 head injury patients (55 - acute subdural hematoma, 10 - cerebral contusion) underwent 65 ODC (once bilateral). The benefit of ODC was assessed using clinical status, midline shift on CT and by ICP monitoring. ODC was performed with ICP monitoring in 17 patients (27%). Outcome was evaluated 1 month after surgery.

Results: The study included 31 patients (48%) with severe head injury (GCS 3–8), 16 (25%) with moderate head injury (GCS 9–12) and 17 (27%) with mild head injury (GCS 13–15). Emergency surgery (<24 h) was performed in 51 patients (78%), delayed surgery in 14 patients (22%). The mean midline shift on CT before surgery was 12 mm and after 3 mm.

In total, 10 patients (16%) died (GOS 1), the outcome was unfavorable (GOS 2–3) in 26 patients (41%) and favorable (GOS 4–5) in 28 patients (44%). The outcome did not differ between patients with or without ICP monitoring. Additional bone flap removal was necessary in 9 cases (14%), 7 times because of insufficient decompression and in 2 cases due to wound infection. There was no evidence of the bone flap depression in any patients.

Conclusions: ODC is an effective method of treating post-traumatic brain oedema when the degree of expansion does not require removal of the bone flap. The main advantage is a shortening of hospitalization, because further surgery – cranioplasty is not needed.

0196

Vegetative state patients caregivers' burden of care and quality of life in a long-stay hospital.

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Objectives: Few studies have addressed the psychological distress and general psychophysical burden of caregivers of patients in a vegetative state and hospitalized in a dedicated facility. The objective of this study is to assess and monitor the burden of care and quality of life (QOL) of the caregivers of such patients over a one-year period in order to evaluate the appropriateness of psychological support programs in use.

Method: The caregivers' emotional burden of care and the quality of life was assessed using the Family Strand Questionnaire (FSQ2) and the SF-36 Questionnaire (both instruments are validated in Italy). The FSQ2 questionnaire is aimed at assessing perceived care-giving related problems, while the SF-36 is a multi-purpose, short-form health-related quality of life survey. After obtaining written informed consent, both questionnaires were administered at hospitalization time and after 6 and 12 months by a single, trained interviewer. Frequency distribution was used to analyze the socio-demographic characteristics of the caregivers. The Student's t-test was used to explore any differences in the test scores. Repeated measures analysis of variance (ANOVA) was used to detect differences among the test scores in the different follow-up times.

Results: Thirteen primary caregivers (10 men and 3 women) were enrolled and completed the questionnaires schedule. The emotional burden and the health-related QOL steadily remained below critical levels. Emotional distress mean value was 7.00, 6.15 and 6.38 at 0, 6 and 12 months respectively, the cut-off level demonstrating clinically relevant problem being above 9.00. The factor assessing problems in social involvement showed good results and the need for further knowledge about the disease process was low (mean value: 1.07, 1.23, 1.00). The scores of death-related thoughts paralleled that of an average population of oncologic patients' caregivers. The SF-36 described constant satisfying QOL levels over the observation period.

Conclusions: Results showed that caregivers' psychological distress did not increase over time, while studies carried on in different settings of care showed different results. The strongest psychological support that a dedicated facility may offers, either as groups of discussion or as on-purpose evaluation, may be a possible explanation. Social relationships score showed partial impairment. The lack of caregivers' need for further knowledge about the disease may

express either a sufficient level of information delivered or a form of self-defence. The scores of death-related thoughts paralleled that of a population of oncologic patients' caregivers, possibly because both populations share a sense of loss even though the former is just relational while the latter is mainly physical. The finding of constant levels of distress and QOL suggests the effectiveness of an enduring psychological support but a larger number of subjects undertaking the tests is required in order to define the caregivers' needs and to identify those subjects to focus attention on.

0197

Preferential Use of a Modified Step Test over the Berg Balance Scale to Assess Balance Abilities and to Determine the Most Appropriate Assistive Device among TBI Patients?

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Objectives: Following a traumatic brain injury (TBI), patients often present decreased balance abilities. The Berg Balance Scale (BBS) is a tool commonly used in clinic to assess balance problems. However, this tool shows a ceiling effect with TBI patients; in fact many patients obtain a maximal score (56/56) very soon following their admission to inpatient rehabilitation despite demonstrating dynamic standing balance problems. The modified Step Test may provide clinicians with more information about the balance abilities of our patients and help us decide on the appropriate assistive device needed when walking. The goal of this research was to examine the relationships between patients' scores on the BBS with those of the modified Step Test (right and left sides, eyes open/eyes closed), and with the type of assistive device provided to patients with moderate or severe TBI upon admission to intensive inpatient rehabilitation.

Method: The clinical test results (scores on the BBS, modified Step Test, 6 minute-walking test) of 96 moderate or severe TBI patients treated at our rehabilitation center between 2007–2009 and the assistive device used upon admission were examined and compared.

Results: Among 96 persons with a TBI (mean age of 57 + 19 years, mean GCS = 9.9 + 4), significant moderate correlations ($p < 0.01$) were found between their scores on the BBS and the 4 components of the Step Test (Pearson correlation coefficient, $r = 0.66$ to 0.77). Step Test scores were also correlated with those of the 6 minute walk ($r = 0.75 - 0.76$). All 3 tests could differentiate between patients using different assistive devices (no device, cane, walker), however, the Step Test was not more significantly associated with assistive device than the BBS or the 6 min walk. 32% of patients had a maximum score on the BBS and this ceiling effect was seen mostly in younger patients who did not need an assistive device. The Step Test (eyes closed) showed a tendency of a floor effect.

Conclusions: Step test performance is moderately correlated to scores on the Berg Balance Scale indicating that they measure slightly different constructs. Although providing objective interval data, the Step test does not appear to be a better tool than the Berg Balance Scale in determining the type of assistive device to be used by persons with TBI upon admission to inpatient rehabilitation. Future research is needed to determine whether the Step Test is a better tool than the BBS to document the progression of patients' balance abilities during an inpatient rehabilitation stay.

0198

A model for conducting community-based participatory research with individuals with traumatic brain injury: Challenges and opportunities

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Objectives: Community-based participatory research (CBPR) is defined as scientific inquiry conducted in communities and in partnership with researchers. The process of scientific inquiry involves community members, including persons affected by the issue under study and other key stakeholders becoming full participants in each phase of the work (from

conception - design - conduct - analysis - interpretation - conclusions - communication of results). The National Institutes of Health and the Centers for Disease Control support CBPR through grants. The process of conducting CBPR with people with disabilities has rarely been described and there are no data driven reports examining the process of conducting CBPR with individuals with traumatic brain injury (TBI). TBI can involve cognitive and communicative impairments that could present unique challenges and opportunities to conducting CBPR. The aim of this workshop/Panel is to present a preliminary, data driven, model of the process of conducting CBPR with individuals with TBI.

Method: Our model of conducting CBPR with persons with TBI is derived from a federally funded CBPR study on the experience of post-traumatic irritability among people with TBI ($n = 13$), families and caregivers of persons with TBI ($n = 7$) and healthcare providers of persons with TBI ($n = 14$) who met monthly for 10 months. Meetings were recorded digitally and transcribed. We used a grounded theory approach to code transcripts looking specifically at the process of conducting CBPR.

Results: Specific challenges and opportunities in building a team incorporating individuals with TBI and other stakeholders in the research process will be presented.

Conclusions: While CBPR holds tremendous promise, its use with individuals with TBI hold a number of significant challenges, and there are no guidelines for conducting CBPR in this population. This workshop will help physicians, researchers and communities become more aware of the potential challenges and opportunities of using CBPR with persons with TBI.

0200

Neurological Examination and Magnetic Resonance Imaging Findings in Patients Who Complain of Headaches, Problems with Sleep, Recent Memory, or Balance after Blast Exposure in a Combat Theater The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense, nor the U.S. Government.

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Objectives: Traumatic Brain Injury (TBI) can be defined as a force applied to the brain that disrupts brain function. Mild TBI (mTBI) is a unique subset of TBI patients; there may be a further sub categorization of mTBI patients – those whose mTBI due to explosive blast (mbTBI). We describe the findings on physical exam and brain magnetic resonance imaging (MRI) of patients seen in the neurology clinic at Naval Hospital Camp Lejeune with mbTBI.

Method: IRB approval was obtained for a retrospective study to search the Armed Forces Health Longitudinal Technology Application (AHLTA) electronic medical records of patients seen in our neurology clinic from 1 December 2006 to 15 April 2007. The records of every patient who had a diagnosis of headache, or a problem with mood, memory, sleep, or balance and gave a history of blast exposure was identified and the findings on physical examination and brain MRIs were reviewed.

Results: There were a total of 59 patients seen in the clinic who reported one or more of the above symptoms and a history of blast exposure. 32 of these patients had a shrapnel injury, orthopedic injury, a significant head injury since the blast exposure, or their medical record was unavailable and so were excluded from this study. The most common findings on physical exam in the remaining 27 patients were problems with balance. 11 patients, (41%), had problems with Romberg, 5 patients, (19%) had a normal Romberg but difficulty with sharpened Romberg, 4 patients, (15%) had difficulty with tandem gait testing, and 4 patients, (15%) had multiple findings on examination. Of the 26 MRIs available, 14 (54%) were completely normal. The remaining MRIs revealed a variety of nonspecific findings, including white matter changes, arachnoid cysts, a cavum septum pellucidum, and a Chiari I malformation. There was no correlation between findings on physical examination and brain MRI.

Conclusions: The MRIs of the brain done in this group of patients did not consistently demonstrate any abnormalities specific for mbTBI. Further, no stratification of these patients based on symptomatology was able to improve the sensitivity of MRI as a diagnostic tool. This would suggest that this type of MRI may not be particularly useful in the evaluation of patients who present with a history of mbTBI. Further studies with other imaging modalities, such as Single Photon Emission Computed Tomography (SPECT), Positron Emission Tomography (PET), functional MRI, and diffusion tensor imaging (DTI) MRIs, as well as formal vestibular function testing, may be helpful in identifying abnormalities that are sensitive and specific to brain injuries in patients with mbTBI.

0201

The Epidemiology of Traumatic Brain Injury in a Rural Southeastern State: The Challenges of Statewide Health Data Collection for Treatment Services

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Objectives: Traumatic Brain Injury (TBI) is a significant health problem in Kentucky. In 2006, over 4500 brain injury cases were reported by Kentucky hospitals as individuals admitted to acute care as well as the fatalities. This does not include the numerous individuals treated in outpatient facilities, emergency rooms, and surrounding states. In 2008, preliminary reports of outpatient data estimated over 19,000 individuals have been diagnosed with brain injuries. Much effort is being focused on analyzing the data and determining interventions to lessen the number of individuals affected by brain injury in Kentucky however variance in coding and limited collection of data indicates a strong need to examine the system.

Objective:

To develop a statewide data collection system for inpatient and outpatient traumatic brain injury (TBI) cases in Kentucky.

Method: Methods:

Statewide inpatient data for calendar year 2006 and outpatient data for the first two quarters of 2008 have been collected from Kentucky hospitals. These data include variables for ICD-9 diagnostic coding, discharge status, age, and payor. The data was analyzed using SPSS and ICDMAP-90. The ICDMAP-90 software, developed by Johns Hopkins University, can be used to calculate injury severity scores (ISS) and abbreviated injury scores (AIS) using the ICD-9 diagnosis coding. In order to focus on the severity of TBI injuries, AIS specific to the head region were examined for cases with a principal diagnosis of TBI. This assures that the severity score reflects the actual TBI and is not complicated with multiple injury scores.

Results: The data revealed that two-thirds of skull fractures, cerebral lacerations, cerebral contusions, and intracranial hemorrhages were coded by AIS severe or higher, yet more than fifty percent of these resulted in a routine home or self discharge. Intracranial hemorrhage was the majority diagnosis in the inpatient population and roughly seventy-two

percent of these received an AIS of severe or higher. The second most frequent inpatient diagnosis was concussion and eighty-one percent were scored moderate using AIS criteria. Over one-third of inpatient TBI diagnostic codes were billed to Medicare while for outpatient TBI cases the largest billing group was commercial insurance. Outpatient diagnostic codes were primarily concussion or “unspecified”.

Inpatient diagnostic coding of TBI in this study is currently more precise than outpatient coding, but there are many more outpatient cases of TBI than inpatient cases. There is a significant need to reduce variance in TBI coding in order to improve the planning of statewide healthcare services for TBI patients.

Conclusions: Kentucky has a significant number of individuals affected yearly by TBI yet the ability to fully understand the extent of the severity of the problem is limited. Inpatient diagnostic coding of TBI in this study is currently more precise than outpatient coding, but there are many more outpatient cases of TBI than inpatient cases. Further, comparing inpatient and outpatient coding it appears that outpatient coding is not as stringent as inpatient. Individuals treated in outpatient facilities based upon the data collected are being diagnosed with an unspecified brain injury which does not enable a severity score to be applied creating much ambiguity in addressing the health problem or intervention. The data revealed that two-thirds of those injured were coded by AIS severe or higher, yet more than 50% (fifty percent) of these resulted in a routine home or self discharge. This emphasizes the problem and prompts the question of are those individuals receiving the interventions needed. Based upon the data collected and analyzed, a strong conclusion can be made that there is a significant need to reduce variance in TBI coding between the inpatient and outpatient setting in order to improve the planning of statewide healthcare services for TBI patients.

0202

Exploring perceived self-efficacy following a sports-related concussion in youth ice hockey players

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Objectives: Concussion is one of the leading ice-hockey related injuries. Previous research has

reported that following concussion, children appear to lack confidence in their ability to return to pre-injury levels of performance. Ice hockey-related concussion has the potential to affect one’s perceived self-efficacy in relation to hockey performance. Perceived self efficacy can be considered the belief in one’s own potential to successfully perform a given occupation. Perceived self-efficacy is derived from four major sources of information: 1) previous performance; 2) physical and emotional state; 3) observation of others; and, 4) encouragement of others. The objective of this case series study was to gain insight into the psychosocial effects of sustaining an ice hockey-related concussion and to explore the impact on a player’s perceived self-efficacy related to ice hockey performance.

Method: Participants for this case study were selected from 60 male youth ice hockey players (ages 10–11 years). Participants were organized into three groups depending on injury type: 1) Concussion (n = 1); 2) Orthopaedic Injury Control (n = 1); and, 3) Non-Injured Control (n = 2). Control subjects were selected from the cohort and matched to complete the assessment protocol at the same time interval as their concussed counterpart. Participants completed baseline (pre-injury) and follow-up (post injury, upon resolution of post-concussion symptoms) assessment on the Youth Hockey Self-Efficacy Questionnaire (YHSE-Q).

Results: On the ‘hockey skill’ domain of the YHSE-Q, the concussed participant’s perceived self-efficacy declined when comparing pre- and post-injury evaluations. In particular, the greatest declines in self-efficacy rating were found on questions of the YHSE-Q referring to perceived hockey performance in practice and game situations. When comparing self-efficacy ratings on the ‘hockey skill’ domain of the YHSE-Q at follow-up between all participant groups, the concussed subject demonstrated the lowest total score (concussion = 910; orthopaedic injury control = 920; non-injured control A = 975; non-injured control B = 990), where a lower score indicates lower perceived self-efficacy.

Conclusions: Perceived self-efficacy specific to ice hockey performance was shown to decline following a concussion in a single youth ice hockey player. When compared to orthopaedic injury and non-injured controls, follow-up evaluation found that the concussed participant demonstrated the lowest perceived self-efficacy. This case study can be considered an initial step in the examination of perceived self-efficacy following concussion in youth ice hockey players and may help inform a better understanding of the psychosocial needs upon return to sport following a concussive injury within this population.

0203

Mild head injury and executive function as predictors of behavioural disinhibition

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Objectives: The frontal lobes occupy the largest area of the neocortex and thus are most susceptible to damage during traumatic brain injury. One of the functions of the frontal lobes is the regulation of behaviour, and more specifically inhibition of responses. Thus, severe damage to the frontal lobes leads to uninhibited and maladaptive behaviour, also known as behavioural dyscontrol. Less serious head injuries, as in mild head injury (MHI), lead to similar but more subtle consequences. As such we conducted a study investigating the relationship between MHI, executive function and impulsivity as a measure of behavioural dyscontrol.

Method: Undergraduate university students ($N=87$), participated in the study, and 51% reported a previous MHI defined as experiencing forces to the head sufficient to produce an alteration in consciousness. Neuropsychological tests of frontal lobe executive function (subscales from WAIS-III, CTONI, DKEFS) as well measures of impulsivity were used (a self-report questionnaire, the Barratt Impulsiveness Questionnaire-11, and a monetary decision making task, the “delay discounting” task).

Results: Multiple regression analysis revealed all four measures of executive function produced a significant overall model for prediction of impulsivity; however, the contribution of each component varied depending on the impulsivity dimension chosen (impulsive decision making, distractibility, non-planning, disinhibition). Additionally, analysis of variance indicated that the MHI group demonstrated higher levels of behavioral disinhibition, but not higher levels of other impulsivity dimensions measured (e.g., non-planning, decision making).

Conclusions: Thus, even in a competent and capable population (i.e., university students) MHI is associated with lasting impairments, more specifically the ability to withhold response, which is a function associated with the areas of the frontal lobes most vulnerable to damage, the OFC. Therefore, persons who report sustaining a previous MHI may be more impulsive (as evidenced via disinhibition) than their no-MHI counterparts and this may have implications for everyday, and overall, functioning.

0204

Alterations to integrated locomotor and cognitive function in elite athletes more than 30 days following a sport-related concussion

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Objectives: While many neuropsychological tests have been developed to assess cognitive performance following sport-related concussions, very little research has been done regarding the combined assessment of dynamic motor and cognitive task performance in an ecological environment. It is known that traditional neuropsychological measures sensitive to deficits from non-complex concussion generally return to baseline within 7 days. The objective was to investigate if there are residual combined cognitive and locomotor deficits for navigational behaviour in elite athletes at least 30 days after they have sustained a sport-related concussion.

Method: A sample of six elite athletes (4 men, 2 woman; age, 19.7 \pm 2.3 y) who sustained their first medically diagnosed sports-related concussion and an age, sex and team position matched control group (4 men, 2 woman; age, 20.1 \pm 2.7 y) without previous history of concussion were recruited from contact sport teams. Both groups walked along an unobstructed or obstructed path both with and without a simultaneous visual interference task (Stroop task). Gait measures were taken on average 37.3 (\pm 4.8) days after the concussion using an Optotrack 3020 system. Voice recordings for responses to the Stroop task were also made. The outcome measures were maximal gait speed, minimal clearance of the obstacle when present, response reaction times and response errors to the task. Clinical symptoms and a battery of neuropsychological tests were also administered.

Results: The athletes with concussion were symptom-free and their neuropsychological test results were not statistically different than those of the control group at the time of testing. Yet, more than 30 days following concussion these athletes showed more

response errors in the interference task as well as a main effect for minimal obstacle clearances.

Conclusions: These results show that concussion can result in residual planning and attention deficits in complex, but ecologically valid, environments even well after return-to-play. This suggests that functional assessment incorporating divided attention within an ecological context could be used as an innovative way to evaluate athletes with concussion before sending them back to play, even in the absence of medically related symptoms or abnormal neuropsychological test results.

0205

Mild head injury and underarousal: Effects on decision making

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Objectives: Across the lifespan, head injuries introduce a constellation of affective, behavioural, cognitive, and social dysfunction. It has been well established that the orbitofrontal cortex, an area highly susceptible to trauma during closed head injury, is involved in successful decision-making based on associative reversal learning, processing emotional valence related to decision outcomes, and regulating behavior to adhere to contextual demands. Research into milder forms of head trauma indicates that metabolically disrupting brain activity may be sufficient to create residual deficits in neuropsychological and neurophysiological functioning and converging behavioural, electrophysiological, and neuroimaging data indicates that lower performance in cognitive, emotional, and social domains can be evidenced in cases of mild head injury (MHI) in populations who are considered high functioning (e.g. university students, college athletes). The purpose of this study was to examine the relationships between neuropsychological performance, physiological arousal, and decision-making in university students who have or have not reported a history of MHI, and are otherwise cognitively competent and capable.

Method: In addition to questionnaires targeting demographic information and history of impulsive antisocial behaviours, forty-four participants (41% reporting MHI) engaged in an executive function test, the Iowa Gambling Task (IGT) while electrodermal activity (EDA) was recorded, and decided on a course of action for various non-moral, moral impersonal, and moral personal dilemmas.

Results: As expected, both groups responded similarly to the cognitive demands of neuropsychological testing by making more errors as task complexity increased, with no difference in overall performance. Unexpectedly, history of MHI was not related to increased endorsements of antisocial and disinhibited behaviours, or poorer overall decision-making performance as both groups exhibited equal and appropriate learning across the initial block (i.e. 20 trials) during the IGT. Strikingly, self-reported MHI severity is a correlate of underlying neural/metabolic disruption as it negatively predicted decision-making success, accounting for approximately 25% of the variance in net total IGT score. EDA magnitude in response to reward and punishment outcomes indicate that individuals with MHI have the capacity to be affectively aroused, in a reactive way, comparable to their non-MHI cohorts. Despite this, those reporting MHI were significantly less aroused when anticipating potential consequences to their decisions. Further, in line with other studies involving participants with brain injury, compared to the non-MHI group, individuals with MHI took less time to consider a course of action, selectively, for personal moral dilemmas. In addition, they indicated significantly less reticence for making risky moral decisions compared to their cohort.

Conclusions: Together, these findings support the argument that a history of MHI can differentially impact physiological and psychological mechanisms which sustain adaptive social decision-making.

0206

Affective and Physiological Underarousal in Persons with Mild Head Injury

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Objectives: Previous research has shown that persons with traumatic brain injury (TBI) with damage to the ventromedial prefrontal cortex (VMPFC) regions present with flattened affect and lessened physiological responsiveness (e.g., see Naqvi et al., 2004), referred to as underarousal. Research from our lab investigated whether persons with more mild head injuries (MHI; e.g., concussion) present with a profile of underarousal similar to those with more severe injuries. Our previous research has demonstrated that university students with MHI report significantly lower levels of anxiety, are less responsive to stressors in their environment, and, correspondingly, are physiologically underaroused compared to their non-MHI cohorts. In our current

study we further investigated the emotional and cognitive sequelae that can follow MHI. Based on their expected underarousal (physiological and self-reported), we examined the possible cognitive benefits of increasing arousal through a psychosocial stressor manipulation in persons with self-reported MHI.

Method: Using a quasi-experimental research design (N = 90), we examined changes in cognitive performance (cognitive flexibility, memory processing, and selective attention) as a function of manipulated arousal (i.e., induced activation/stress; reduced activation/relaxation) in university students with, and without, subtle MHI. In addition to self-reported stress and state anxiety measures, physiological indices of arousal state (i.e., electrodermal activity (EDA), heart rate, and respiration activity) were recorded across a two-hour interval.

Results: Results replicated earlier studies from our lab such that students who simply acknowledge sustaining a MHI are underaroused, both physiologically (i.e., reduced EDA) and emotionally, despite increased reports of experiential life stressors relative to their MHI cohorts. Similarly, they were significantly less responsive to the arousal manipulations. Further, exposure to a stressor differentially affects cognitive performance for persons with and without MHI. Cognitive flexibility and processing speed are improved with increased stress, and disadvantaged with reduced stress, in persons with MHI. Finally, university students with MHI reported experiencing significantly more, and qualitatively different, post-concussive-like symptoms compared to their no-MHI cohort.

Conclusions: Overall, our findings demonstrate that despite increased reports of experiential life stressors persons with mild head trauma are underaroused in terms of their affective and physiological responses, suggestive of lasting effects of neural disruption. The underarousal profile of persons with a history of MHI mirrors that of persons with more severe injury to the VMPFC. The VMPFC is involved with managing emotional and autonomic responses, therefore its could account for the differential arousal status, even in those with injuries at the very mild end of the spectrum.

0207

Concurrent locomotion and cognition in youth ice hockey players: Towards an ecologically valid functional assessment following sports-related concussion

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Objectives: Concussion is common in the sport of ice hockey and can cause deficits in cognitive and motor function. In most situations, ice hockey participation requires the performance of more than one skill at a time. It has been reported that following concussion, performance deficits arise when locomotor and cognitive tasks are performed concurrently (i.e. dual-tasking) that may have otherwise gone unnoticed if assessed in isolation of one another. The primary objective of this study is to better understand the attentional demands of navigational behavior in youth ice hockey players while performing concurrent locomotor and cognitive tasks in an ecologically valid, sport-specific context. The direction of this study is to inform the development of an onsite method of functional return-to-play assessment following hockey-related concussion.

Method: Data specific to performance on locomotor (skating) and cognitive tasks were collected from eight non-injured competitive youth male ice hockey players (age, 11.25+/-0.89 y). Participants performed combinations of four tasks with trials ranging in complexity depending on how many of the four tasks were performed concurrently. The tasks included: 1) skating on ice; 2) performing a visual interference task (Stroop word); 3) avoiding a fixed obstacle in the skating path; and, 4) carrying a hockey puck while stickhandling. Levels of task complexity ranged from level I (skating along an unobstructed path) to level IV (completing all conditions concurrently). Dependent variables were dual task costs (DTC) or the subtraction of response reaction times (RRT) to the Stroop-task during skating from RRT during standing, response errors on the Stroop-task, maximal skating speed and minimal obstacle clearance. Kinematic data during skating were collected using a three dimensional VICON motion analysis system.

Results: With respect to locomotor task performance, decreases in maximal skating speed and minimal obstacle clearance were found with increased task complexity. A main effect for stickhandling was demonstrated (p = 0.010) where handling the puck during task performance resulted in a higher DTC for all conditions. Additionally, a significant effect of obstacle circumvention on cognitive performance was found (p = 0.02) where Stroop errors were elevated in the presence of an obstacle.

Conclusions: This study presents an innovative method of assessment by comparing separate and concurrent performance of locomotor and cognitive tasks during skating. Traditionally, post-concussion

locomotor and cognitive performance is assessed in isolation of one another. When assessed concurrently, it has been found that locomotor and cognitive performance deficits are observed that may have otherwise gone unnoticed. This study acts as an initial step towards the development of an ecologically valid, sport-specific assessment of functional performance following concussion in youth ice hockey players. This approach to assessment following concussion can help inform safer return-to-play and in turn, limit the occurrence of subsequent injury.

0208

Self-report concussion history negatively impacts headache, fatigue, and general health-related quality of life.

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Objectives: Sport-related concussion may have an impact on health-related quality of life (HRQOL), a global concept that encompasses physical, psychological, and social health domains. In adolescents, lower HRQOL may result in increased school absences and decreased academic performance. Understanding the impact of sport-related concussion on HRQOL may help determine the extent to which athletes are globally affected by these injuries and identify areas for improving patient care. This study examined the relationship between self-report concussion history and HRQOL in adolescent athletes.

Method: A cross-sectional, comparative design was used to assess HRQOL in adolescent athletes with ($n = 713$, age = 15.3 ± 2.0 years, grade level = 10.3 ± 1.1) and without ($n = 625$, age = 15.1 ± 1.8 years, grade level = 10.1 ± 1.1) a self-report history of concussion. All subjects completed a concussion history questionnaire, the Pediatric Quality of Life Inventory (PedsQL), PedsQL Multidimensional Fatigue Scale (MFS), Headache Impact Test (HIT-6), and a graded symptom scale (GSS) during the preseason. Subjects were grouped as “positive” or “negative” according to their concussion history on the questionnaire. Group differences were assessed with the Mann-Whitney U. Dependent variables included: 4 subscale scores of the PedsQL [physical functioning (PF), emotional functioning (EF), social functioning (SOF), and school functioning (SCF)], 3 subscale scores of the MFS [general fatigue

(GF), sleep fatigue (SLF), and cognitive fatigue (CF)], the HIT-6 score, and the GSS total symptom score (TSS). Higher scores on the HIT-6 and lower scores on the PedsQL and MFS indicate lower HRQOL.

Results: The positive concussion history group reported significantly lower HRQOL (all $p < .001$) for the PF (88.8 ± 12.0 vs. 91.6 ± 11.0), EF (86.7 ± 15.1 vs. 90.0 ± 14.1), and SCF (82.0 ± 16.2 vs. 86.3 ± 14.9) subscales of the PedsQL, and the GF (82.5 ± 17.0 vs. 88.0 ± 15.2), SLF (68.9 ± 19.7 vs. 77.0 ± 18.2), and CF (83.8 ± 18.0 vs. 87.3 ± 16.3) subscales of the MFS. The positive group also reported a significantly higher HIT-6 total score (47.2 ± 8.2 vs. 44.5 ± 6.8 , $p < .001$) and a significantly higher TSS (14.1 ± 15.3 vs. 8.4 ± 11.6 , $p < .001$).

Conclusions: Adolescent athletes with a self-report concussion history demonstrated lower HRQOL on several PedsQL and MFS subscales, including those related to emotional and school functioning, and general, sleep and cognitive fatigue. Athletes with a concussion history also reported significantly more concussion-related symptoms during preseason and a greater impact of headache on their general health. These findings suggest that a history of concussion may affect other aspects of health status, beyond the somatic and cognitive domains that are normally evaluated in concussed athletes, and that a positive concussion history may have a lasting mental and physical impact on adolescents' HRQOL. Future prospective studies are warranted to investigate the short- and long-term impact of sport-related concussion on HRQOL to assist clinicians in developing management and rehabilitation strategies that better address the needs of concussed adolescent athletes when returning to sports and school.

0209

Prediction of energy expenditure in mechanically ventilated patients with severe traumatic brain injury – a validation study by use of continuous indirect calorimetry

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Objectives: A balanced energy intake in patients with severe traumatic brain injury (TBI) may minimize morbidity and promote neurological recovery. During the first weeks post injury, energy intake is generally low while most patients are hypermetabolic. Consequently, malnutrition is common. By its deteriorating effect, malnutrition may increase the risk for other secondary complications and thus delay or worsen the recovery process. Nutritional treatment may be hampered by lack of routines and of clinically valid methods to predict energy expenditure. There is an urgent need for evidence-based, clinically applicable methods to predict energy expenditure (EE). The aim of this study was to evaluate the accuracy of methods to predict EE and to explore factors associated with EE in these patients.

Method: Energy expenditure was measured continuously by indirect calorimetry in six patients with acute, isolated and severe TBI during mechanical ventilation. Clinical and laboratory variables with possible influence on EE were recorded simultaneously. The estimated EE according to twelve suggested equations for prediction of EE and a non-invasive monitor, the SenseWear Armband, were compared with the "golden standard" data obtained by indirect calorimetry.

Results: The majority of methods for predicting EE agreed poorly with the measured EE. A good agreement was found only with the three Penn-State equations but two were biased according to Bland Altman analysis. The Penn-State equation from 1998 was the only valid predictive method, with a mean difference per day close to zero (+22 kcal), an excellent agreement (intraclass correlation 0.82) with 72% (n54/75) accurately assessed days ($\pm 10\%$ of the measured EE) and with all patients within clinically acceptable levels, i.e. $\pm 15\%$ of the measured EE. Out of 13 variables entering regression analysis, male gender and increased heart rate were independently associated with high EE (≥ 27 kcal/kg).

Conclusions: The findings of this study suggest that the Penn-State equation from 1998 is sensitive to changes in EE both within and between individuals. Thus, prediction of EE by use of this Penn-State equation is an adequate alternative in mechanically ventilated patients with severe TBI. The findings also indicate that male gender and elevated heart rate

are independent factors influencing EE, although this study does not allow any firm conclusion in this respect.

0210

Long-term follow-up of upper-limb function of children with severe traumatic brain injury

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Objectives: 165 survivors of TBI, injured 1987–1991, were identified in the former southwestern Swedish health care region. Inclusion criteria were age between 0 and 17 years and documented severe brain injury. The traceable individuals (149) were invited to a 10 year follow-up investigation. A total of 109 individuals answered a questionnaire on symptoms and 29 had problems with upper-limb function. A new questionnaire was sent 15 years after the injury to the traceable subjects (79/109) with detailed questions about upper-limb dysfunction and all 26 subjects who were invited belonged to the group of 29 that originally at the 10 year follow-up had upper-limb problems. Fifteen accepted and twelve came to evaluation. Those individuals did not differ significantly in terms of severity of injury from those 29 that originally told they had problems with upper-limb function. This study was undertaken to clarify the pattern of impaired fine-motor skills in patients with a severe traumatic brain injury acquired in childhood.

Method: Methods: Hand function was evaluated with the standardised Sollerman hand function test, which consist of 20 different activities of daily living where seven main hand-grips are used (pulp-pinch, lateral pinch, tripod pinch, five-finger pinch, diagonal, transverse and spherical volar grip). Each subtest is scored on a scale from 0–4 points. The rating are based on time and quality of performance of the hand-grip. Each task must be performed within 20 seconds. Thus the maximal score is 80. The bimanual fine motor skills were classified by Bimanual Fine Motor Function (BFMF) classification system. BFMF consists of five levels describing grade of function of the hands separately, developed for children with cerebral palsy. Level I is normal function, level II one hand manipulates without restriction while the other has limitations, level III a) one hand manipulates without restrictions and the other has no functional ability b) one hand has limitations in more advanced grips and the other has

only ability to grasp. Level IV is when both hands have only ability to grasp and Level V when both hands have only ability to hold or worse.

Results: All patients had subnormal test-results on the Sollerman test. In the BFMF- test 58% had abnormal scores.

Conclusions: The Sollerman-test seems reliable in picking up hand motor problems in the studied group, as all who subjectively reported such problems scored subnormally. When reviewing the literature there is to our knowledge no earlier study using the Sollerman test for evaluating the late effects on upper-limb function after TBI.

This is in contrast to the the findings in the BFMF-test, in which only 60% of our group scored subnormally which make us conclude that this test is not recommendable in TBI.

0211

Cerebral perfusion pressure/intracranial pressure dose index: Dynamic 3-D scoring in the assessment of Traumatic Brain Injury

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Objectives: Introduction: Intracranial pressure (ICP) and cerebral perfusion pressure (CPP) data guide therapy in severe traumatic brain injury (TBI) patients, but current linear analytic methods are insufficiently sensitive and specific to provide useful prognosis in dynamic situations over time.

Method: We have developed algorithms incorporating a CPP/ICP “dose” (pressure times time) function to process the continuous, high frequency digital ICP and CPP recordings of severe TBI being monitored during critical care at our Level I trauma center using 5-minute mean values calculated for ICP and CPP. Using these values, in the current study, we calculated cumulative pressure*time doses using thresholds of ICP > 20 mmHg and CPP < 60 mmHg and graphed these as a CPP/ICP dose index. We then compared the prediction power of a cumulative CPP/ICP dose index <3 and <2 for three unfavorable outcome measures: 30-day mortality, 3-month Extended Glasgow Outcome Scale (GOSE) <5 and 6-month GOSE <5, using receiver operating characteristics (ROC) analysis. In addition, we graphed index values for each patient as linear functions over time as a next step

toward development of a real-time bedside monitoring tool.

Results: Twenty eight subjects yielded a total of 2858.4 hrs of data (1,715,040 data points). CPP/ICP dose <3 and <2 were significantly better than ICP>20 mmHg in predicting mortality ($p = 0.001$). CPP/ICP <2 was more powerful than CPP <60 mmHg in predicting unfavorable functional outcome both at 3 months and 6 months ($p < 0.05$). No difference was found between the prediction power of CPP/ICP <3 and <2.

Conclusions: Calculation of cumulative CPP/ICP dose index by processing continuous digital data demonstrated high predictive power for unfavorable functional outcome in severe TBI. Future work will focus on developing time-series analyses with the ultimate goal of providing real-time bedside early-warning systems to support intensive care decision-making.

0212

Right Median nerve stimulation for Coma Treatment

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Objectives: Right median nerve electrical stimulation (RMNS) is a safe and convenient portal for resuscitation of the severely injured brain. In the last three decades, pulsed transdermal electrical stimulation has been shown to have both peripheral and central nervous system effects in paraplegia, quadriplegia, and post-traumatic coma. All of these conditions are amenable to electrical treatment with varying degrees of clinical success. In the 1990s, American pilot studies commenced at the University of Virginia, Duke University, and East Carolina University. Subgroups of coma patients stimulated while in the decerebrate/decorticate clinical condition experienced more rapid and better awakening than control or historical patients.

Method: Injured central neural circuitry can be enhanced by peripheral nerve surface electrical stimulation for a period of weeks. RMNS is started while the coma patient’s Glasgow Coma Scale is less than 8 in the first week post brain injury. The protocol is 20 seconds on, 40 seconds off, differentiated pulses at 40Hz delivered at 10–15 milliamps, through rubber electrodes (imbedded in a plastic

right wrist orthosis) over the median nerve at the right wrist. Treatment is given for 8 hours/day for 3 weeks or until following commands, whichever is sooner.

Results: One case study from 15 years ago illustrates the very functional recovery of a teenage traumatic brain injury comatose female who was near death when stimulation began 3 days post injury. A video will show her progress over a period of months and years.

Other series of coma patients treated with RMNS will be presented by tables and graphs.

Conclusions: Probable mechanisms of electrically induced neuro-awakening include increased cerebral blood flow, boosted dopamine, and 40 Hz pulses creating alert state thalamo-cortical oscillations.

Future applications of RMNS will cover the chronological spectrum of unconscious injured patients. A multi-center investigation at eastern United States medical centers will be accomplished through the International Brain Research Foundation.

When electrical treatment is started in the early stage of coma, RMNS can accelerate the upward progress toward re-awakening. Sometimes a more functional outcome will be the result. Median nerve stimulation can communicate with the profoundly injured idling brain. When electrical treatment is applied early as an adjunct to aggressive ICU and neurosurgical neuro-resuscitation, a more functional outcome may result for many coma patients.

0213

Neuropsychological Rehabilitation of Executive Functions After TBI

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Objectives: This investigation describes the neuropsychological rehabilitation of a young man who suffered TBI which presented a severe executive dysfunction and anosognosia. Objective: To inform the necessary components of the neuropsychological evaluation and rehabilitation of the executive functions being the main topic of the recovery the planning and decision making, and eliminate the presence of anosognosia. To this purpose it was used the neural networks approach and the ecological paradigm.

Method: Unique case; man of 35 years old with TBI. It was used the ecological approach for the evaluation using the following instruments and direct

observation at the patient's home and work place. Instruments: Wechsler Adult Intelligence Scale, Wisconsin Card Sorting Test, Rey-Osterrieth Complex Figure Test, in addition to studies of image like CT and RMI and EEG.

Results: Evaluation results: The executive dysfunction significantly impaired the everyday activities (planning, verification, and cognitive flexibility), there were also evidence of short term memory disorder and severe anosognosia. Rehabilitation results: the main objective of the rehabilitation was to give insight on decision making, planning and sequencing of activities at home and work. Using the ecological approach, the rehabilitation sessions were held at the consulting room, patient's home and work place. A.C. improved in everyday activities, being able to get a new job with a satisfactory performing, needing help at first from a co-worker and being completely independent afterwards.

Conclusions: Executive functions combine emotional, volitional, awareness and verification behavior necessary to carry out plans. The lack of conscience of the dysfunction is the main topic in the neuropsychological rehabilitation program so the goals can be achieved. If not, the presence of anosognosia interferes in the functional reorganization, and makes difficult to desing a rehabilitation plan and the use of compensatory strategies. This paper contributes to new guides for the approach and explanation of the neuropsychological function in patients who suffer cognitive impairment posterior to TBI with anosognosia and executive dysfunction.

0214

Effects of chronic exposing to methylmercury chloride on NMDAR-2A subunit expression in hippocampus of newborn rats during developmental stages

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Objectives: To study the effects of methylmercury chloride (MMC) on NMDA receptor2A subunit (NR2A) in hippocampus of newborn rats chronically exposed to MMC during developmental stages.

Method: Pregnant Wistar rats (120 ± 20 g) were randomly divided into control group and experimental group. In experimental group, the rats were fed on forage containing different dosage of MMC (0.75, 1.50 and 3.00mg/kg) each day for 90 days. Proteins were exacted from hippocampus of

newborn rats on postnatal days (P) 7, P14, P21, and P28. NR2A protein expression was investigated by Western blotting.

Results: The NR2A reached the peak at P14. A decreasing tendency appeared in amount of NR2A from hippocampus of MMC exposed rats on P7, 14, 21, and 28 compared with control group. *Conclusion:* NMDAR in rat brain involves in brain developmental process. Decrease of NR2A expression in rat exposed to MMC may be the key molecular mechanism of MMC damage of the developing brains.

Conclusions: NR2A protein was detected in both control and experimental groups. Expression of the NR2A reached the peak at P14. A decreasing tendency appeared in amount of NR2A from hippocampus of MMC exposed rats on P7, 14, 21, and 28 compared with control group.

0215

Using Principles of Motor Learning to Treat Apraxia of Speech after Traumatic Brain Injury

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Objectives: Available evidence from non-speech motor learning and limited studies of motor learning in speech suggest that application of motor learning principles may be used for motor relearning in populations with impaired speech and should be explored (Maas et al., 2008). This study examined the effectiveness of a modified version of the Motor Learning Guided (MLG) approach, a treatment protocol to establish functional speech that incorporates principles of motor learning: blocked and random practice schedules, delayed and summary knowledge of response (KR) feedback, and specificity of training.

Method: A 29-year-old male survivor of traumatic brain injury diagnosed with moderate-severe apraxia of speech (AOS) participated in this protocol. The Brief Test of Head Injury indicated moderate severity of head injury characterized by severe deficits in linguistic organization, and moderate deficits in the six remaining modalities. With consultation from his family, the participant and clinician determined 10 functional phrases four to six syllables in length. The MLG protocol includes a

fading hierarchy of cues provided before client produces phrase four times: clinician and client say phrase in unison, clinician provides a model prior to participant, and finally client produces phrase after only looking at the written phrase. After each cue, the participant says the phrase four times and then the clinician provides KR feedback (e.g., 3 out of 4 were accurate). A time-series ABA design measured the participant's production of the ten (i.e., two sets of five) phrases, and his ability to maintain accurate productions four months after treatment. A multi-dimensional scoring system is used to provide data on accuracy and automaticity of speech.

Results: Improvements were seen in the participant's ability to produce both sets of trained phrases, however the second set were practiced with more frequency, which may have lead to a greater accuracy of production in less time compared to the first set of five phrases. Although phrases were not maintained at the same degree of accuracy achieved during training, target items were produced at a higher level of accuracy several months after treatment had stopped compared to pre-treatment measures.

Conclusions: More than three years after this participant's penetrating TBI, this participant has acquired and maintained the ability to say several multi-word phrases. Application of motor learning principles through the modified MLG approach can lead to increased accuracy and automaticity of trained phrases, and the ability to maintain accurate phrase production following cessation of treatment. Adherence to a frequent practice schedule and other motor learning principles is influential to success of this treatment for AOS.

0216

The isoform-specific influence of APOE on the electrical activity of brain induced by traumatic brain injury

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Objectives: To investigate whether the isoform-specific influence of apolipoprotein E gene (APOE) on the electrical activity of brain is induced by traumatic brain injury.

Method: The clinical data of 118 patients with mild/moderate traumatic brain injury and 40 normal subjects for control were collected, and the APOE genotyping was performed by means of PCR-RFLP.

The electrical activity of brain in every patient was recorded by electroencephalogram within 3 days after injury and all the subjects for control were examined by electroencephalogram under conscious, calm, eyes-closed and normoglycemic condition. Quantitative data of every electroencephalogram was collected.

Results: The quantitative data among APOE ϵ 2, APOE ϵ 3 and APOE ϵ 4 groups of normal subjects had no statistic difference ($P=0.097$). In 118 patients with mild/moderate traumatic brain injury, the quantitative data among APOE ϵ 2, APOE ϵ 3 and APOE ϵ 4 groups had significant difference ($P<0.05$). Compared with APOE ϵ 3 group, the energy value of slow waves was more in the APOE ϵ 4 group and less in APOE ϵ 2 group.

Conclusions: In normal adults, the electrical activity of brain is not significantly different among the three APOE groups. However, under the provocation of traumatic brain injury, the electrical activity of brain in the three groups shows different. After traumatic brain injury, APOE ϵ 4 is bad for the electrical activity of brain but APOE ϵ 2 protects brain function.

0217

The Brain Injury Drop-In Centre: An Innovative Program Addressing Social Participation and Quality of Life

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Objectives: Many individuals with traumatic brain injury (TBI) experience long-term or lifelong changes in social participation and quality of life, including shrinking social networks, decreased involvement in social and leisure activities, increased social isolation and loneliness, and reduced satisfaction with life. There are few community-based programs available to address these issues over the long term, and little research on their effectiveness. One innovative, relatively low-cost program is the brain injury drop-in centre. Located in community and not hospital settings, brain injury drop-in centres provide a comprehensive set of services and opportunities targeted toward improving social participation and quality of life. There is little description of them in the literature, and no systematic investigation has been published of their effect on outcomes for individuals with brain injury. This presentation will provide results from a study

investigating social participation and quality of life outcomes for individuals attending at brain injury drop-in centres as compared to those who do not attend.

Method: Fifty community-dwelling adults with traumatic brain injury participated in the study: 25 who attend at brain injury drop-in centres, and 25 who have been assessed as good candidates to attend, but who do not attend, such as owing to environmental or other barriers. Participants completed questionnaires relating to social participation (social integration, social supports, social and leisure activities) and subjective quality of life, and details about their participation in drop-in centres and the importance of a drop-in centre in their lives (for those who attend) or their knowledge about drop-in centres (for those who do not attend).

Results: The study participants who attend at brain injury drop-in centres reported attending 2 to 5 times per week, and that they benefit from socializing, leisure activities, peer support, and the opportunity to help out at the centre. They rated the drop-in centres as having high importance in their lives, and reported that, without a drop-in centre, their lives would be boring, lack friendships, and have limited meaningful activity. Preliminary analysis of the comparison data indicates that individuals who attend, as compared to those who do not, have higher happiness and other ratings of subjective quality of life, and increased social integration and participation in social and leisure activities, including more diversity of activity and frequency of participation.

Conclusions: This investigation of brain injury drop-in centres, which appears to be the first of its kind, provides evidence that this innovative program contributes to social participation and quality of life, two of the primary goals of community-based rehabilitation for individuals with traumatic brain injury.

0218

Better managing the Lifetime Care Costs and Outcomes for People with Moderate to Severe Brain Injury

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Objectives: As the United States looks to better manage its health and welfare systems and escalating costs for personal injury litigation, New Zealand

offers an alternative via a no-fault insurance scheme. Run by the Accident Compensation Corporation (ACC) the scheme has supported the injury related needs of New Zealanders for some 35 years.

This presentation will discuss the management, costs, services and risks associated with no-fault insurance funding for lifetime care and support for people with moderate to severe brain injury.

Method: Of the 4,661 children and adults with a serious injury (brain injury, spinal cord injury and like injuries) covered by ACC, 57.6% (n=2686) have a moderate to severe brain injury and 1,264 (47.1%) receive attendant care services.

Attendant care services are responsible for 85% of the liabilities for the serious cohort, with liabilities for the brain injury cohort as a whole being NZ\$4.75 billion. In response to the hours of care growing well beyond actuarial predictions by June 2007 a specialist serious injury service was established to deliver a sustainable rate of growth and improved client outcomes.

The presentation will address the strategies applied and scheme risks, thereby providing valuable lessons to other jurisdictions considering no-fault insurance options.

Results: In the most recent financial year (June 08 to June 09) the rate of growth in attendant care costs attributable to a growth in hours had fallen to 2.7% from a previous overall growth rate of 14% in the 2006–07 financial year, alongside improvements in client services and outcomes.

Conclusions: It is possible to deliver needs-based, financially sustainable services to people with the most serious of brain injuries when services and management are based in person-centred practice, evidence-based assessment and outcome measures and support to people to resume valued roles.

0219

Effects of neurodevelopmental treatment on the recovery of neural function and Transforming growth factor- β 1 levels and in children with cerebral palsy

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Objectives: To explore the relationship between the concentration of transforming growth factor- β 1 (TGF- β 1) and brain injury or its prognosis by dynamic observation of serum TGF- β 1 levels of fetuses, neonates with high risk of cerebral palsy

(CP) and children with CP; the present study is a probe into this mechanism by means of observing the effects of neurodevelopmental treatment (NDT) on the recovery of neural function and TGF- β 1 levels and in children with CP. To provide a new way to study and theoretical basis for the clinical application of early intervention of NDT for children with CP high risk and CP in order to promote their nerve repair.

Method: Serum samples of 55 CP children, 33 children with CP risk factors (12 fetuses, 21 neonates) and their control groups were obtained respectively and kept at -40°C until the time of measurement. TGF- β 1 levels were measured by the enzyme-linked immunosorbent assay double sandwich method (ABC-ELISA) retrospectively. The curative effect before and after NDT for CP patients were quantitatively assessed by gross motor function measure (GMFM)-88 items.

Results: Serum TGF- β 1 Levels in children with CP risk factors were significantly higher than in controls and CP children without NDT ($P < 0.01$). There was no significant difference in serum TGF- β 1 levels between fetuses with CP risk factors and CP children with NDT ($P > 0.05$). Serum TGF- β 1 levels in CP children without NDT were significantly lower than in controls ($P < 0.01$). Serum TGF- β 1 levels in CP children with NDT were significantly higher than in controls and in the CP children without NDT ($P < 0.01$). The total scores of GMFM-88 items in CP children with NDT were significantly higher than in the CP patients without NDT ($P < 0.01$).

Conclusions: Serum TGF- β 1 Levels in children with CP risk factors were significantly higher than in controls, suggesting that TGF- β 1 is correlated with brain injury induced by intrauterine infection. Serum TGF- β 1 levels in CP children without NDT were significantly lower than in controls and in children with CP risk factors, indicating that the role of TGF- β 1 is weakened in inhibiting inflammation and neuroprotection. Serum TGF- β 1 levels in CP children with NDT were significantly higher than in controls and in the CP children without ND, that was correlated with stimulating the synthesis and secretion of TGF- β 1 in CP children through early intervention of NDT to increase the input of cortex information. The GMFM-88 can reflect the change of gross motor development in CP children and can be sensitively directly quantified assessment of curative effect of NDT for CP. With TGF- β 1 and GMGM-88 stems, curative effect of CP is overall assessed. Moreover, it provides the scientific basis for treatment plans of the neurological rehabilitation of CP children.

0220

Adam17/Tace Inhibits Neuron Generation from Neural Stem Cells and Promotes Glia Formation in the Injured CNS

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Objectives: Neural precursor cells (NPC) are activated in CNS lesions of different origins. However, in spite of being multipotential, they do not differentiate into neurons, but give rise only to glial cells in the lesioned area. We have investigated the role of the endogenously activated epidermal growth factor receptor (EGFR) in the generation of gliogenic conditions, in search for a therapeutic target that could favour neuronal rather than glial differentiation.

Method: NPC were isolated from postnatal mouse subventricular zone and maintained in neurosphere cultures. After several passages, neurosphere cells were exposed to differentiating conditions, in the absence of any added growth factor, and the generated cell phenotypes were analyzed by immunocytochemistry 72 hours later.

Results: In control cultures the majority of differentiated cells were astrocytes, identified by GFAP immunostaining, and about 10–20% were neuroblasts, immunopositive for β III-tubulin. AG1478, a specific inhibitor of the EGFR, produced a significant decrease in the number of astrocytes and significantly increased the number of neuroblasts generated from NPC. These results suggested that EGFR was activated in control conditions by some endogenous EGFR ligand, in an autocrine/paracrine manner. Membrane-bound EGFR ligands need to be cleaved by a metalloprotease in order to become active. We tested the effect of a broad-spectrum metalloprotease inhibitor, GM6001, on our differentiating NPC cultures, and a 3-fold decrease in the number of GFAP+ cells, together with a 1.5-fold increase in the number of neuroblasts, were observed. We next attempted to identify the metalloprotease that prevented neuronal, and favoured glial, differentiation. ADAM17/TACE and ADAM10 were expressed by the differentiating cultured cells; prevention of ADAM-17, but not ADAM-10, expression by using specific siRNA resulted in a significant enhancement in neuroblast generation and a reduction in the formation of new

glial cells. Furthermore, the expression of ADAM17, but not that of ADAM10, was up-regulated selectively in areas of brain cortical injury in adult mice, and also EGFR and its ligand TGF- α were up-regulated in the lesion. Interestingly, the NPC which appeared in the damaged tissue, identified by the novo nestin expression, contained the three molecules necessary for EGFR activation and glial differentiation.

Conclusions: These results strongly suggest that activation of ADAM17 in brain injuries initiates EGFR ligand shedding and EGFR activation in an autocrine manner, leading to preferential glial differentiation. Inhibition of ADAM17, the limiting step in this sequence, may be essential in the generation of neurogenic/non-gliogenic niches in areas of brain damage.

0221

Community-Based Crisis Intervention in Acquired Brain Injury: Developing a Model for Response

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Objectives: The dual diagnoses of acquired brain injury (ABI) and mental health illness is well recognized. The Commonwealth of Virginia's Action Plan for the Appropriate Treatment of Persons with Brain Injuries in the Mental Health System (1999) recommended providers avoid admitting individuals with a primary diagnosis of head-injury and no known mental health illness to state psychiatric facilities. Further, in those instances of diagnosed ABI and mental health comorbidity, the report advocated for interprofessional consultation and staff development to optimize interventions. Unfortunately, ten years later, many individuals affected by acquired brain injury struggle to access appropriate services, particularly when in crisis.

This grant-funded research project endeavors to formulate an educational plan and practice protocol that improves community-based services such as crisis intervention or mental health services for survivors of acquired brain injury. This multi-year project addresses the Commonwealth of Virginia's Neurotrauma Initiative (CNI), which seeks to strengthen relationships across state supported

brain injury and mental health organizations and agencies. The three-year project goals are:

Year 1: Assess Needs and Determine Barriers to Crisis Intervention

Year 2: Identify Best Practices and Determine Model for Crisis Intervention

Year 3: Implement and Evaluate Protocol for Crisis Intervention

This presentation reports the progress and findings for Year One.

Method: The methods provided reflect the first year initiative to design, pilot, and deploy a nonexperimental (descriptive and correlational) study to ascertain needs and barriers.

The purposeful sample for the survey consists of personnel who work for regional (Virginia) agencies or organizations that serve individuals diagnosed with mental illness and/or acquired brain injuries. Surveys are disseminated via Qualtrics. Participants' responses are anonymous.

This is a mixed-methods survey that relies on qualitative and quantitative data. Quantitative data will be analyzed via SPSS. Qualitative data will be imported into N-Vivo 8 for coding, aggregation and analysis. N-Vivo 8 has a casebook/attribute function that allows for statistical analysis of quantitative data (imported from SPSS) and sophisticated querying across both paradigms of inquiry. The results of the survey will be analyzed to find common themes among participants with focus on the questions related to barriers to access. Institutional Review Board approval has been secured for this project.

Results: The survey has been deployed and results are forthcoming. Survey findings will be triangulated via focus groups and interviews with identified stakeholders.

Conclusions: The findings from the initial year of this project will inform stakeholder summits, guide educational outreach, and identify regional resources. In addition, findings will enhance understanding and planning for improved response management for survivors of acquired brain injury when in crisis (i.e., contribute to the year 2 and 3 project objectives).

0222

Growing Skull Fracture: An Institutional Experience with 101 patients

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Objectives: Growing Fracture of the skull (GFS) is an uncommon complication of trauma in infancy and childhood. It usually presents as an increasing fracture defect in skull. Often it is associated with a pseudo-meningocele. The role of associated dural tear in the pathogenesis of GSF is recognized for long, however, application of MR Imaging has greatly helped in understanding the role of the arachnoid tear, focal brain damage and the altered cerebrospinal fluid dynamics. MR imaging has rationalized the surgical approach. The aim of the present study was to determine the pathogenesis of the growth of the fracture, find an appropriate surgical approach and the long-term effects of surgical intervention. Surgical steps are discussed for the benefit of young neurosurgeons.

Method: Patients (n = 101) managed by the authors over past 25 years were analyzed. All had progressively increasing swelling at the fracture site, appearing at a variable interval following head injury resulting from blunt trauma in most of the cases. Apart from cosmetic deformity, headache and progressive neurological deficits were important presenting complaints. Plain skiagram and CT scan were done in all patients where as MRI studies were undertaken in all cases in the later part of the study. Initial fracture was commonly a linear fracture. The most common location was parietal; however, involvement of every part of the cranium, including orbital roof and posterior fossa was noted. Surgical intervention involved a craniotomy, excision of a leptomenigeal cyst and meningocerebral cicatrice, duraplasty and cranioplasty using autologous or artificial graft. Venticuloperitoneal shunt was important part of management in many patients.

Results: In addition to the dural tear at the fracture site, local brain contusion and arachnoid reaction were observed in all cases and were most important factor in the formation of GSF. Further growth of the fracture resulted from the formation of leptomenigeal cyst and the brain migration through the enlarged fracture. Formation of meningocerebral cicatrice and porencephaly resulted in further increase in the fracture and lateral ventricular dilatation. Surgical correction resulted in prevention of brain shift and increase in meningocerebral cicatrices. Surgical complications included excessive blood loss, seizures, CSF leak and postoperative wound bulge.

Conclusions: There is a need of an early surgical intervention to halt and reverse neurological deterioration and psycho-social stability by correction of cosmetic deformity, however, the ischemic effects of initial trauma persists for a long time requiring long-term surveillance. Meticulous surgery and vigilant

post operative care reduces the morbidity and mortality.

0223

Relationships Between Neuropsychological Assessments And Locomotor Navigational Performance Following Moderate To Severe TBI.

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Objectives: Traumatic brain injury (TBI) results in persistent cognitive deficits. Recent work has shown relationships between performances on neuropsychological tests of visiospatial attention (particularly Trail Making Test B or TMT-B) and the control of foot clearance over an obstacle following moderate to severe TBI (1). The objective of the present study was to see if these indicators of visiospatial attention relate to more general locomotor navigational performance in complex environments involving obstacle circumvention.

Method: Eight persons with moderate to severe TBI (5 men, 3 woman; age, 39.9+/-18.1 y) were recruited from the Quebec Rehabilitation Institute and compared to a control group of 8 participants without neurologic problems (4 men, 4 woman; age, 39.3+/-9.1 y) recruited from the community. All subjects were tested for attention and executive functioning (D-KEFS Trail Making Tests, or TMT, and Color-Word Interference Test, or Stroop; Subtests of the Test of Everyday Attention, Symbol Digit modalities test or SDMT, CalCAP, PASAT, Digit/spatial span). In addition, subjects were studied while walking unobstructed or while circumventing a static or mobile obstacle, all with and without a simultaneous visual interference task (Stroop-interference). Gait was measured with a 3D motion analysis system. Voice recordings of the performance for the Stroop task were also performed. Outcome measurements were response errors, response reaction times (RRTs), maximal gait speed, clearance of the obstacle at crossing and clinical neuropsychological performances.

Results: The TBI group had slower maximal gait speeds overall than the control group along with greater clearance at obstacle crossing. The TBI group also showed greater errors and RRTs than

control subjects. The D-KEFS Trail Making Test 4 (comparable to the TMT-B) was found to be virtually unrelated to obstacle clearance in any the present environmental contexts. However, other tests (TMT1, Stroop4, SDMT) did show relationships, particularly for the TBI group only when walking without the Stroop task. There were no clear relationships between cognitive deficits noted by neuropsychological tests and performance of the Stroop task during the different locomotor navigational conditions.

Conclusions: The present results show that previous reports of ecological validity of D-KEFS TMT4 may be environmentally specific. Other tests of attention may have some relation to mobility performance in ecologically valid environments, but no one test appears to have a specific predictive ability as was seen previously for stepping over obstacles (1). These results may be related to the less constraining nature of the present environmental contexts and show the need to develop more direct, ecologically valid tests that are sensitive to the effects of cognitive dysfunction following TBI on community based activities of daily living such as mobility.

(1) Cantin et al. (2007) Brain Injury 21:327-34.

0224

Association of APOE Gene Polymorphism with the Change of Brain Function in the Early Stage of Aneurysmal Subarachnoid Hemorrhage

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Objectives: Recent studies have indicated that early brain injury may be responsible for the detrimental effects seen in patients after subarachnoid hemorrhage (SAH). In this study, we investigated the relationship between apolipoprotein E gene (APOE) polymorphism and the change of brain function in the early stage of aneurysmal SAH.

Method: A total of 79 patients admitted within 5 days after aneurysmal SAH were recruited in the study. Patient characteristics, such as age, gender, Fisher and Hunt-Hess grade were collected when admitted. Electroencephalogram (EEG) was recorded on admission and at 3~5 days after onset to assess the change of brain function of the patients in acute stage of SAH. The result of the second EEG recording was defined as EEG deterioration if the

decrease in alpha wave frequency, increase in slow wave or decline in amplitude were observed when compared with the first EEG recording. The APOE polymorphism was determined in all patients by polymerase chain reaction-restriction fragment length polymorphism (PCR-RFLP).

Results: Ten of 17 patients with APOE ϵ 4 (58.8%) showed the deteriorated EEGs, which was significantly different from those without APOE ϵ 4 (18 of 62 patients, 29.0%, $P=0.023$). However, neither the presence of ϵ 2 nor of ϵ 3 was significantly different from those absent of it ($P>0.05$). Univariate logistic regression analyses showed that both high Fisher grade ($P=0.028$, OR=2.917, 95% CI=1.124~7.572) and APOE ϵ 4 ($P=0.027$, OR=3.492, 95% CI=1.150~10.604) were risk factors to EEG aggravation after aneurysmal SAH. The association of APOE ϵ 4 for deteriorated EEG was more significant after adjustment for age, gender, Hunt-Hess grade on admission, and Fisher grade ($P=0.007$, OR=5.741, 95% CI=1.625~20.280).

Conclusions: Our findings suggest that APOE ϵ 4 allele is a risk factor to brain function aggravation in the early stage of aneurysmal SAH, and it may contribute to early brain injury after SAH.

0225

The influence of Transforming growth factor- β 1 and proinflammatory cytokines in the development of cerebral palsy

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Objectives: To investigate the value and significance of TGF- β 1 as a brain-protective cytokine and proinflammatory cytokines in the pathogenesis of cerebral palsy (CP).

Method: Serum samples of 55 CP children, 21 neonates with CP risk factors such as hypoxic-ischemic injury and/or perinatal infection, and 20 controls were obtained respectively and kept at -40°C until the time of measurement. Serum TGF- β 1 and TNF- α levels were measured by the enzyme-linked immunosorbent assay double sandwich method (ABC-ELISA) retrospectively.

Results: Serum TGF- β 1 Levels of neonates with CP risk factors were significantly higher than those of controls ($P<0.01$). Serum TGF- β 1 levels of CP children were significantly lower than those of controls, those of neonates with CP risk factors ($P<0.01$). Serum TNF- α levels in CP group and

neonatal patients group were significantly higher than in controls ($P<0.01$). Serum TNF- α levels in CP group were higher than in neonatal patients group ($P<0.05$).

Conclusions: Increased levels of TGF- β 1 is a instinctively protective reaction to brain injury in the central nervous system, and subsequently material conditions are accumulated in brain function reconstruction. Immune inflammatory responses mediated by proinflammatory cytokines gain the upper hand in brain injury against the brain-protective effect mediated by TGF- β 1. This may lead to CP through triggering the cascading effect of the neuro-immune-endocrine network.

Keywords: cerebral palsy, Transforming growth factor- β 1, inflammatory cytokine, TNF- α neuro-immune-endocrine-network.

0226

An animal model of sports-related concussion and chronic traumatic encephalopathy: The effects of repeated mild fluid percussion injury on behavior and neuropathology in the rat

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Objectives: Brain concussion is a serious public health concern, particularly in athletics. Due to the nature of contact sports, athletes are at risk of suffering concussion, and repeated concussions can often occur within short time periods. A single concussion is often associated with short-term cognitive impairment, potential long-term impairment, and increased vulnerability to additional concussion injuries. Studies examining the consequences of multiple concussions in humans have found both short- and long-term cognitive impairment and it has been suggested that concussion injury increases the risk of developing significant neurological diseases such as dementia, depression, chronic traumatic encephalopathy (CTE), and schizophrenia. Past studies examining traumatic brain injury in animals have modeled injury by using the fluid percussion injury technique. Initial studies from our laboratory examining the effects of a single mild fluid percussion injury (mFPI) in the rat have found behavioral and pathological changes consistent with those seen in humans suffering a single concussion. The current study investigated the effects of repeated mFPI in the rat in an attempt to model the multiple concussions experienced by athletes.

Method: Male Long-Evans rats received sham, one, three, or five mFPIs (1–1.5 atm). Each repeated injury was separated by 5 days. Following the final injury, rats received either an acute (24 hours) or chronic (8 weeks) recovery period. Following recovery, rats underwent a detailed behavioral analysis consisting of tests for cognition (water maze), anxiety (elevated plus maze), depression (forced swim task), social behavior (Ethovision social interaction test), and sensorimotor function (open field, beam task). All rats were sacrificed and brains were examined immunohistochemically at the end of the testing period.

Results: Results indicate that rats receiving one, three, and five injuries displayed significant acute impairments on measures of cognition compared to rats receiving sham injuries. Furthermore, rats receiving five injuries also displayed significant acute cognitive impairments compared to rats receiving a single injury. In addition, rats suffering five injuries displayed increased anxiety levels compared to sham-controls. Preliminary chronic findings suggest behavioral abnormalities associated with repeated mFPI on a number of behavioral tasks associated with repeated mFPI. Initial neuropathological findings indicate a widespread neuroinflammatory response and diffuse axonal injury in rats suffering repeated mFPI.

Conclusions: These behavioral and neuropathological findings are similar to the symptoms associated with multiple concussions and CTE. Overall the current study supports the use of repeated mFPI in the rat as a model of sports-related concussion and CTE. Additional behavioral and neuropathological analyses are currently ongoing.

0227

Olfaction assessment in university level football players: do the concussions affect olfactory performance?

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Objectives: It is know well documented that the detrimental effects of concussion still remain beyond the acute phase. At the same time, previous studies showed that some symptoms of an olfactory impairment can occur and persist following a traumatic brain injury in a non-athletic context. Thus, the aim of this study is to investigate if there is a relationship

between a sports concussion and the performance in an olfactory test.

Method: 21 athletes from a University football team were included in the study. Eleven of them suffered from one or more concussions, the reminder served as controls. Olfactory function was determined by means of the Sniffin' Sticks test, which allows for assessment of the ability to discriminate and identify odors as well as the detection threshold. The results of the three subtests were summed up to an aggregate score (TDI score). In addition, during the identification task, subjects were asked to rate intensity and pleasantness of the presented odorants.

Results: the number or severity of sustained concussions does not seem to be significantly related to the olfactory performance. However, we observed a negative correlation between time elapsed since the last concussion and both the identification score ($r [11] = -0.805$; $p = 0.003$) and the TDI score ($r [11] = -0.738$; $p = 0.01$). These results indicate that concussions have an increasingly negative impact on the sense of smell over time.

Conclusions: These preliminary data suggest that there is a long term effect of a concussion on olfactory function.

0228

Getting the best out of the executively challenged individual through adapted communication

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Objectives: Individuals with moderate or severe traumatic brain injury (TBI) are known to have cognitive and/or linguistic limitations affecting their social interactions. Executive function (EF) impairments are thought to underlie these problems. However conversational partners can also contribute to increasing or attenuating an individual's problems. Limited attention has been given to understanding how a skilled communication partner facilitates an individual's functioning. We hypothesized that expert therapists with TBI clients provide an opportunity to demonstrate this relationship. Objective: To investigate how an expert therapist (20 years of experience with TBI) adapted her conversation within the context of the administration of the IADL Profile (Bottari et al., 2009), an ecological observation-based measure of independence in instrumental activities of daily living

based on EF. More specifically, we documented therapist/TBI subject interactions that facilitated the subject's eventual planning and carrying out of a complex task that involved finding information about a long distance bus schedule.

Method: Two TBI subjects were selected from a pool of 100 subjects who participated in an earlier study on the IADL Profile because they represented subjects who required assistance or were dependent when planning the obtaining information task. Subject 1 was a 59 year old male, 18 months post severe TBI. Subject 2 was a 19 year old male, 3½ months post moderate TBI. A conversational analysis of verbatim transcriptions of video recordings of therapist/TBI subject interactions occurring within the context of the IADL assessment was completed. Segments of the interactions were identified and coded to reflect macro and microstructure events with QDA-Miner. C-Map representations of codes were used to analyze the therapist's behaviours i.e. type of assistance provided, signals preceding assistance, immediate impact on subject's behaviour. *Results:* Three major types of communicative behaviours were identified in the therapist's speech: 1-natural markers of basic conversational processes; 2-motivational supports; 3-hierarchical assistance for planning (context reminders, task-specific instruction reminders, and hints on task specific steps). The therapist demonstrated undivided attention to subjects' verbal/non-verbal signals for assistance and kept both subjects engaged in the complex task (20 and 32 minutes) with the subtle use of previously described communicative behaviours. Communicative behaviours were adapted to each individual subject's signals (related to their cognitive profiles). Most hints were formulated as questions, appealed to the subject's competence and built upon previously expressed ideas. Explicit hints occurred later in the interaction after the therapist had offered many less explicit hints and opportunities for independent planning.

Conclusions: This study describes the elaborate process of adapting one's communication to match an individual's cognitive limitations. In both cases, subjects were eventually able to execute their plans, providing evidence of their residual competence.

0229

Should we be concerned about driving after a mild traumatic brain injury?

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Objectives: Mild traumatic brain injury (mTBI) is a major public health problem disproportionately affecting young adults. Abnormal neuropsychological profiles frequently associated with persistent symptoms include deficits in working memory, attention, information processing speed, and integrative tasks where executive functions (EF) are needed. However, little is known about the impact of these cognitive changes on driving ability despite the importance of this complex and cognitively demanding everyday activity. *Objectives:* This pilot study aims at investigating the impact of mild TBI on driving ability. Our objectives are: 1) to compare a group of mTBI who report difficulties with driving (D) on the ADL Profile Interview (Dutil et al., 2005) to a group who do not (WD); 2) to document whether neurophysiological or neuropsychological differences exist between these two groups.

Method: Twenty eight participants with symptomatic mTBI who resumed driving shortly after their injury were assessed with the Post Concussive Symptoms (PCS) scale, neuropsychological tests of EF, event related potentials (ERP) and the ADL Profile Interview. In addition, semi-structured interviews were conducted to obtain information on participants' perception of the impact of their trauma on driving performance (difficulties impacting driving, strategies used to compensate perceived cognitive difficulties). T-tests were calculated to compare the means of each variable for both groups.

Results: Sixteen participants reported difficulties driving and 12 reported no difficulties. Participants who reported difficulties driving tended towards being slightly younger (mean age D = 29.69 + 8.76; mean age WD = 36.75 + 11.80, $p = 0.08$) and more symptomatic according to the PCS scale (mean D = 48.13 + 20.40; mean WD = 34.58 + 18.74, $p = 0.08$) than the group without difficulties. Participants who reported driving difficulties showed significantly slower visual information processing as measured with the ERP method (latency of the N200 component) ($p = 0.029$) and poorer visual spatial memory on the Weschler Memory Scale III ($p = 0.017$). Participants with driving difficulties reported significantly more problems with vision, balance, memory, organization and respecting their limits on the ADL Profile Interview. In addition, a significantly higher impact on activities of daily living was reported for fatigue and concentration for this group of subjects. Overall, participants reported feeling safe while driving, but many had adapted their driving by incorporating compensatory strategies such as avoiding night time driving, long distances, and traffic. Some participants reduced their average speed of displacement and increased their distance from other vehicles.

Conclusions: To our knowledge, this is the first time that a link between objective neurophysiological/neuropsychological measures of areas fundamental to safe driving and self-reported driving difficulties has been demonstrated. Despite the small sample, this pilot study suggests a need for further investigation on potential driving difficulties and safety issues particularly in symptomatic mTBI.

0230

Cognitive consequences of the treatment of medulloblastoma among children

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Objectives: Progress in the treatment of medulloblastoma has resulted in an increased rate of survival among children. Yet, the effectiveness of radiation therapy was found to have negative consequences on the cognitive development of children. The determination of the factors underlying intellectual decline has been a matter of concern as it may influence the type of rehabilitation needed. In this study, we focus on the explanation of the cognitive decline and concentrate on the controversy between the complex attention model and the processing speed model.

Method: Six children aged between 4 and 11 years diagnosed with medulloblastoma were selected. The tumor was localized in the cerebellum in three cases, in the right frontal lobe in one case, around the fourth ventricle in one case and in the parietal/occipital lobe in one case. The tumor was radically operated in four cases. All children were treated with chemotherapy and radiation therapy according to standard protocol.

The children were assessed with the Wechsler Intelligence Scale for Children on two occasions. The mean age at diagnosis was 7 years (range 4–11 years). The first assessment was carried out at the mean age of 10 years (range 8–12 years) and the second at the mean age of 12 years (range 11–14 years), which means that the first investigation was carried out 3 years and the second 5 years after diagnosis.

Results: A raw score analysis of twelve subtests was performed showing deficits in verbal ability, visual organization, numerical ability, social perception and visual motor coordination. The difference between the first and the second assessments show a stronger cognitive decline than previous studies.

The verbal IQ decreases >6 points per year ($p < 0,05$) from an already low level (77,0 IQ points). The full scale IQ shows a decrease with 6 points per year ($p < 0,05$) from an extremely low level (54,0 IQ points).

Only one of the four factors exhibit a significant decline compared to the pre-station of the reference group, the PO (Perceptual Organization). Two factors show a decline which is not significant, the VC (Verbal Comprehension), and the PS (Processing Speed). One factor, the FD (Freedom from Distractibility), a measure of attentional ability, shows a development comparable to the norm group.

The children in our sample make progress comparable to same-aged children on measures of attention (digit span), memory (picture completion), speed (symbol search) and non-verbal concept formation (block design), which means that these factors cannot be invoked as underlying the low IQ levels.

Conclusions: These results indicate that the cognitive decline shown by the IQ data yields primarily the children's visuospatial and verbal abilities as well as processing speed, but not their attentional capacity.

0231

An overview of attention deficits and it's assessment after paediatric traumatic brain injury.

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Objectives: Attention could be seen as a function supporting higher cognitive thinking, learning and problem solving. There is no agreed upon definition of the structure of attention. One way to explore the structure of attention is to use factor analysis including Focus/selective attention, sustained attention, Shifting attention and Encode/attention Span. Less established is the divided attention factor, but it seems to have an important impact in the child TBI population. Factor analyses have also identified a Speed of processing factor that influences all attention measures where the time factor is important. In this review we wanted to evaluate the type of attention deficits that occur after pediatric traumatic brain injury and to explore the ability of the attention tests used to detect deficits in the traumatic brain injured children.

Method: Keywords as attention, child, traumatic, brain, injury from MEDLINE articles published 1991–2009 were used and those articles were manually cross-referenced.

Results: Sustained attention showed the largest difference in performance between the TBI groups in the acute phase, but this gap narrowed during the first year post injury due to a rapid recovery in the severe TBI group. The studies on the Selective/focused attention factor presented disparate results. There are also five different tests used for measuring selective attention and it could be that they are not directly tapping the same underlying construct that explains these findings. The group differences were largest at the acute state and decreased during the following year. The studies of the Shifting attention factor reported few significant differences. This indicates that this factor is less prone to deficits after TBI. The Divided attention factor showed the most consistent association between injury severity and performance. The tests measuring divided attention seem to be the highly sensitive for detecting deficits in the attention domain. The Attention span/encode factor presented ambiguous results depending on the tests used. On the auditory and visual span tests from the Wechsler scales did the large majority of studies not show any significant difference between TBI groups at all, and children with severe TBI did even repeatedly perform in the normal range. The other type of span test used seems to be more complex, or rely on word or sentences. These tests were very sensitive for detecting attention span-working memory deficits. Finding significant attention span deficits therefore seems to be highly dependent on the tests used.

Conclusions: There is ample evidence that traumatic brain injury leads to diminished attentional performance and that the extent and nature of these problems are related to the specific attentional domain. The attention subtest of the Wechsler scales seem to be least likely to identify problems in attention in children with TBI.

0232

The Impact Of Caring For A Child With An Acquired Brain Injury On Care-Giving Members Of A Family.

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Objectives: This research explores the types of impacts that care-giving family members experience as a result of caring for a child with an acquired brain injury (ABI). It looks specifically at impacts at least three years post injury and is located within a population that has received rehabilitative services via the Victorian Paediatric Rehabilitation Service (VPRS) at The Royal Children's Hospital (RCH), Melbourne Australia.

Following an ABI to a child, family members with a care-giving role are inevitably affected. Care-givers are required to manage their own response to the often traumatic event that lead to their child's injury, the significant changes to the child as they were pre-injury, and the ongoing demands that caring for a child with an ABI requires. There is a potential to experience increased levels of stress and burden across many areas of family functioning. Recovery is often unpredictable and changes to the child can continue to occur throughout the child's life.

Method: Care-givers from 75 families who were at least three years post discharge from the VPRS at the RCH were recruited to complete the Impact on Family scale (IOF), a demographic survey and the question 'is there anything else you would like to say about the impact of your child's injury on your family?' The IOF is a qualitative scale that measures care-giver stress and burden across various domains of family life. These domains include financial, social, familial relationships, siblings and mastery. Recruitment was completed via a mail out and data was analysed according to common trends and themes amongst the participants.

Results: Preliminary data indicates that care-giving family members experience stress and burden across various life domains at three and more years post discharge from a paediatric rehabilitative setting.

Conclusions: It is known that care-giving family members continue to experience stress and burden associated with paediatric ABI for undefined periods of time post injury. This research provides evidence as to the types of impacts experienced at least 3 years post injury.

0234

Longitudinal Investigation of Emotion Recognition after Early Childhood Traumatic Brain Injury

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Objectives: A growing body of literature has documented evidence for emotion recognition (ER) deficits after traumatic brain injury (TBI). There is limited data on the long-term effects of TBI on ER abilities, particularly with young children who are undergoing rapid brain maturation and development of cognitive abilities.

Method: We investigated emotion recognition abilities in 82 children with orthopedic injuries (OI) and 54 children with TBI (18 severe, 13 moderate, and 23 complicated mild) shortly after injury and at 18-months post-injury. Children were recruited from four tertiary care hospitals in the Mid-Western US. All children were between 3–0 and 6–11 years of age and hospitalized overnight for a traumatic injury. Emotion recognition was measured using the Diagnostic Assessment of Nonverbal Accuracy (DANVA-2; Nowicki, 2003). Overall emotion recognition accuracy (percent correct) and mislabeling errors of each of the four basic emotions (happy, sad, angry, and fearful) were calculated. The Differential Abilities Scale, General Conceptual Ability index (DAS:GCA), obtained shortly after injury, provided a measure of overall cognitive ability.

Results: After controlling for age at injury and DAS:GCA, GLM analyses revealed no significant acute group differences on indices of emotion recognition ability. However, at 18-month assessment, significant group differences emerged for overall emotion recognition ability ($F[3,130]=3.17$, $p < 0.05$), with poorest performance by the moderate TBI group. Moderate and severe TBI groups also demonstrated a tendency to mislabel facial expressions as fearful more often than the complicated-mild TBI and OI groups ($F[3,130]=3.67$, $p < 0.05$).

Conclusions: These results provide preliminary evidence of emerging emotion recognition deficits after early childhood TBI that are related to injury severity.

0235

Responses to a Survey on Changes in Writing Ability After Brain Injury: Considerations for the Forensic Document Examiner

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Objectives: When examining writing to determine whether an individual penned a questioned signature or body of text, the Forensic Document Examiner must consider whether a subject was capable of executing the writing in question based on the skills exhibited in writing samples provided for comparison. Involuntary changes in written expression are of relevance in cases of disputed legal documents, financial transactions, and other matters that may be brought to the Forensic Document Examiner for resolution. The Document Examiner must understand that an individual's writing may look different before, just after, and long after sustaining a brain injury, and should take these factors into consideration when rendering an opinion. This research was conducted to gain an understanding of how brain injury can affect an individual's written expression with respect to penmanship, spelling, syntax, sentence-building, and narrative construction.

Method: Online survey software was used to create a ten-question survey that was sent to brain injury support groups in the United States, Canada, and other English-speaking countries overseas. Printed copies of the survey and return postage were sent to individuals and support group coordinators upon request. In the survey, participants were asked their gender, age, age at time of injury, means and severity of injury, whether they sustained an open or closed head injury, and whether their ability to write was affected. Five of the multiple choice questions provided comment fields in which participants could say more in their own words about the severity, events leading to, and impact of their brain injury.

Results: 100 persons with brain injury and 7 caregivers responded to the survey, for a total of 107 participants. 74 participants (69.2%) reported a change in writing ability as a result of brain injury. 65 participants entered comments describing the changes they currently experience or experienced in the past. Several post-injury changes of particular significance to the Document Examiner are stated below, followed by the number of persons who reported them:

Sloppier writing (19); difficulties with spelling, grammar, sentence construction, or putting thoughts into writing (10, 5, 4, and 9, respectively); a temporary or permanent change in handedness (8); poor handwriting that improved over time (9); slow writing speed (7); impaired vision (5); impaired fine motor skills (5); tremor (4); poorer handwriting when stressed or fatigued (3); and micrographia (2).

Conclusions: The survey results reveal a number of post-injury changes that are of significance to the Forensic Document Examiner; persons with brain injury may have difficulty putting thoughts into writing and may experience changes in penmanship,

spelling, grammar, or sentence-building skills. Further study of writing samples from brain-injured persons using a longitudinal approach is recommended. The contributions of attentional and short-term memory deficits, impaired vision, and other impairments are additional considerations requiring further study.

0236

Improving Rehabilitation through Patient-centered, Contextually-relevant Assessment and Care

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Objectives: Traditional rehabilitation of persons with neurological injuries emphasizes remediation of injury-related impairments with the goal of improving functional independence. However, effectiveness of impairment-focused rehabilitation is a source of debate. An alternative approach focuses on everyday skills that the individual undergoing rehabilitation needs to be able to demonstrate. This approach, patient-centered and contextually-relevant rehabilitation, uses the individual's ultimate treatment goal in the current setting, rather than his or her impairment per se, to guide the development of rehabilitative interventions.

For example, impairment-focused rehabilitation of a patient with difficulties remembering information might, in the therapist's office, emphasize worksheet-based exercises or repetition of words. Although this approach may assist with list-learning, this task is unlike the type or context of tasks performed in everyday life. Therefore, generalization of this discrete task to real-life is unlikely and superfluous.

By contrast, a patient-centered and contextually-relevant approach uses a patient's ultimate goal in the present setting (i.e., discharge from acute rehabilitation) to guide assessment and shape treatment tasks. For example, in order to discharge from the acute rehabilitation setting, a patient may need transfer independently. To that end, speech therapy assists the patient in organizing, writing down, and learning transfer steps which allows physical therapy to focus on practicing the steps. By appropriately contextualizing rehabilitative intervention, personally salient tasks and goals can be identified, appropriate and relevant compensatory

strategies can be designed, and patients and family members can be educated in direct, functional, and personally-oriented approaches, all of which foster collaboration and improved satisfaction with care.

Method: Literature review resulting in presentation or poster.

Results: See below.

Conclusions: Patient-centered and contextually-relevant neurorehabilitation is intuitive and would seem relatively straightforward to implement. However, the traditional focus of rehabilitation on impairment rather than function leaves many professionals unprepared to perform the types of assessments and interventions needed to develop a functionally-based treatment plan.

0237

New In Vitro Model Of Experimental Traumatic Brain Injury: Evaluation Effects Of APOE Subtype And Early Cell Apoptosis

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Objectives: Traumatic brain injury (TBI) is a significant public health and socioeconomic problem worldwide. In humans, apoE is the polymorphic protein, with three common isoforms (apoE2, E3, E4), encoded by three alleles (ϵ 2, ϵ 3, ϵ 4). APOE gene has become one of the most extensive studied genes in neurotrauma research. However, the precise molecular mechanism remains controversial. In vitro models of traumatic injury are useful adjuncts to animal models for studying mechanisms of post-traumatic cell death.

Method:

- (1) Human apoE cDNA clone for the E3 isoform was obtained in our previous work. Site-directed mutagenesis was used to obtain the cDNA encoding apoE2 and apoE4 isoforms. Cultivation and purification of the primary NSCs from rat embryo pallium of APOE knock-out mice were performed. Recombinant plasmid was transfected into NSCs with Lipofectamine 2000.

- (2) Construct and identify new in vitro model carrying human APOE genotype: The 2nd generation NSCs carrying human APOE isoform were inoculated into 6 shadow mask, and differentiated after 2d adherent culture using optimized culture condition to establish the neuron/glial co-culture system. Mechanical injury was produced with a plastic tip fixed on the special device crossing onto the cultured cells. Annexin V/PI flow cytometry was used to analyze the relationship between APOE genotype and early cell apoptosis.

Results: The mechanical injury cell model was established successfully on neuronal/glial co-culture system. Early cell apoptosis after injury were identified in all cell groups with or without APOE genotype. Early cell apoptosis rate at 24h were higher than 6h and 12h ($p < 0.05$) in each group. APOE ϵ 4 group and rat APOE(\sim) group showed severe early cell apoptosis at 24h which were statistically different in early cell apoptosis rate from another groups (rat APOE(+), human APOE ϵ 2 group and human APOE ϵ 3 group) ($p < 0.05$).

Conclusions: This model appears to be well-suited for the study of selected mechanisms of post-traumatic neuronal injury which carrying different APOE genotype.

0238

Recovery From Severe TBI Utilizing Unconventional Therapies

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Objectives: Introduction: No protocol care like Advanced Cardiac Life Support, Advanced Trauma Life Support, or Advanced Burn Life Support programs exist for traumatic brain injuries. As medical professionals, the traumatic brain injury suffered by our daughter thrust us into a world of chaos and uncertainty. The purpose of this presentation is to utilize a case study to elucidate concepts and principles for the care of TBI patients aimed at both families and health care providers.

Method: Case Study: This 18 year old female was thrown from a motorcycle resulting in left occipital

impact trauma, right frontal contra coup brain injury, and a basilar skull fracture. CT scan demonstrated a severe midline shift and evidence of brain-stem shearing. Her Glasgow Coma Score was 3, and she underwent emergent craniotomy for a subdural hematoma. This was followed by days of high intracranial pressures, ventilator support, 4 months in a coma, and months of inpatient rehabilitation. This was the beginning of the journey from coma to community.

Results: Treatment and Results: Many methods of treatment were undertaken without or against standard medical recommendation. Aggressive rehabilitation started from day one by a family unwilling to accept the "she will never walk or talk again" prognosis. Repetitious limb ranging, music and conversational stimulation, and constant verbal as well as tactile reassurance were instituted. A BIS monitor was used to evaluate consciousness while still in a coma. Transfer to a neuro-rehabilitation facility 1500 miles away was arranged instead of placement in a recommended nursing home. Inpatient rehabilitation was extremely aggressive including pharmacological therapy, early removal of all catheters, and limb restraint therapy. Subliminal suggestion, botulinum toxin muscle injections, serial casting, passive harness ambulation, and daily neuropsychology modalities were employed. Subsequent outpatient therapy included persistent intellectual stimulation; speech, exercise and progressive physical therapy; agonist/antagonist electrical muscle stimulation, and accelerated ambulation without assistance. All rehabilitation modalities available have been used and any potentially effective therapies continue to be explored.

Conclusions: No standardized protocol has been developed for these patients, and treatment has changed little for TBI injuries over the last 30 years. No negative attitude should be tolerated and every potentially beneficial modality should be employed for maximal recovery. Unconventional approaches should be explored for TBI patients and implemented when found to be successful. More research for TBI treatment and rehabilitation should be undertaken. Advanced protocols for treatment of TBI patient should be developed and instituted. The TBI patient is not a dispensable person. This case study is intended to illustrate, for families and medical personnel, that recovery from severe traumatic brain injury can be achieved with an indefatigable spirit, maximal effort to gain full recovery, and a willingness to utilize any therapeutic modality available for treatment.

0239

Comparing Model Performance for Outcome Prediction Using Total GCS and Its Components in Traumatic Brain Injury

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Objectives: To analyse the prognostic power of various GCS components and combinations of components in traumatic brain injury patients and to investigate which time point of GCS measurement (at scene versus on admission to the Emergency Department (ED)) has more prognostic strength.

Method: Records of patients with brain injury since 1989 were extracted from the Trauma Audit and Research Network (TARN) database. Using logistic regression, a baseline model was derived with age and Injury Severity Score (ISS) as regressors and discharge outcome (survival) as the dependent variable. Total GCS, its components and their combinations were separately added to the baseline model in order to compare their effect on model performance.

Results: 21454 cases with brain injury were analysed. The eye subscore has significantly lower performance compared to total GCS, motor score and various combinations of GCS subscores [e.g. eye subscore: AUC of 0.89 (95% CI: 0.89–0.90) and Nagelkerke R² of 0.53, total GCS: AUC of 0.91(95% CI: 0.91–0.92) and Nagelkerke R² of 0.58]. The total GCS and the motor subscore have the same predictive strength. Furthermore, the total GCS score at scene and its components hold significantly lower predictive power as compared to those recorded on arrival at ED [scene total GCS: AUC: 0.89(95% CI: 0.89–0.90) and Nagelkerke R² of 0.54, arrival total GCS: AUC of 0.91(95% CI: 0.91–0.92) and Nagelkerke R² of 0.58].

Conclusions: Significantly lower predicative performance of the eye subscore may indicate the need for a surrogate scale when collection of both motor and verbal response is not reliable due to paralysis and intubation. Further, better predicative strength of admission scores than scene scores may be due to less accurate measurement of GCS at scene. This highlights the importance of initiatives to improve GCS collection at scene since GCS affects critical

decisions as to field endotracheal intubation or triage for referral to the trauma centres.

0240

Beneficial effect of porous biodegradable collagen-glycosaminoglycan matrix on promoting of neuronal regeneration and functional recovery through a mechanism of autophagy after surgically-induced brain injury

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Objectives: Surgical brain injury (SBI) is unavoidable during many neurosurgical procedures intrinsically linked to postoperative neurological deficits. To date, SBI resulting from neurosurgical interventions is not well treated or covered under neuroprotective regimen. Tissue engineering scaffolds have several potential advantages for the repair of injured neural parenchyma and are used extensively as analogs of the extracellular matrix. The purpose of this study was to evaluate the effect of collagen-glycosaminoglycan (GAG) matrix scaffolds in a rat model of SBI. **Method:** A rodent model of SBI was used which involves resection of a part of the right frontal lobe. Sprague-Dawley male rats (weight, 300–350 g) were randomly divided into three groups: 1. Sham 2. SBI 3. SBI with collagen-GAG matrix implantation. Postoperative evaluations of functional recovery were performed and animals were then sacrificed for histological immunohistochemical staining as well as gene and protein expression of autophagy-related proteins and HO-1 at various time periods (1, 4, 7, 14, 21, 28 days).

Results: Preliminary studies on the animal model revealed localized edema around the operative site, i.e. SBI region. We also found significant survival and migration of neurons but not astrocytes, and was accompanied by functional improvement as early as 7th day after collagen-GAG matrix implantation immediately following SBI. Autophagy is a regulated cellular degradation process responsible for the turnover of long-lived proteins and organelles. Although autophagy is mostly regarded as a

stress-induced process, recent studies have indicated that it is constitutively active in CNS neurons and is protective against neurodegeneration. We also observed SBI-induced autophagy in injured brain regions. Implantation of collagen-GAG matrix enhanced the autophagy in a time-dependent manner after SBI. Relative protein levels of heme oxygenase-1 (HO-1) in injured brain regions increased time-dependently after SBI and reached the maximum at 14 days, while mRNA level of HO-1 peaked at 24 hr. Collagen-GAG matrix implantation also Current studies are undergoing to examine the expression of several other proteins involved in apoptosis, inflammatory, and oxidative stress in injured tissue in order to delineate the mechanism underlying the protective effects of collagen-GAG matrix implantation against SBI.

Conclusions: Our results indicate that the porous biodegradable collagen-GAG on promotes neuronal regeneration and functional recovery and offers a potential therapeutic approach for SBI with these tissue engineering scaffolds.

0241

Comparing the Prognostic Performance of S100B with Prognostic Models in Traumatic Brain Injury

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Objectives: There are currently two prognostic tools available to predict outcome in traumatic brain injury (TBI); these being prognostic models which combine clinicodemographic characteristics of patients for outcome prediction and serum brain injury biomarkers. S100B is a widely-acknowledged biomarker of brain injury.

Objective: To identify which tool has better prognostic strength and also to identify how combination of these tools would improve the prognostic strength.

Method: A dataset of 100 TBI patients all admitted to the intensive care unit with their venous S100B level recorded at 24-hour after injury was analysed. TBI prognostic models A and B constructed in Trauma Audit and Research Network (TARN) [1] were run on the dataset and then S100B was added as an independent predictor to each model. Similarly, another model was developed containing

only S100B and then prognostic variables from TARN A and B models along with those found significant on univariate analysis (such as compressed cisterns) were added to assess their ability to add to the predictive power of S100B. The outcome measures were survival and favourable outcome at three months.

Results: Among all the prognostic variables (including age, cause of injury, GCS, pupillary reactivity, Injury Severity Score (ISS) and CT classifications); S100B has the highest predictive strength on multivariate analysis. No difference between performance of prognostic models or S100B in isolation is observed. Addition of S100B to the prognostic models improves the performance (e.g. Area Under the roc Curve (AUC), R2 Nagelkerke and classification accuracy of TARN model A to predict survival increase from 0.64, 0.08 and 71% to 0.72, 0.20 and 74.7% respectively). Similarly, the predictive power of S100B increases by adding other predictors to S100B (e.g. AUC (0.69 versus 0.78), R2 Nagelkerke (0.15 versus 0.30) and classification accuracy (73% versus 77%) for survival prediction).

Conclusions: S100B appears to be the strongest prognostic variable in TBI. A better prognostic tool than those which are currently available may be a model which contains S100B with 1 or 2 other TBI prognostic variables.

- (1) Lesko MM, Bouamra O, Jenks T, Woodford M, Lecky F: Models of mortality probability in severe traumatic brain injury. *Injury Extra* 2009, 40:212–212.

0242

Models of Mortality Probability in Severe Traumatic Brain Injury: Results of TARN Modelling

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Objectives: Background

Prognostic models in traumatic brain injury (TBI) are employed to design clinical trials, to assess/compare trauma care systems and to adjust trauma care for an individual patient. The current available

prognostic models are either old (the IMPACT models) [1] or derived from non-homogenous datasets in terms of the trauma care delivered (the CRASH models) [2].

Objective: To construct prognostic models to predict outcome in TBI.

Method: Records of patients with brain injury since January 2005 were extracted from the Trauma Audit and Research Network (TARN) database. TARN holds the records of patients with severe injuries i.e. longer than 3 days stay at hospital, inter-hospital transfer, critical care in hospital or death. Following a literature review, the covariates age, cause of injury, GCS, pupillary reactivity, Injury Severity Score (ISS), CT classifications, systolic and mean blood pressure, hypoxia and the presence of extracranial injury were tested with survival at discharge as outcome. Covariates with no significant correlation on univariate analysis were excluded. Stepwise logistic regression analysis was performed with split sampling for internal validation.

Results: Two models were derived on 802 patients with significant brain injury (models A and B). Age, GCS, pupillary reactivity, hypoxia and brain stem haemorrhage are significant predictors in both. However, model A contains ISS and brain swelling in contrast to model B with the presence of cause of injury and major extracranial injury i.e. AIS > 3 instead. Both models have high predictive performance (Model A; Area Under the ROC Curve (AUC) = 0.92 (95% CI: 0.89–0.94), R2 Nagelkerke: 0.61 and HL test: P value = 0.32, Model B; AUC = 0.93 (0.90–0.95), R2 Nagelkerke: 0.63 and HL test: P value = 0.29).

Conclusions: We have developed two prognostic models applicable to the patients hospitalised after traumatic brain injury using a recent homogenous dataset.

- (1) Steyerberg EW, Mushkudiani N, Perel P, Butcher I, Lu J, McHugh GS, Murray GD, Marmarou A, Roberts I, Habbema JD, Maas AI: Predicting outcome after traumatic brain injury: development and international validation of prognostic scores based on admission characteristics. *PLoS Med* 2008, 5:e165; discussion e165.
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0243

A recent dataset of traumatic brain injury demonstrates that brain swelling and brain stem injury are the only significant predictors of outcome among various Computed Tomography (CT) findings

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Objectives: Various CT findings in Traumatic Brain Injury (TBI) can potentially help to make predictions on outcome. CT findings can be categorised using the Marshal Classification or the AIS dictionary or can be described through traditional terms referring to the type/subtype of injury such as contusion, Subarachnoid Haemorrhage (SAH), Subdural Haemorrhage (SDH), Epidural Haemorrhage (EPH) etc.

Objective: To determine which CT classifications and types/subtypes of brain injury are more valuable for outcome prediction following TBI.

Method: A dataset of TBI patients in the Trauma Audit and Research Network (TARN) comprising 801 cases was analysed using logistic regression. All cases were submitted to TARN following September 2005. Initially the reference models were constructed with age, Glasgow Coma Scale (GCS), pupillary reactivity, Injury Severity Score (ISS), cause of injury and presence/absence of extracranial injury as predictors and survival at discharge as outcome. Subsequently, various CT classifications (the Marshal Class and Abbreviated Injury Scale (AIS) scores) and traditional descriptive findings such as SAH, contusion etc. were added to assess the improvement in the predictive performance of the models and also to assess the relative predictive strength of each CT class and feature.

Results: Adding each classification to the prognostic models results in equal increase in the predictive performance (Area Under the Roc Curve (AUC) increases from 0.91 to 0.92). However, various AIS scores or Marshal Classes do not appear to significantly affect the outcome. Among traditional descriptive terms, only brain stem injury and brain swelling hold a significant influence on outcome (odds ratios: 0.17 (95% CI: 0.07–0.37) and 0.47 (95% CI: 0.28–0.77) respectively). Neither haemorrhage nor its subtypes such as SAH, SDH, and EPH are significantly associated with outcome.

Conclusions: Neither common classification systems of CT findings are reliably discriminative for predictive purposes. The significant effect of brain swelling and brain stem injury on outcome in comparison to injuries such as SAH suggests the necessity of improvement in therapeutic approaches to patients who have sustained these injuries.

0244

Effect Of Neuroprotective Therapies (Hypothermia And Cyclosporine A) In Apoptotic Neuronal Death In An In Vitro Neuronal Model

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Objectives: Hypothermia and Cyclosporine A (CyA) have been proposed as neuroprotective agents after traumatic brain injury. Neuroprotective effects of both therapies are produced by multifactorial mechanisms that include modulation of apoptotic cell death by preservation of mitochondrial function and integrity. We aimed to evaluate the effect of hypothermia and CyA on neuronal survival after induced injury in a neuronal model.

Method: Dopamine, an oxidant that induces cytotoxicity in human-derived neuronal cells was used as apoptotic stimuli. Undifferentiated human neuroblastoma SH-SY5Y cells were seeded at 1×10^5 in 1 ml of DMEM on plastic 12-well plates and allowed to grow for 72 hrs until monolayer. To determine whether lower temperatures protect from dopamine-induced apoptosis, cells were treated with dopamine at 100 and 300 μ M or medium alone and incubated at 32°C or 37°C for 24 hrs. To assess the effect of CyA, cells were pre-incubated with 1 or 10 μ M CyA. After 2 or 6 hrs incubation at 37°C, 100 μ M dopamine was added. Apoptosis was assessed by TUNEL assay. Experiments were run in triplicate.

Results: After 24 hrs of incubation at 37°C, 100 μ M and 300 μ M dopamine induced $42\% \pm 21\%$ and $58\% \pm 7.9\%$ apoptotic SH-SY5Y cells, respectively. In cultures at 32°C dopamine-induced apoptosis could be reversed by hypothermia ($7 \pm 1.4\%$ and $3.45 \pm 1.1\%$ for 100 μ M and 300 μ M, respectively), similar to levels obtained in non-treated cells

($2.4 \pm 1.5\%$). Cyclosporine A treatment did not render the expected result, since CyA-pretreated cells SH-SY5Y cells showed higher levels of apoptosis than those observed with dopamine alone (see table).

2 hrs (mean \pm SD) 6 hrs (mean \pm SD)

Dopamine 100 μ M $48,3 \pm 11,1\%$ $42,5 \pm 11,9\%$

CyA 1 μ M $12,0 \pm 4,4\%$ $15 \pm 5,2\%$

CyA 1 μ M + Dopamine 100 μ M $74,2 \pm 10,0\%$ $83,5 \pm 4,8\%$

CyA 10 μ M $15,5 \pm 10,1\%$ $19,2 \pm 5,6\%$

CyA 10 μ M + Dopamine 100 μ M $76,0 \pm 4,0\%$ $87,8 \pm 6,5\%$

Conclusions: These results show that hypothermia has a marked protecting effect against apoptotic cell death induced by dopamine in a human neuroblastoma cell line. The neuroprotective effect of CyA described with other apoptotic cell death stimuli was not demonstrated with our experimental conditions. These results could help to elucidate the yet unclear mechanism underlying the dopamine-induced neuronal cytotoxicity.

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0245

Relationships between partners after acquired brain injury

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Objectives: The consequences of an acquired brain injury (ABI) also affect the partner and their relationship. Many studies have shown an increase in rates of separation and divorce. It is therefore important to understand the factors that influence relationships after ABI. This pilot study used qualitative methodology to investigate these factors, and unlike most other studies it included not only people with ABI but also their partners.

Method: The subjects in this study were 10 adults under the age of 65 who had previously been treated by a post-acute NHS brain injury rehabilitation service in Scotland during the period 2000–05, as an inpatient and/or an outpatient, as well as their uninjured partners. All 10 couples had been in a stable relationship together since before the ABI. The study utilised the Golombok-Rust Inventory of Marital Satisfaction (GRIMS), a validated instrument that comprises 28 items relevant to

relationships, to obtain each person's view of their relationship. Semi-structured interviews with each brain injured subject and partner then explored how each felt the relationship had changed, and identified the positive and negative factors that had influenced this. All subjects were fully able to complete a questionnaire and to take part in an interview.

Results: Marital dissatisfaction was higher in the partner than the person with ABI in five couples (50%), lower in the partner in two couples (20%), and no different between them in three couples (30%). The factors influencing relationships that couples raised at interview were in keeping with their individual GRIMS scores.

Conclusions: This pilot study highlights factors which couples feel have influenced their relationship after ABI, confirms the usefulness of the GRIMS tool for studying this, and points to a number of areas that require further investigation: communication strategies, the impact of family support, and changes in the relationship over time.

0246

The study of comparing and evaluating the effect of thrombolysis through artery using urokinase at different time window on protecting brain against injury in rats with thrombus-occluded cerebral ischemia

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Objectives: To compare and evaluate the effects of urokinase thrombolysis therapy using at different time through internal carotid artery on the protection of brain from injury in rats with thrombus-occluded cerebral ischemia, and then to find the relatively exact time window for thrombolysis therapy through artery after cerebral infarction.

Method: The study was performed in 130 male Sprague-Dawley rats which were randomly divided into sham-operated, model and urokinase three groups. Rats thrombus-occluded cerebral ischemia model was duplicated by autologous blood clot combined with inserted nylon thread. Rats were administrated with urokinase thrombolysis therapy through internal carotid artery at 3, 6, and 9 h after cerebral infarction. At 24 h of administration of

urokinase thrombolysis through artery (5000U/kg), rats neural symptoms evaluating scores (NSES) were examined according to the standard of score evaluation, then took rats brain and observed brain pathologic changes using light microscope. Rats water ratio (BWR) and cerebral infarction size (CIS) were measured, as well as rats the calculation of intracranial hemorrhage ratio (ICHR) and fatality.

Results: NSES of rats in 3 h (4.63 ± 1.06, P < 0.01), 6 h (5.25 ± 1.03, P < 0.01) and 9 h (6.00 ± 0.53, P < 0.01) groups were different after cerebral infarction injury, which were all higher than that in sham-operated group. Rats BWR in 3 h (84.32 ± 2.14, P < 0.01), 6 h (85.93 ± 1.42, P < 0.01) and 9 h (86.71 ± 2.09, P < 0.01) model groups all increased in comparison with that in rats of sham-operated group (74.10 ± 1.22). Rats CIS in 3 h (32.86 ± 0.48, P < 0.01), 6 h (34.99 ± 1.04, P < 0.01) and 9 h (38.95 ± 2.35, P < 0.01) model groups increased significantly, as well as the exacerbation of rats brain pathologic injury degree after cerebral infarction. In rats of thrombolysis groups, NSES were all lower in 3 h (2.50 ± 0.75, P < 0.01), 6 h (3.00 ± 0.75, P < 0.01) and 9 h (4.38 ± 0.51, P < 0.01) than that of rats in their corresponding model groups respectively. Rats BWR and CIS in 3 h (79.32 ± 1.64, 24.18 ± 1.13), 6 h (81.09 ± 1.42, 28.93 ± 0.47) and 9 h (83.47 ± 2.05, 30.98 ± 1.63) thrombolysis groups all increased and brain pathologic changes abated obviously (303.00, 378.50, 403.50). Meanwhile, rats fatality (46.67%) and ICHR (66.67%) in 9 h thrombolysis group increased significantly in comparison with that in 3 h (29.41%, 18.75%) and 6 h (29.41%, 33.33%) groups respectively. Comparing the effects of urokinase thrombolysis therapy on protecting the brain against injury, it seemed that the effect of urokinase thrombolysis therapy at 3 h after rats cerebral infarction was more obviously than that at 9 h time window.

Conclusions: Nerve functional impairment, brain drosy and pathologic detriment in rats with cerebral infarction exacerbated following the prolongation of cerebral infarction. Delayed thrombolysis therapy could increase rats intracranial hemorrhage ratio and make the fatality rise. At different time window (3 h, 6 h and 9 h) after cerebral infarction, urokinase thrombolysis therapy could all protect brain against injury, while the effects of thrombolysis performed at 3 h and 6 h were more significant than that of thrombolysis at 9 h. Although the effect of thrombolysis performed at 3 h could abate rats cerebral edema and decrease cerebral infarction size more obviously than that of thrombolysis at 6 h, the role in lessening brain pathologic changes and improving nerve functional impairment showed no significant difference. In this study, it seemed that urokinase

thrombolysis therapy through artery could lead to the increase of intracranial hemorrhage ratio and fatality, which showed that urokinase thrombolysis therapy should be performed in 6 h after cerebral infarction.

0247

Study of survival of Bone Mesenchymal Stem Cells in brain at different time after transplantation via artery and its effect on protecting brain against injury in rats with cerebral infarction

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Objectives: To explore the survival of Bone Mesenchymal Stem Cells (BMSCs) in brain at different time after transplantation via internal carotid artery and its effect on protecting brain against injury in rats with cerebral ischemia reperfusion (I/R).

Method: Rats whole bone marrow were taken and cultivated, and then BMSCs were purified and amplified by methods of adherence and selection in vitro. BMSCs were labeled by 5-bromodeoxyuridine (BrdU) at 48 h before transplantation. 140 male Sprague-Dawley rats were randomly divided into sham-operated, model and transplantation groups. Rats middle cerebral artery occlusion model (MCAO) was duplicated with nylon thread. At 3 h after operation, inserted nylon thread was drawn out about 3 mm to make reperfusion. Rats of transplantation group were implanted with labeled BMSCs (2×10^6 cells) via carotid artery at 24 after ischemia reperfusion. At 7 d, 14 d and 28 d after BMSCs transplantation, rats general neural function (GNF) was evaluated, then rats brain was taken and pathologic changes were observed. Method of immunohistochemical double-staining was used to test the survival and migration of BMSCs. Rats brain water ratio (BWR), cerebral infarction size (CIS) and weight change rate (WCR) were measured.

Results: Rats GNF (10.45 ± 1.75 , versus 18.00 ± 0.00 , $P < 0.01$) in 7 d model group was lower than that of rats in sham-operated group, and rats weight decreased (15.38 ± 5.00 , versus 1.20 ± 0.67 , $P < 0.01$). Meanwhile, rats brain pathologic injury

exacerbated, as well as the increase of BWR (81.85 ± 2.80 , versus 71.13 ± 3.69 , $P < 0.01$) and CIS (18.20 ± 2.13 , versus 0.00 ± 0.00 , $P < 0.01$). Most number of BMSCs were in brain vessels at 7 d after transplantation, while only a few BMSCs entered brain tissue through blood brain barrier. BMSCs were different between cerebral ischemic side and the other side (25.50 ± 5.54 , versus 8.83 ± 1.72 , $P < 0.01$). In 14 d groups, decrease of rats GNF (11.08 ± 0.95 , $P < 0.01$), increase of rats BWR (84.84 ± 1.88 , $P < 0.01$) and CIS (19.64 ± 2.09 , $P < 0.01$), as well as the exacerbation of brain pathologic injury all became obviously. Though rats weight increased in 14 d model group, the ratio was lower (4.65 ± 2.98 , versus 9.53 ± 2.38 , $P < 0.01$). BMSCs in brain tissue increased in rats of 14 d group than that of 7 d group (43.67 ± 3.33 , versus 25.50 ± 5.54 , $P < 0.01$) and the role of BMSCs transplantation showed the gradually increasing tendency. In 28 d model groups, rats GNF (12.11 ± 1.05 , $P < 0.05$) was higher, while BWR (81.48 ± 1.92 , $P < 0.05$) and CIS (16.32 ± 2.11 , $P < 0.01$) were lower than that of rats in 14 d group. Meanwhile, the improvement of the GNF (13.33 ± 0.82 , $P < 0.05$), brain pathologic injury, BWR (78.61 ± 1.70 , $P < 0.05$), CIS (15.57 ± 1.78 , $P < 0.05$) and weight increase (7.54 ± 2.73 , $P < 0.05$) were more obvious in rats of 28 d transplantation group. The improvement above in 28 d transplantation group were all obvious than that in 14 d group.

Conclusions: Brain injury exacerbated following the prolongation of cerebral ischemic reperfusion from 7 d to 14 d and abated from 14 d to 28 d. BMSCs transplanted via internal carotid artery could survive and move towards the area of infarction through blood brain barrier. Following the prolongation of transplantation, BMSCs in brain tissue increased gradually from 7 d to 14 d and still remained the higher level at 28 d after transplantation. It also could be seen that the effect of BMSCs transplanted via internal carotid artery on protecting brain against injury became more and more obviously following the prolongation of transplantation.

0248

Cerebral glucose metabolism in patients with traumatic brain injury (TBI): a retrospective FDG-PET study with statistical parametric (SPM) analysis.

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Objectives: Structural cerebral imaging is still the dominant method in the diagnostic process in patients with traumatic brain injury (TBI), even in mild TBI (MTBI). Especially in MTBI this method often shows no abnormalities which raises the complex question if the symptoms are based on an organic basis or not. A false negative diagnosis can be the result of this and can have serious consequences for the patient. Functional imaging studies, especially SPECT, show that in case of normal structural imaging abnormal cerebral perfusion is present in about 75%. It is a fact that PET-imaging has a higher resolution than SPECT. The interpretation of this significant finding is under pressure because almost all TBI-studies with functional imaging use visual analysis although there is a known problem of inter- en intrarater reliability. This is a serious problem in the acceptance of functional imaging in the evaluation of TBI. Analysis with SPM is an important tool to solve this problem and a route to a better understanding of symptoms in patients suffering from (possible) TBI. Functional imaging studies using SPM can prove that this method has an important role in the correct diagnosis and treatment of symptoms in TBI.

Method: Included in this study are at least 6 patients with TBI evaluated with cerebral FDG-PET and MRI in their diagnostic process. SPM was used to determine the quantitative differences in metabolic activity between the TBI-patients and age matched controls. Comparison was made with MRI results. The PET-scanner is a Philips Gemini GXL. A dose of 22 Mbq fluor-18 deoxyglucose was injected intravenously.

Results: Data evaluation is running at the moment.

Conclusions: Functional neuroimaging is a grossly underestimated tool to understand and explain the underlying neurobiological pathology in TBI and is strongly advised especially when structural neuroimaging is normal but symptoms are related to brain injury. To overcome the criticism on the reliability of visual analysis of PET, SPM-analysis is a necessary step towards a more professional diagnostic process.

0249

Experiences using a mobile near-infrared-spectroscopy system for noninvasive detection of traumatic intracranial hematoma

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Objectives: Early recognition of intracranial hematoma strongly influences the sequelae of patients. A mobile laser optic system for quick diagnosis was tested for the ability to detect traumatic intracranial hematoma in the prehospital phase.

Method: 100 patients after skull injury were examined using the system (CRAINSCAN, odicrain, Germany) and the results were compared with corresponding CT or MRI films.

Results: In 74 patients with intracranial hematoma, this was detectable in 50 cases (67%). The absence of any hematoma was correctly shown in 18 of 26 patients (69%).

Conclusions: Unilateral hematomas underlying the calvarian bone are detectable in a safe manner if artificial factors are absent. The positive predictive value is low in patients with severe skull injury. Bilateral bleeding is not detectable. The system is helpful in continuous monitoring of patients with mild to moderate skull trauma, especially of those without relevant soft tissue damage. The computed tomography can not be replaced by near-infrared-spectroscopy-systems.

0250

Escin promotes TNFSF14/LIGHT gene expression in hippocampus of transient global cerebral ischemia mice

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Objectives: Inflammation is involved in cerebral ischemia injury and macrophage (glia) plays an important role in ischemia induced inflammation. Tumor necrosis factor superfamily member 14 (TNFSF14/LIGHT) is a member of the tumor necrosis factor superfamily that binds to lymphotoxin-beta receptor to induce cell death including macrophage apoptosis. Escin is a natural mixture of triterpenoid asponin and demonstrates anti-oedematous and anti-inflammatory effects. Here we explored the effect of escin on TNFSF14/LIGHT gene expression by using a transient global cerebral ischemia model.

Method: Global cerebral ischemia was induced by occluding both common carotid arteries and withdrawing 0.3 ml of blood from the tail vein in mice. Treatment with escin was performed starting 0.5 h

after ischemia induction, once a day for three consecutive days. Then mice were anesthetized deeply and TNFSF14/LIGHT gene expression in hippocampal tissue of cerebral ischemia mice was examined using real-time PCR.

Results: The results showed that TNFSF14/LIGHT gene was downregulated more than four fold after induction of transient global cerebral ischemia. After escin treatment, the gene expression of TNFSF14/LIGHT was upregulated more than six fold compared with the mice of cerebral ischemia.

Conclusions: The results made an interesting observation that subjecting mice to escin after ischemia significantly promotes the TNFSF14/LIGHT gene expression, and this is probably one of the anti-inflammatory mechanisms of escin and may be a potentially useful therapy for ischemic stroke.

0252

Outcome of Geriatric Patients with Severe Brain Trauma who have Glasgow Coma Scale Scores <5

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Objectives: Geriatric patients with severe traumatic brain injury (TBI) are considered to have an almost hopeless prognosis. Patients aged >65 years, and those with Glasgow Coma Scale (GCS) scores of <5 are excluded from most clinical studies. To the best of our knowledge this special group of patients has not been studied before. We therefore decided to investigate the outcomes of patients with severe TBI who had a GCS score <5 and were >65 years of age. **Method:** Between 01/2001 and 12/2005 13 European centers enrolled 1172 patients with severe TBI (GCS < 9). Data sets of all patients aged >65 years who had GCS scores of 3 or 4 were analysed. According to the Glasgow Outcome Scale score (GOS) 12 months after trauma patients were classified as having "favourable" (GOS scores 5+4) or "unfavourable" (GOS scores 3-1) outcome, and relevant data for these two groups was compared. We did univariate analyses first (chi-square and Wilcoxon-Mann-Whitney tests), and used variables that showed differences as covariates in logistic regression models. A p-value of <0.05 was considered statistically significant.

Results: Of the 1172 patients in the database 100 (8.5%) had GCS scores of 4 or 3 and were aged >65 years. Of these 100 patients, 11 had a favourable outcome, and 89 had an unfavorable outcome. There were 29 female, and 71 male patients. Factors that were significantly associated with favourable outcome were gender „female“ (21% of the female, but only 7% of the male patients had favourable outcome), trauma severity mean (median Abbreviated Injury Score [AIS] „head“ 4 vs. 5), „open“ or „partially open basal cisterns“ on first CT scan, and „no midline shift“ on first CT scan. Factors that were significantly associated with unfavourable outcome were gender „male“, higher trauma severity, and „closed basal cisterns“ on the first CT scan (this last factor was associated with 100% mortality). Mean age was slightly higher in the group with unfavourable outcome (74.8 vs. 73.6 yrs) but this was not significant. There was only one survivor >82 years old and no >88years old. No other CT features (e.g. subdural or intraventricular hematoma), and none of the treatment factors (e.g. prehospital treatment, direct transfer, neurosurgery, intracranial pressure monitoring) were associated with outcomes.

Conclusions: In general, geriatric patients with severe TBI and low GCS scores have a poor prognosis. Prognosis is better for women who have AIS scores of 4 or lower, and have open/partially open basal cisterns and no midline shift on the first CT scan. Patients who have closed basal cisterns on the first CT scan have 100% mortality.

0253

The Clinical Course of Concussion Symptoms in a Referral Population

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Objectives: The prognosis for symptom recovery is a vital part of the clinical care of concussed pediatric patients and their families. We were interested in whether symptom recovery could be predicted on the basis of early Sport Concussion Assessment Test (SCAT) scores.

Method: We retrospectively reviewed a clinical case series of children referred to a consultant pediatric neurologist for the assessment and management of a symptomatic concussion. All were encouraged

to: 1) limit physical, social and cognitive exertion, 2) self-monitor their symptoms “if it makes your headache worse quit doing it”, and 3) graph the daily total on the SCAT to assess symptom recovery. Symptom recovery was defined as a nightly total score of less than two, with no reported headache or sleep disturbance.

Results: Twenty one patients were reviewed. The average age was 13y (range 9–17y). 16 (76%) were male, and for half this was their first concussion. Winter sports were primarily responsible for the injuries. The initial assessment was done 0–42 days following the initial injury (mean: 15 days).

Symptom scores at assessment ranged from 4 to 67. 25% filled the definition of symptom recovery by day 10, 50% by day 15, 75% by day 25 and 100% by day 64.

Using a linear plot of day of assessment and day 7 scores, or a linear regression of day of assessment through day 7 scores routinely underestimated the time to recovery. The relationship of recovery time to the baseline symptom score appeared to reflect a non linear (polynomial) relationship. A secondary survival analysis confirmed a potential relationship ($p = 0.057$), which can be summarized pragmatically as a recovery within 14 days of initial consultation (10/21, 48%) or within a period less than (the initial SCAT score –14) days (cumulative 17/21, 81%).

Conclusions: The number of, and magnitude of concussive symptoms at clinical presentation may be related to the time to symptom recovery. Further work on larger populations of concussed children from varying clinical populations may clarify the nature of this relationship and allow more accurate prognosis for symptom recovery early in the clinical course.

0254

Study of proinflammatory cytokines in the pathogenesis of cerebral palsy

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Objectives: To investigate the role of proinflammatory cytokines in the mechanisms of cerebral palsy.

Method: Thirty-one patients diagnosed as cerebral palsy, twenty healthy controls and neonates ($n = 37$) who suffered hypoxic–ischemic injury and/or perinatal infection, twenty healthy neonates who were used as controls were studied retrospectively. Enzyme-linked immunosorbent assays (ELISA)

were performed for TNF- α and IL-6 in serum from all subjects.

Results: TNF- α and IL-6 were significantly higher in cerebral palsy patients than in controls ($P < 0.05$), TNF- α and IL-6 were significantly higher in suffered neonates than in controls ($P < 0.05$); TNF- α is significantly higher in patients than in suffered neonates ($P > 0.05$), there was no statistical difference of IL-6 levels between two groups.

Conclusions: Overexpressed proinflammatory cytokines play an important role in the pathogenesis of cerebral palsy and may be an independent risk factor of cerebral palsy.

0255

A retrospective study on the diagnoses and treatment of 4462 cases with severe traumatic brain injury

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Objectives: To analyse and summarize the diagnostic and treatment modality in order to increase the cure rate and survival rate for patients with severe traumatic brain injury (STBI).

Method: A retrospective study was made on the diagnoses and treatment of 4462 cases with STBI. There were 3298 male and 1164 female in this group. The most frequent cause for injury was traffic accident (35.5%). Closed head injury happened in 3654 (81.9%) cases and open head injury in 808 (18.1%) cases. The most common clinical manifestations unconsciousness, changes of pupils and life signs. In this group, 1158 cases (26.0%) were found to have injury to other organs and 1356 cases (30.4%) with complications. All the cases underwent first aid, surgery or conventional treatment. Emphasis was put on the treatment of secondary insults.

Results: Surgery was made on 3023 cases (67.7%) with a mortality of 17.9%, and conventional treatment on 1439 cases (32.3%) with a mortality of 23.7%. There were 2462 cases (55.2%) with fair recovery, 508 cases (11.4%) with mild disability, 339 cases (7.6%) with severe disability, 272 cases (6.1%) in vegetative state and 881 case (19.7%) of death in this group on discharge according to the Glasgow outcome scale.

Conclusions: Active diagnoses and treatment, strict rules for medication and prevention and treatment for secondary insults may be the keys for the higher cure rate and lower morbidity as well as mortality of STBI.

0256

The influence of neurodevelopmental treatment on erythropoietin levels in patients with cerebral palsy

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Objectives: To observe the effect of neurodevelopmental treatment (NDT) on erythropoietin (EPO) levels in cerebral palsy (CP) patients and neonates who suffered asphyxia and/or infection.

Method: Serum samples of 31 CP patients, 37 neonates who suffered asphyxia and/or infection and their respective 20 controls were obtained and kept at -40°C until the time of measurement. EPO levels were measured by the enzyme-linked immunosorbent assay double sandwich method (ABC-ELISA).

Results: The EPO levels in serum of CP patients with NDT treatment were higher than those in the CP patients before they treated with NDT treatment and control group ($P < 0.01$). There was no difference between CP group before they treated with NDT treatment and control group with regard to serum EPO levels ($P > 0.05$). EPO level in serums of neonate group was higher than its control group ($P < 0.01$).

Conclusions:

- (1) EPO level in serums of neonate group was higher than its control group. EPO as a kind of neurotrophic and neuroprotective cytokine play an important role in the pathogenesis of cerebral palsy.
2. EPO can be used as an independent biomarker that reflects curative effect of NDT.

0257

The influence of abnormality expression about progesterone regulating IL-12 in the patients with multiple sclerosis

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Objectives: Multiple sclerosis (MS) is the inflammatory disease of the CNS with a CD4+Th cell mediated abnormality immune response. We observe the horizontal alleosis of IL-12 about CSF and blood serum and probe into the immunoregulation mechanism of action about progesterone regulating IL-12 in male and female patients with multiple sclerosis. We want to provide theory evidence for developing original immunotherapy plan in clinical.

Method: IL-12 in the CSF with 59 patients and blood serum with 39 patients was assessed by enzyme-linked immunosorbent assay (ELISA) and progesterone in the blood serum with 39 patients by radio-immunity (RI). We compared them with the 37 control subjects. There are 29 male patients and 30 female patients in all the CSF subjects, 19 male patients and 20 female patients in the blood serum and 19 male patients and 18 female patients in control subjects.

Results: The level of IL-12 in CSF and blood between male and female patients were significantly higher than those in the controls ($P < 0.01$); The level of male patients about IL-12 in CSF and blood were significantly lower than the female patients ($P < 0.05$). The progesterone of blood in the female patients was significantly lower than that in the control ($P < 0.01$). There were no obvious difference in the level about progesterone between the male research group and the control group ($P > 0.05$). There was negatively adjusted effectiveness between progesterone and IL-12 in the blood of female patients ($r = -0.80$, $P < 0.01$). The male patients are not significant ($r = -0.38$, $P > 0.05$).

Conclusions: i. The level of IL-12 in CSF and blood between male and female patients were significantly higher than those in the controls, so phlegmasia cytokine IL-12 directly participate phlegmasia demyelinate pathematology procedure. ii. The level of male patients about IL-12 in CSF and blood were significantly lower than the female patients and it demonstrates that female patients possesses distinct immune environment. iii. The progesterone of blood in the female patients was significantly lower than that in the control. We can know that progesterone to restrain overexpression of IL-12 in patients and directly regulate immunocell activation dynatron effect. iv. Ours dependability statistics data sheet indicate that the level difference of progesterone is one of reason of sex differences about pathogenesy with MS. We can to provide theory evidence for developing original immunotherapy plan in clinical.

0258

Quantitative and Qualitative Validation of a Group Treatment Program for Mild ABI

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Objectives: Group treatment for acquired brain injury (ABI), based on holistic principles has been found to be efficient in a series of studies in different treatment centers for patients with moderate ABI. Patients with mild ABI have different needs and resources and few treatment programs are developed for this particular patient group. Our aim is to report the specific features of a group treatment program developed for mABI based on qualitative and quantitative evaluations and an independent replication in a different clinical setting.

Method: The original program was evaluated in a study (n=37, F/M 27/10; 20–60 yrs) with the following instruments: DSST, COWAT, Buschke Selective Reminding Test, PGWB, QoL. For the qualitative evaluation nine patients (4/5 M/F, 33–59 yrs) were recruited by purposive sampling after the program. The interviews lasted approximately 1 hour and were analyzed by the Grounded Theory Method of constant comparison. Trustworthiness was ensured by triangulation in researchers. The independent validation was done through running the same program with another staff in a different rehabilitation facility. Data are presented for 3 groups with 5–6 patients each (n=16, 7 men, 9 women, mean age 34 years, range 22–62 years). For the evaluation the following instruments were used: Rivermead Post-Concussion Symptoms Questionnaire, Rivermead Head Injury Follow-Up Questionnaire, Impact of Event Scale, Multidimensional Pain Inventory, KASAM, Becks Depression Inventory II; Becks Anxiety Inventory, Social support.

Results: For the original program the results indicated a significant improvement in ratings of Quality of Life, significant increase in Self-Control and a trend to decreased anxiety according to the Psychological Well Being Scale and significantly improved recall and the Buschke Selective Reminding Test. At the three months' follow-up 91% of participants were very satisfied with the group treatment program.

For the independent replication significant improvements ($P < 0.05$; Wilcoxon signed rank test) were found for Social Support, MPI och IES. There was a tendency to improvement for BDI ($P = 0.063$) and KASAM ($P = 0.074$) and a subjectively reported improvement.

The qualitative interview study found that this group treatment can be considered as a shortcut to change and increased awareness by speeding up adaptation. Participants needed support for how to deal with changes and what are life's new priorities? Continued struggle with everyday challenges after treatment was rather a sign of incomplete adjustment after mTBI.

Conclusions: Cognitive group rehabilitation according to the Danderyd model has been shown to have a positive effect in two different clinical settings. Both quantitative evaluations and the qualitative interview study emphasizes the importance of group treatment for the integration of knowledge, strategies and self-image leading to changes in how to handle problems or prioritize in major life choices.

0259

Changes in serum levels of IL-10 and its clinical significance in the course of cerebral palsy's occurrence

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Objectives: To explore the relationship between interleukin-10(IL-10) and brain injury or its prognosis by dynamic observation of serum IL-10 levels of fetuses, neonates and children with cerebral palsy (CP).

Method: Serum samples of 50 CP patients, 20 fetuses and 20 neonates who suffered asphyxia and/or infection and 25 control groups were obtained respectively and kept at -40°C until the time of measurement. Il-10 levels were measured by the enzyme-linked immunosorbent assay double sandwich method (ABC-ELISA) retrospectively.

Results: The levels of IL-10 in fetuses with CP risk factors were lower than those in control group ($P < 0.05$). IL-10 Levels of neonates with CP risk factors were higher than those of controls ($P < 0.01$); IL-10 levels of CP patients were significantly higher than those of controls, neonates with CP risk factors and fetuses with CP risk factors ($P < 0.01$).

Conclusions: IL-10 may be involved in the occurrence and development of CP; IL-10 can be used as an independent biological parameter of acute stress; IL-10 levels can be reflected the extent of brain injury, which there is an important clinical significance to the prevention and treatment of CP.

0260

The effect of acupuncture on central facial paralysis after acute stroke

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Objectives: to investigate the effect of acupuncture on central facial paralysis after acute stroke.

Method: 60 patients with central facial paralysis after acute stroke (about 24–72 hours after stroke onset) randomly recruited and grouped in two groups: Patients in group A received acupuncture based on routine pharmacotherapy (n = 30), patients in group B only received the same routine pharmacotherapy as control (n = 30). The following acupoints were selected: Xiaguan(ST7), Sibai(ST2), Qianliao (SI18), Yifeng(TE17), Baihui(GV20), Zusanli (ST37) and Hegu(LI4). All the chosen acupoints were located according to The National Standards of the People's Republic of China: the Meridian and Acupoint Standards, published in 1990. Sterilization and insertion were performed on these acupoints. The acupuncture was performed for 30 minutes during the "Qi" was reached, once a day, for a month. Functional recovery was assessed by measurement of facial movements and by electrophysiological examination. Before the therapy and 10 days later, 20 days later, 30 days later, all the patients received the Portmann analysis by the blind investigators.

Results: There was no difference between the two groups before therapy and 10 days after acupuncture. But the significant difference ($p < 0.05$) was observed between the two groups at the 20th day (Portmann score was 14.76 ± 2.6 in group A versus 12.13 ± 2.08 in control) and 30 days (Portmann score was 17.03 ± 2.5 in group A versus 13.03 ± 1.97 in control). The latency of compound muscle action potentials of musculus orbicularis oris and musculus orbicularis oculi on the ill side were

longer in group B than that in group A after a month treatment ($p < 0.05$).

Conclusions: Acupuncture may improve facial movements in patients with central facial paralysis after 20 days performance.

0261

The expression and function of molecular complexes: GluR-Homer-Shank-IP3R in neurons associated with traumatic brain injury in rats

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Objectives: To study the expression and function of molecular complexes: GluR-Homer-Shank-IP3R in neurons associated with traumatic brain injury (TBI) in rats.

Method: Firstly, one hundred and thirty-five male Sprague-Dawley rats were randomly assigned into a normal control group, sham-operated control group, and TBI group. The TBI group was subdivided so that different time points (1, 3, 6, 12, 24, 48, and 72 h) post-injury could be studied. Immunohistochemistry, Western blot, real time RT-PCR and co-immunoprecipitation were used to examine the expression of molecular complexes. Secondly, calcium imaging and shRNA experiments of Homer and Shank2/3 were used to explore the function of molecular complexes in vitro.

Results: We show here that this molecular complexes consist of a GluR isoform: mGluR1a, a Homer isoform: Homer1a, two subtypes of Shank: Shank2/3 and IP3R, and protein of complexes were over-expressed in neurons of the DAI group from 1h to 72 h after TBI. In addition, Homer1a and Shank2/3 strongly attenuated calcium mobilization as well as MAP kinase activation induced by glutamate receptors. Preventing activity-induced upregulation of Homer1a and Shank2/3 using shRNAs in vitro exacerbated TBI. Furthermore, we examined that targeted gene transfer of Homer1a and Shank2/3 to neurons of hippocampus in vitro reduced LDH concentration.

Conclusions: The molecular complexes: GluR-Homer-Shank-IP3R play potential role in the development of TBI and may be a promising therapeutic target for the treatment of TBI.

0262

Evaluating In-Patient Rehabilitation For Subjects With Traumatic Brain Injury: Use of Early Variables to Predict Functional Outcomes and Direct Clinical Practice

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Objectives: Purposes of the present study are to:

- outline a predictive model of functional change and outcome of an inpatient rehabilitation programme for patients with traumatic brain injury through the use of selected indicators and variables available at the beginning like age, time from injury to rehabilitation admission, GCS and initial functional status to identify predictive factors for functional outcome;
- verify if subdivision into admission DRS categories, identifies homogeneous groups of patient with regard to effectiveness and efficiency of rehabilitation treatments as measured by length of stay, functional gain and efficiency and discharge disposition.

Results on the basis of concrete data, from a large number of patients with TBI homogeneously treated along both intensive care and rehabilitative phase would provide valuable considerations on programme organization, resources planning and outcome evaluation.

Method: We set here a retrospective analysis of data regarding the phase of inpatient rehabilitation for subjects with traumatic brain injury (TBI) in our Rehabilitation Department of the Don Calabria-Sacro Cuore Hospital. 175 patients admitted to an Intensive Rehabilitation Unit between 2004 and 2007 were considered. Data collected included demographic characteristics, first 24-hours worst GCS, length of acute and rehabilitative stay, admission and discharge FIM, DRS, LCF and GOS. All patients had rehabilitative motor and cognitive treatments as necessary, for 3 hours a day, 5 days a week, in observance to Italian rules about centers for severe acquired brain injury. Rehabilitation of motor aspects follows Bobath concept and repetitive task training.

Results: Main outcomes and results: there was a statistically significant recovery over the course of admission for all assessment tools ($p < 0,000$). When patients were subdivided on the basis of admission

DRS categories a linear correlation among variables could be observed, with most disabled patients showing the longest acute and rehabilitation stays and the lowest functional gains. Within each DRS category age appeared to affect improvement ($p < 0,005$) while final outcome was influenced not only by age but also by initial functional status ($p < 0,000$) and time from injury to admission ($p < 0,004$).

Conclusions: The use of electronic databases and statistical analysis and systematic data collection in intensive rehabilitation, is of great importance to monitor recovery and plan appropriate programmes on the basis of admission functional status.

0265

Sensitivity to Text-based Social Cues in Persons with Traumatic Brain Injury

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Objectives: One common complaint of everyday communication partners with traumatic brain injury (TBI) is that they do not take the social context into account when conversing and therefore do not adjust their communication accordingly. The purpose of this study is to determine if persons with TBI detect implicit social cues in written information and adjust their responses accordingly.

Method: Forty-two participants with brain injury and twenty control participants were asked to read a newspaper article about a mass murderer and completed a questionnaire requesting five reasons explaining this person's actions. The questionnaire was presented with one of two letterhead conditions (Institute for Social Research vs. Institute for Personality Research). These letterhead conditions have been shown in previous research to induce a biasing response. In this research respondents were more likely to attribute the actions of a criminal to situational factors if they believed their audience was a social psychologist, and more likely to attribute their actions to dispositional factors if they believed their audience was a personality psychologist.

Results: As in previous research, participants without TBI showed a response bias related to letterhead condition. Participants with TBI did not demonstrate this bias.

Conclusions: Individuals with TBI did not respond in the same manner as controls to implicit social cues in written form. Findings extend recent research

indicating deficits in processing spoken and non-verbal social cues in individuals with TBI, and raise questions regarding their processing of written information in activities of daily living in brain injury survivors.

0266

Assessment of the S100B Blood-CSF-Passage following Acute Brain Injury

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Objectives: S100B is being discussed as a marker of brain damage, and high S100B serum levels are considered to result from a compromised blood-brain-barrier (BBB). However, since the BBB is restored for proteins larger than 10KD within hours after injury, the dynamics of the passage of the 22KD protein S100B from brain into blood remain unclear. In order to assess the contribution of the blood-cerebrospinal fluid (CSF)-barrier, we calculated a serum/CSF ratio and compared the chronological sequence of the two neurotrophic, glial proteins S100B (22KD) and the lepto-meningeal β -trace protein of similar molecular weight (26KD). **Method:** In 17 patients with subarachnoid hemorrhage (SAH) treated with a ventricular drainage, we measured S100B in the CSF, serum and urine for up to 23 days (Elecsys[®] S100 Immunoassay, Roche Diagnostics, range of detection 0.005–39 μ g/l). Six patients with a lumbar drainage following transsphenoidal pituitary surgery served as control group. The serum/CSF ratios were compared using the Mann-Whitney rank sum test. Statistical analysis was performed with the SPSS software, significance was accepted at $p < 0.05$.

Results: In the healthy controls, S100B and β -trace protein in serum comprised around 8% of the CSF concentration. Following acute brain injury, S100B CSF level were excessively increased for the first week ($54.1 \pm 9.3 \mu$ g/l on admission), and decreased thereafter ($7.8 \pm 7.8 \mu$ g/l on day 10). S100B serum concentration was highest on admission ($0.20 \pm 0.27 \mu$ g/l SAH), and normalized thereafter steadily ($0.09 \pm 0.04 \mu$ g/l on day 10). The β -trace protein was constant in CSF (6.7 ± 0.35 mg/l), serum (0.63 ± 0.03 mg/l) and urine (0.04 ± 0.003 mg/l). The S100B serum/CSF ratio was significantly decreased compared to the β -trace

ratio for 12 days ($p < 0.05$ day 1–12) following injury.

Conclusions: The serum/CSF ratio of the lepto-meningeal β -trace protein was constant (around 8%) following SAH, thereby suggesting an intact blood-CSF-barrier. On the other hand, the respective S100B ratio was decreased immediately after injury and recovered over time. Thus, there appears a discrepancy between the stimulated cerebral S100B release after injury, as reflected by the excessively increased S100B CSF level in our study, and the significantly decreased S100B serum/CSF ratio at the same time. We hypothesize that this mismatch may result from an enhanced neuronal demand serving repair mechanisms.

0269

Influence of the Recovery of Walking on the Hospital Impatient Time in Children with Traumatic Brain Injury

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Objectives: Traumatic brain injury is the most important cause of acquired disability in children and young people. Restoring walking ability is one of the primary purposes of our rehabilitation program. Our aim is to study the incidence of the walking ability on hospital discharge time and its effects on the average hospital stay in children and young people with traumatic brain injury admitted to a Children's Hospital Rehabilitation Service.

Method: Forty children with traumatic brain injury and average age of 13,5 were admitted to the rehabilitation service. Walking was evaluated at the time of discharge quantitatively (presence or absence of walking ability) and qualitatively (independent or device assisted walking). The variables analyzed were: lesion type through neuroimaging, associated lower limb injuries, average stay in Intensive Care Unit and Rehabilitation Service, presence of Autonomic Dysfunction Syndrome and functional outcome on discharge by Glasgow Outcome Scale.

Results: Thirty-five (87,5%) of the 40 children and adolescents were walkers on discharge. 29 (72,5%) as independent walkers. 6 (15,0%) walked with device assistant and 5 (12,5%) were non-walkers. Average Hospital stay was 32,15 days for walking children and 46,35 for non walking ones. A correlation was found between walking ability, length of coma and length of the impatient stay in

the Intensive Care Unit. Other correlated variables but with less statistical significance were average Rehabilitation service stay and total length of inpatient stay. We did not find any correlation with initial traumatic brain injury severity or with lower limb or pelvis injury.

Conclusions: Most of the children were walkers at discharge. The average Rehabilitation inpatient stay and total average inpatient stay were lower than non-walking patients. We conclude that walking ability has an influence over total average Hospital inpatient stay.

0270

In Vivo Assessment Of Brain Motion And Deformation Patterns By Magnetic Resonance Imaging And Its Implication For Cerebral Contusion Pathogenesis Research

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Objectives: Among all types of injuries worldwide, brain injury is the most likely to result in death or permanent disability. This indicates a critical need for more effective ways of understanding the mechanisms of TBI (traumatic brain injury) in order to prevent brain injuries. Previous studies indicate the relative brain-skull motion as a determinant factor in the occurrence of TBI, particularly for closed brain injuries without skull fractures. Although relative brain motion has been studied for decades, the patterns of relative brain motion with respect to the skull are not yet thoroughly understood. This study further investigates brain motion patterns in humans under quasistatic loading conditions using experimental Magnetic Resonance Imaging (MRI).

Method: 15 human volunteers with different age were scanned in four different head positions (left lateral, right lateral, prone and supine) with a resolution of 1.1 pixels/mm and using a 3 Tesla MRI scanner. Image analysis and segmentation were performed using MimicsTM®. Pair-wise comparison (prone vs. supine and left vs. right) of the obtained 3D models was performed for each volunteer by subjecting the skull models to a global registration process

and alignment using 3-maticTM®. The whole brain motion, the regional brain motion patterns and the regions where brain deformation is dominant were analyzed using the Focus Inspection® 4.8 software.

Results: Head movement in the coronal plane determines a whole brain translation in the coronal plane with a slight rotation in the axial plane with maximum amplitudes between 2.01mm and 5.67mm. Head rotation in the sagittal plane leads to a whole brain rotation in the same plane with individual maximum amplitudes between 2.65mm and 12.02mm. These maximum amplitudes were seen at the inferolateral and medial cortex of the frontal and temporal lobes. For the lateral ventricles displacement, individual maximum values varied between 1.19mm and 3.44mm for lateral head movement and between 0.01mm and 6.38mm for prone-supine head movement. In general, higher displacement amplitudes were observed for the older volunteers. Beside head displacement, also brain deformation was observed, again being most pronounced for prone-supine head movement.

Conclusions: The relative brain-skull movement is most pronounced at the orbital gyri, the lateral aspect of the frontal lobes and at the inferolateral and medial aspect of the temporal lobes. More important brain displacement and deformation occur in prone-supine head movement. The present study provides a possible etiology for the frontal and temporal lobes as being predilection sites for cerebral contusions. The results have also implications for the use of navigation in brain surgery, radiation therapy and for brain cine-MRI modalities.

0271

Impact of Social Relation in Quality of Life of People with Multiple Sclerosis.

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Objectives: Multiple sclerosis (MS) it is a chronic inflammatory neurological disease, of the central nervous system. Recent evidence increasingly suggests that rehabilitation improves activities, participation in social activities as well as the quality of life in patients with multiple sclerosis.

The aim of the present study is to examine the Impact of family role perception in quality of life in patients with MS.

Method: We use the domain of Social Relation (6 items) of the IPA (Impact on Participation and

Autonomy) questionnaire, that measures several aspects of participation and autonomy, and the Multiple Sclerosis Quality of Life scale (MSQol-54) a multidimensional quality of life questionnaire. 280 patients with MS were recruited via their physician at a neurology department of a central hospital in Lisbon. They were eligible for inclusion in the study if they met the following criteria: diagnosis according to relevant medical criteria, between 18 and 65 years, being diagnosed at least 1 year ago, EDSS score under 7. The mean age was 40 years (range 18- 65), 71.3% were women, 61.1% were currently married, 63% active workers, mean school level of 12 years, and scores of EDSS is 2.8. *Methods:* the study is cross-sectional and correlational.

Results: The correlations between family role and the domains of MSQOL-54: Physical Health ($r=0.41$, $p<0.01$), Physical Role Limitations ($r=0.48$, $p<0.01$), Emotional Role Limitations ($r=0.44$, $p<0.01$), Pain ($r=0.42$, $p<0.01$), Well-being ($r=0.45$, $p<0.01$), Energy ($r=0.47$, $p<0.01$), Health in General ($r=0.37$, $p<0.05$), Social function ($r=0.55$, $p<0.01$), Cognitive Function ($r=0.38$, $p<0.05$), Health Distress ($r=0.43$, $p<0.01$), Overall Qol ($r=0.54$, $p<0.01$), Sexual function, ($r=0.46$, $p<0.01$), Change Health ($r=0.20$, $p<0.05$), and Satisfaction with sexual function ($r=0.41$, $p<0.01$),. are all statistic signification.

Conclusions: There is a statistically significant correlation between the variables, suggesting that social relation can play an important perspective in the quality of life of patients with MS.

0272

A Methodology for Identifying the Lifetime Traumatic Brain Injury History of Individuals in a General Population Survey

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Objectives: As part of a larger investigation to determine rates of long-term disability following traumatic brain injury (TBI) of various severities treated in various settings, a telephone interview procedure was needed to identify the lifetime history of TBI in individuals. The purpose of this research presentation is to describe the development, implementation, and evaluation of the general population survey procedure to illicit information about an

individual's history of traumatic injury from all etiologies, including all severities and care paths, while collecting considerable detail about any TBI occurring.

Method: Over 100 questions are imbedded in a complex branching structure designed to efficiently collect maximum information in minimal time. The interview begins by using a series of etiology prompts to help the respondent recall the traumatic injuries occurring during their lifetime. Questioning then focuses on injuries to the head and neck and data is gathered about injuries involving loss or alteration of consciousness, including TBI severity indicators; whether treatment involved hospitalization, being seen in an emergency department and released, care provided in a clinic or physician's office, or no treatment sought; and age at or years since injury.

Results: To date 2,181 representative members of the Colorado general population have been interviewed in a random-digit-dialed survey. The procedure has classified 24% of respondents as not reporting any traumatic injury in their lifetime; 38% have reported traumatic injury without any TBI; and 38% have reported one or more mild to severe TBIs in their lifetime. The 38% reporting TBI include 14% who only report mild TBI without loss of consciousness, 16% report mild TBI with loss of consciousness less than 30 minutes, and 8% report one or more moderate to severe TBIs. This computer assisted telephone interview procedure has taken an average of only two minutes for those reporting no traumatic injuries; five minutes for those reporting traumatic injuries, but no TBI; and an average of six minutes for those reporting TBI.

Conclusions: This survey technique is efficiently identifying high percentages of people who report experiencing TBI in their lifetimes. If this methodology is validated in the next research phase, it will be used to estimate the incidence of TBI of all severities and the prevalence of long term disability resulting from the wide variety of TBI occurring in people's lives, as well as adapted for use in clinical settings as a screening tool.

0273

Social Network Analysis As A Tool For Evaluating The Collaborative Potential Within The International Pediatric Brain Injury Society: A Baseline Analysis.

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Objectives: Acquired brain injury (ABI) is the number one cause of morbidity and mortality in children and adolescents worldwide. As such the International Pediatric Brain Injury Society (IPBIS) was created as a collaborative group of professionals interested in the prevention, management of and research in pediatric/adolescent ABI (PABI) by the sharing of ideas, concepts, best and emerging practices and fostering collaborative research. The purpose of our work was to utilize Social Network Analysis (SNA) as a means of evaluating group dynamics by illustrating the interconnections within countries and between countries and identifying key players in research, clinical practice, advocacy and knowledge translation.

Method: As a new society, IPBIS held its first conference in July 2009. Conference attendees were invited to participate in a survey, which was developed and distributed for the purpose of establishing a baseline of social network interconnections and collegiality two weeks prior to the Toronto meeting. At that time a total of 66 surveys were distributed via email. 51 responded who formed the basis of the analysis. Data gathered included country of origin, percentage of time worked in PABI, funding sources, work site affiliation, professional role and qualifications, and if primarily research or clinical practice. Further, the respondents were asked to identify whether they were aware of fellow respondents and their role in PABI and whether they would seek their advice or expertise.

Results: The analysis included the responses of 51 participants. 55% were Canadian, 12% American, 25% European, 8% from Australasia/Africa. 47% spent more than 60 percent of their time in PABI either clinically and/or in research. 57% were publically funded, 14% NGO's, 29% private. 51% were primarily clinical. The top four professions were 20% medical doctors, 22% psychologists, 16% educators and 14% therapists. Of those who participated in research, 45% were principal investigators. The SNA revealed 17% were likely to reach out to persons within the network to discuss innovation and key insights about PABI and 16% were aware of others qualifications. These interactions were primarily based WITHIN a country rather than across countries. There were a few key individuals identified that were known by the vast majority. The social network diagram highlighted these people and with whom they were connected.

Conclusions: IPBIS is a new society that is dedicated to the field of pediatric and adolescent ABI. The development of the society and its effectiveness in fostering collaborative research and practice is being evaluated using a social network analysis paradigm. As the various professionals from around the world that are in the field of PABI continue to connect, more and more opportunities should develop that will promote collaboration within the network. This work will act as the base to which future evaluations can be compared.

0274

A Novel Workshop for Healthcare Workers Dealing with TBI Patients

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Objectives: Traumatic Brain Injury (TBI) is a leading cause of death and disability. Research has demonstrated an increased likelihood of suicide following TBI. Individuals with TBI are more likely to attempt, and four times more likely to die of suicide. This research study evaluated the effectiveness of a newly created suicide awareness workshop aimed at medical and allied staff involved in the care of TBI patients.

Method: Four identical workshops were held for separate shifts of the Neurotrauma Nursing Unit (NNU) at St. Michael's Hospital in Toronto, Canada. The format was a one-hour "Lunch and Learn" session. Participants included the nursing and allied staff from the NNU (n=39). The following components were featured: a case study, an overview of suicide and its relationship to TBI, and suicide risk factors and assessment scales (SAD PERSONS Scale and Powell Suicide Risk Factor Scale). The workshop was interactive; participants applied risk factor scales during the case study and contributed to the list of suicide risk factors and possible interventions.

Outcomes of the study were assessed using three quantitative sets of measures, including: a participant demographic assessment, a knowledge assessment of suicide following TBI, and a self-rating component regarding the participants' skills and confidence in dealing with at-risk patients. Evaluations occurred prior to the workshop, immediately after it, and one month later.

Results: Demographic data indicated that the majority of participants were nurses and had at least six

years of experience, reinforcing the emphasis on information particularly relevant to nursing staff. The objective knowledge test results indicated that the workshop improved participant knowledge in the area of TBI and suicide. The self-rating component of the questionnaires showed increases in participants' confidence and knowledge related to suicide and TBI, and increased ability to assess and manage at-risk patients. Workshop feedback was positive. All participants stated that they found the workshop to be useful, and most stated that they would attend another suicide-related workshop. The comprehensiveness and conciseness of the workshop were viewed as its greatest assets, thereby reinforcing the need of the workshop to fit into the schedules of busy staff working in the NNU.

Conclusions: The results of this study indicate that within a relatively short period of time, quantitative improvements in participant knowledge of TBI and suicide, along with ways to deal with at-risk patients can be observed. The nature of the workshop makes it easily amenable to presentation at facilities other than St. Michael's Hospital that deal with TBI patients. Researchers, educators and clinicians seeking to run similar workshops in their own healthcare settings can modify this workshop to suit the demographics and requirements of any participants.

0275

Supporting Survivors and Caregivers after Acquired Brain Injury: A program for regaining control of your life.

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Objectives: An innovative, evidence-based program has been developed for caregivers and family members to provide psychosocial support to people with ABI in daily life. Using a structured protocol for interviewing and information gathering, caregivers and family members identify goals and needs of survivors and explore strategies and resources to address them. The program is designed to facilitate discussions between caregivers and survivor and reinforce the survivor as the locus of control for decision making and life planning. This method helps the person with ABI reassert control over his/her life again and build a new future. This method is based on experience and findings from people with ABI, their families and caregivers.

Method: The program comprises two successive phases: Exploration (personal profile) and

Evolution (working with goals). The Exploration phase focuses on acquiring information about the person with ABI (about personality, abilities and What to achieve?), about the person's life (What about your pre-injury life and post-injury life?) and aspirations for the future. This phase examines diagnoses, abilities and limitations, pre-injury development, life events, coping strategies and lifestyles. The method distinguishes twelve life themes: 1) appearance, 2) health, 3) family relationships, 4) sexuality, 5) work, 6) recreation, 7) social contacts, 8) housing and housekeeping, 9) finances, 10) certainty about future, 11) independence, and 12) meaning in life. Comparing each life theme before and after the BI helps the person self reflect from a new perspective. It also increases the understanding of the individual by his/her social network.

In the Evolution phase, the person's aspirations are defined as concrete goals with a plan of action. (Start, Find the question behind the question, Plan, Do, Evaluate). The model is flexible so the sequence of phases and various components can change depending on the individual's priorities. The Question behind the question phase is very crucial in this method and specific for people with ABI.

Results: Interviews with 40 persons with ABI and 40 caretakers were conducted using two standardized and validated dutch checklists on satisfaction with care and quality of life prior to using the method, at one year and again 6 months later. There was a control group of 20 persons with ABI and 20 caretakers.

People with ABI reported increased satisfaction with care with the use of this method. Quality of life was enhanced in all respects and individual goals attained more often. The caretakers found it a very useful and meaningful method and were willing to continue using the method and advised colleagues to do so as well.

This program can be used in clinical settings as well in individual home settings, by caretakers and also by family-members.

Conclusions: The results are significant, demonstrating that this program contributes to improving their quality of life and enhancing satisfaction with the care received by persons with ABI.

0276

Post-Traumatic Stress Symptoms after Traumatic Brain Injury at 3 and 12 Months Post-Injury: A Prospective Study

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Objectives: Post-traumatic stress symptoms can occur among individuals who sustain a traumatic brain injury (TBI) during a traumatic event. The aims are to investigate the frequency of severe posttraumatic stress symptoms after TBI at 3 and 12 months postinjury, and the variables associated with post-traumatic stress symptoms.

Method: A prospective study including 115 participants (16–55 years) with mild, moderate, and severe TBI. The Impact of Event Scale-Revised (IES-R), Coping Style Questionnaire (CSQ-30) and Hospital Anxiety and Depression Scale (HADS) were administered. The original IES (0, 1, 3, 5) scoring was used with a cut-off score above 43 for severe posttraumatic stress symptoms. The independent predictors evaluated for posttraumatic stress symptoms (IES-R total score) at 12 months were age, gender, posttraumatic amnesia, and Intrusion, Avoidance, and Hyperarousal subscales of IES-R, Avoidant-, Emotion-, and Task-focused coping styles of CSQ-30, and Depression subscale of HADS assessed at 3 months.

Results: Approximately 11% of individuals scored above cut-off for severe posttraumatic stress symptoms at 3 months and 6% at 12 months. No significant differences were found between the three TBI groups. The regression model best explaining the variance in the intensity of posttraumatic stress symptoms at 12 months included greater levels of avoidance, hyperarousal, and depressive symptoms at 3 months, and younger age. Significant correlations were found between scores on Avoidant-focused coping style and the three clinical subscales of IES-R.

Conclusions: This study identified four variables present at 3 months that were associated with posttraumatic stress symptoms at 12 months. The low percentage of posttraumatic stress symptoms is in accordance with other studies. However, the results have implications for the importance of early interventions for a small, but vulnerable subgroup.

0277

Traumatic brain injury in young adults injured during childhood; medical invalidity, education and employment

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Objectives: The incidence of severe traumatic brain injury in Sweden has been estimated to 12/100 000. The care of patients with TBI has improved, more patients survive and are in need of care and rehabilitation. Sequelae are common, many suffer from cognitive, behavioral and neuropsychological deficits. Children with a severe TBI have more difficulties in school and require more help, compared to children with a mild or moderate TBI. There is also a higher risk of unemployment among those who had a TBI. Medical invalidity is graded by an insurance company, and is crucial in determining the insurance amount.

The aim is to describe employment, level of education and return to school, education and work in children and adolescents who suffered a TBI 15–20 years ago, and to analyse their contact with insurance companies and the occurrence of medical invalidity.

Method: 37 persons surviving a TBI during 1987–91 in the south-western Swedish health care region, aged 0–17 years.

This is a descriptive study. We used a questionnaire with questions in 4 subject fields: employment, absence due to illness, insurance and medical follow-up. If permission was given, we also contacted the subjects by phone.

Results: 37 persons participated, 17 (45,9%) females and 20 (54,1%) males. 21 (56,8%) persons were injured in a traffic accident and 16 (43,2%) were injured in other accidents. Half the population (20 persons, 54,1%) were working, 5 (13,5%) were unemployed and 4 (10,8%) had granted an early retirement pension. 19 (51,4%) had received compensation from an insurance company, and 12 (35,3%) had a medical invalidity grade. 12 (33,3%) were on medication and 5 (13,9%) had a medical follow-up. There were more people working and fewer unemployed among those injured in a traffic accidents. Everyone who had granted an early retirement were injured in traffic accidents but fewer had been absent due to illness. There was also a larger part who had a medical invalidity grade and insurance compensation.

Conclusions: The results confirm that people suffering a TBI are worse situated in labour-market than the general population. Sequelae are common. The educational level in this study does not seem to be lower compared to the general educational level for young adults. Remarkably few have received compensation from an insurance company. Those injured in traffic accidents were better situated in labour-market although they were more severely

injured when admitted to hospital. A larger part of this group had insurance compensation.

0279

The Dutch Approach in Pediatric Brain Injury: The Development of National Models for Family Support and Return to School

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Objectives: Like in many other countries support for families with a brain injured child and education for brain injured students is not optimal. We studied the national situation and developed national models for family support and return to school.

Method: To study the national situation a questionnaire was sent to all relevant family-support providers (N=121) and schools for special education (N=147).

Two panels of professionals were established in order to develop first versions of a Toolkit for family support and a protocol for school re-entry.

Results: Our study into the national situation revealed that in 2008 nationwide only 88 families with a brain injured child received family support in the day-to-day situation at home. Furthermore 314 children with a brain injury were known in schools for special education. Family support as well as education in most cases were not brain injury specific.

A Toolkit was developed containing 19 tools which can be used to support families and a protocol was designed to improve (the routing to) appropriate education. Both products will be presented. Tools for family-support are currently being applied to a limited number of families. Some preliminary results will be presented.

Conclusions: The realization of these models improved long-term support for children with brain injury and their families in the country. The models have to be tested on larger number of families and children and adapted to the development of these children. A growing number of children and families must benefit from these new possibilities.

0280

Identification of problems of patients with Traumatic Brain Injury based on the International Classification of Functioning, Disability and Health

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Objectives: The aim is to identify the common health problems in patients with Traumatic Brain Injury (TBI) using the International Classification of Functioning (ICF) in order to provide health professionals a common language to describe a TBI patient's profile of problems.

Method: This is an international multicentre cross sectional study which is part of the preparatory phase in order to develop the ICF Core Sets for TBI. A sample of TBI patients using information based on the ICF checklist that included additional categories based on a literature review was described. Patients over 18 years, diagnosed of TBI without any comorbidity that could affect his or her function were included. Results were dicotomized in meaning a "problem" (1,2,3,4) and "no problem" (0). Comparisons between inpatients and outpatients as well as differences in Rancho Los Amigos level of cognitive functioning were analyzed.

Results: 103 patients that fulfilled the eligibility criteria were recruited. The mean age was 32 years and 80.6% were male. The mean Glasgow Coma Scale (GCS) was 5(SD=2.3). There were 24 inpatients and 78 outpatients. Related to "body functions" (b), the most affected areas were those regarding mental and musculoskeletal functions whereas all the chapters from "activities and participation" (d) were represented as a problem: 39.02% from "b" that meant a problem in more than 50% of patients contrasted with a 74.57% from "d". Regarding "environmental factors" (e) those categories related to "products and technology" and "relationships" and "attitudes" from family and health professionals were seen as facilitators, specially in the hospitalization phase. More than 90% of the outpatients have a problem in "labor and employment".

Conclusions: This study showed that the ICF could be helpful in providing a tool to describe a functioning profile of TBI patients. The identification of the patient's problems based on a common and international language may be of an incredible help in order to determine which interventions should be done for these patients, particularly in multidisciplinary care environments.

0281

Accuracy of functional imaging (PET and SPECT) in patients with TBI: a meta-analysis.

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Objectives: Structural cerebral imaging (CT, MRI) can fail to show abnormalities after traumatic brain injury (TBI), especially in mild TBI (MTBI). This often raises controversy about the possibility of an organic basis of symptoms. Single photon emission computerized tomography (SPECT) studies (nearly all retrospectively) show that about 75% of these patients have abnormal cerebral perfusion. To reliably relate symptoms of patients to perfusion abnormalities high accuracy is necessary, especially in performing (follow-up) intervention studies. Hitherto no meta analysis on the accuracy, by means of sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV), of functional imaging in patients with TBI has been performed in which both SPECT and PET studies are reviewed.

Method: Pubmed, PsychInfo and reference lists were searched for studies on the combination of TBI and SPECT or PET imaging. Meta analysis on sensitivity, specificity, PPV and NPV was performed.

Results: SPECT-studies: 73 Studies (of which 13 are case studies) were found. SPECT-scans are analyzed visually in 54% and by computerized techniques in 46% of studies. 31 Studies provided sufficient information to define sensitivity and 9 studies to define specificity, PPV and NPV of SPECT on TBI. Despite great variability between studies, the meta analyses showed that sensitivity (78.1%) and NPV (72.5%) of SPECT are much higher than of structural measures (respectively 39% and 53%). Specificity (73.7%) and PPV (84.4%) of SPECT are lower than of structural imaging (89.4% and 88.6% respectively).

PET-studies: review is running at the moment.

Conclusions: This is the first and nevertheless promising meta-analysis on accuracy (by means of sensitivity, specificity, PPV and NPV) of SPECT and PET in TBI-research. It is of great concern that only a very limited number of studies could be used to define accuracy. This underlines the need for standardized analysis. Current analysis gives clear evidence to combine structural imaging (high specificity and PPV) and functional imaging (high sensitivity and NPV) in optimizing diagnostic evaluation and intervention studies.

0282

Behaviors and Supports for Belongingness after Injury

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Objectives: Belongingness is defined as the universal human need to form stable, positive attachments and has been identified as one of the strongest empirical predictors of health and well-being (House, Landis & Umberson, 1988; Uchino, Uno & Holt-Lunstad, 1999). The absence of connections to groups or people has been shown to increase the risk for impaired physical health, disease, immunosuppression, and mental illness (Sapolsky, Alberts & Altmann, 1997; Tomaka, Thompson & Palacios, 2006). The perception of belongingness, post-injury, and its relationship to social, physical, and emotional success has received some initial research attention. Failed belongingness has been identified as a risk for suicidal behavior among injured veterans (Brenner, Gutierrez, Cornette, Betthausen, Bahraini & Staves, 2008; Joiner, 2005) and may play a large role in the adversities associated with the poor outcomes of post-concussive disorder (Ruff, Camenzuli & Mueller, 1996). These findings support the development of interventions specifically targeting belongingness and suggest it may be a fruitful way to avert deleterious long-term outcomes. This presentation will highlight the existing data and provide additional information from programs in Colorado and the U.S. that build belongingness for people and families after brain injury. Areas of focus will be psychological impact, behavior modifications, vocational rehabilitation and education.

Method: A survey of existing literature and program evaluation.

Results: Hands-on results-driven information that can be implemented in a wide range of settings.

Conclusions: Belongingness dictates success in life and, more importantly, post-injury. The perception of community can be the difference between optimal recovery and a negative rehabilitation outcome. Programming specifically targeting belongingness is grounded by the existing research and clinically useful across settings.

0283

Recovery process of Attention and Executive Functions in Children after Severe Traumatic Brain Injury

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Objectives: Attention and Executive Functions (EF) are frequently impaired following Traumatic Brain Injury (TBI). The severity of injury, as measured by various neurological parameters, can impact on the recovery process of these functions. There is paucity of data regarding the recovery process of these cognitive abilities during the sub-acute phase after severe TBI.

Objectives:

To examine the relationship between recovery from Post Traumatic Amnesia (PTA) and Post Traumatic Confusion (PTC) to attention and EF abilities.

Method: Sample: 50 children after severe TBI, aged 6–18 years, admitted to a single sub-acute Rehabilitation Department between the years 2004–2009.

Method: Data were collected during the acute stage, using a variety of cognitive tests- PTA duration: “Three Words Test” (Stuss et al., 1999); Attention: Auditory Digit Span F (DS_F), The Test of Everyday Attention for children (TEA-Ch); EF: Behavioral Assessment of the Dysexecutive syndrome for Children (BADS-C), Auditory Digit Span_B (DS_B). Children were assessed after recovery from Post Traumatic Confusion (PTC) (M = 33.4 days post injury), and before any intervention.

Results: The average time of recovery from PTA was 37.5 days (SD = 3.5). PTA and PTC duration were highly correlated. PTA correlated highly with performance on 5 out of the 7 subtests of the TEA-Ch, but not with any of the subtests of the BADS-C. In addition, PTA significantly correlated with DS_F test, but not with DS_B. Finally, a positive correlation was found between the BADS-C and the DS_B.

Conclusions: The results suggest a dissociation between different cognitive processes during recovery from childhood TBI. While PTA was found to be correlated with several attentional functions it did not correlate with performance on EF tasks. Subsequently, differences in performance on the Auditory DS task also contribute to the possible dissociation. The observed differences in the two cognitive domains should be considered when planning rehabilitation interventions.

0284

Confusion and Amnesia in Children Recovering from Traumatic Brain Injury

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Objectives: Background: Traumatic brain injury (TBI) is a common cause of neurological disability during childhood. Many of the survivors of the more severe injuries will experience significant cognitive deficits across their life span. Understanding the process of recovery in awareness, orientation and memory is important for devising appropriate rehabilitation interventions. However, there is paucity of data regarding the recovery profile in children after TBI.

Objectives:

- (1) To examine the recovery pattern of awareness, orientation and learning after severe TBI, using the scheme devised by Stuss et al. (1999)
- (2) To compare children’s recovery profile with that reported in adults.

Method: A prospective study of 50 children aged 6–18 years, admitted to one sub-acute rehabilitation department, between the years 2004–2009. Children were evaluated using a variety of cognitive tests:

- (1) The Rancho Cognitive Scale (RCS) – for evaluation of cognitive state and awareness
- (2) The Children Orientation and Amnesia Test (COAT) – for evaluation of Post Traumatic Confusion (PTC)
- (3) The “Three Words Test” – for evaluation of Post Traumatic Amnesia (PTA)

Results: Children showed recovery from PTC and PTA when they reached RCS = 6 (M = 31 days from injury). PTC and PTA durations were highly correlated. However, in 40% of the children there was a significant interval (3–17 days) between recovery from confusion (PTC) and the recovery of the ability to learn new information (PTA).

Conclusions: The results suggest a hierarchical recovery pattern following severe TBI in children, similar to that shown in adults. The dissociations between PTA and PTC speaks for separate neurological networks undergoing recovery. This pattern of recovery has significant implications for rehabilitation intervention that will be discussed.

0286

The use of social network analysis in the study of neurotrauma networks

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Objectives: Optimal service delivery for individuals with traumatic brain injury (TBI) can be provided by different organizations linked in various ways within trauma networks. The configuration of these networks, the place each actor holds within it as well as the type of links established between organizations are likely to influence service delivery performance. However, few methods have been proved useful to systematically describe and analyze trauma networks. This lack of systematic description creates, at the organizational level, another “black box” that limits our understanding of the contribution of service organization to the outcomes of individuals with TBI. Borrowed from social science tradition, social network analysis (SNA) could represent an interesting methodology allowing a systematic and reproducible description of trauma networks. SNA represents a method of collecting and analyzing data from multiple organizations that may be interacting with one another, with a special interest in the exam of relationships across and among network members (Provan, 2005).

Method: A review of scientific and methodological articles allows an in-depths analysis of SNA methodology and its applicability in the study of neurotrauma networks. Both scientific and pragmatic criteria were used in the analysis. In addition, we conducted a pilot study using SNA methodology with the goal of describing an existing regional neurotrauma network. Internal documents and questionnaires provided data about 25 organizations delivering care to TBI patients. Following SNA principles, we analyzed the network density, the organizations' centrality, and the type and multiplicity of relationships between these organizations using Ucinet software.

Results: SNA methodology was found scientifically and pragmatically applicable for the study of neurotrauma networks. SNA provided a framework that accurately describes the integrative characteristics of organizations and that is reproducible. In the pilot study, the regional neurotrauma network was identified as moderately dense, with the stronger links established between the acute care and the rehabilitation centers. Others organizations implicated in the continuum of care were less central and their links to other components were weaker.

Conclusions: Social network analysis appears to be a promising methodology, useful for the analysis of trauma networks. We suggest that this methodology

could be used to monitor network growth and consolidation, or to compare different networks configurations. The use of SNA contributes to opening the organisational “black box” of service delivery provided to individuals with TBI.

0287

Deep Regression after Severe TBI-unexplained neurobehavioral phenomena.

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Objectives: There is paucity of data on regressive states after brain injury. We describe five previously healthy patients who sustained Severe TBI but after gaining their consciousness developed deep regression in cognitive, emotional and behavioral domain.

Method: Multiple case study. Five patients suffered from severe brain injury were hospitalized to the rehabilitation hospital and received the intensive multidisciplinary treatment. All our patients were young, only one of them was male, and he was the only one whose regressive state was transient. None of them was guilty of an accident, no suit was brought against any of them, and authenticity of their behavior is not given rise to doubt. The clinical observations, neuimaging data and the fragments of the psychotherapy sessions are described.

Results: The most common denominator between their clinical pictures and their most prominent feature was striking puerility, as if head trauma turned them into children, mostly noisy, obstinate, and ill-bred ones.

One of them improved in short time after the beginning of rehabilitation, the two others improved very slowly and regain partial recovery in term of the behavioral and cognitive symptoms and the two young female patients demonstrated persistent regressive behavior without any tendency to improve.

Conclusions: It is well known that Severe TBI causes significant cognitive, emotional, and behavioral disturbances but clinical pictures of above described patients especially their astonishing childishness, are much beyond what we are used to see in head trauma rehabilitation or in psychiatric practice.

The factors that may be involved in pathogenesis of this phenomenon: One can assume that in some cases of severe head trauma a brain losses, temporarily or permanently, its latest learned abilities that correspond to adult behavior – inhibitions, social conduct etc. and the most vulnerable networks that have provided “adult” behaviors (prefrontal medial cortex).

The role of emotional component and especially anxiety and may be, past traumatic experiences. Imbalance between networks supporting high executive functions (DLPFC), and networks supporting emotional functions (OFPFC, Limbic System).

The role of previous personality/experiences.

0288

A Prospective Analysis of Post-Traumatic Cephalalgia Etiology and Time of Onset in 100 Persons Referred for Concussion

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Objectives: The extant literature is replete with disparate views and data regarding the incidence of post-traumatic cephalalgia (PTC), the underlying etiology of the condition and the typical time of onset of the condition. The degree to which post-traumatic cephalalgia is in fact related to concussion is also a major point of contention across clinicians, as well as, the evidence based literature. In part this latter point is made more complex by the apparent inverse relationship between severity of brain injury and incidence of headache reports. Most of the studies of post-traumatic cephalalgia have been retrospective and typically have relied on self-report and IHS criteria for classification. There are no prospective studies that we are aware of that have relied on both questionnaires and actual physical examination of the patients in question.

Method: One hundred consecutive referrals of persons with presumptive/documentated concussion (i.e. mild traumatic brain injuries) who were at least one week post-injury will be presented. All patients had complaints of persistent post-traumatic cephalalgia. All referrals were made to a tertiary treatment center that specializes in acquired brain injury care. Each patient completed a general questionnaire, as well as, a headache questionnaire, the latter which included details of time post injury for headache onset, location, character, manner in which

headaches currently had their onset (insidiously or suddenly), duration, exacerbating and remitting factors, severity and frequency, trigger factors, associated symptoms, functional consequences, as well as, individual and family history of headaches (similar or disparate), among other questions. Patients were divided into Worker’s Compensation, medicolegal and non-WC/legal groups. All patients underwent elemental neurological exams and directed musculoskeletal and additional focused examination based on the headache questionnaire results.

Results: The presenters will review data for the following findings: time of onset of headache, sex differences in headache time of onset, severity and frequency, mechanism of injury involved in generation of PTC, locations (primary and secondary) of PTC, character of PTC, type of PTC suspected based on questionnaire findings, correlation of headache subtypes with the sex of the individual, individual and family history of headache, as well as, correlation of complaints of headache as well as magnitude with WC or medicolegal status versus none. Based on questionnaire results and exam findings, each patient’s headache subtype(s) will be noted and correlations made with the reported degree of functional disability, type of injury (vehicular, fall, assault or other), individual and family headache history, use of headache medications (relative to concerns about rebound headache from medication overuse) and legal status of their injury.

Conclusions: Post-traumatic cephalalgia is a frequent concomitant of MTBI, cranial trauma and cervical injury. PTC has multiple causes that require in-depth assessment by both appropriate intake questionnaires and focused physical examination. It is more common than not, that any given individual will have multiple pain generators responsible for their headache that must be treated holistically in order to optimize results. Understanding the myriad contributors to PTC including appreciating the high incidence of cervicogenic contributors, as well as, the risk factors for specific headache subtypes based on pre-injury and injury history is also crucial to optimizing treatment outcomes.

0289

Recombinant Factor VIIa (rFVIIa) increases anti-inflammatory response in cerebrospinal fluid after traumatic brain injury (TBI) in swine.

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Objectives: Introduction: The use of recombinant activated Factor VII (rFVIIa) as adjunctive therapy to stop acute post-traumatic hemorrhage and to reverse iatrogenic coagulopathy has been investigated abundantly. It was found that rFVIIa has neuroprotective effects in traumatic brain injury (TBI), independent of its hemostatic properties. However, the underlying mechanisms have not yet been elucidated. In this study, we investigated the effects of pre-hospital bolus administration of rFVIIa on inflammatory markers in cerebrospinal fluid (csf) and serum in a swine model of TBI.

Method: Materials and Methods: 20 Yorkshire swine under isoflourane inhalation anesthesia were subjected to moderate isolated TBI from fluid percussion injury (2–3.5atm). At 15 minutes (T15) post-injury, animals were randomized to receive either a bolus of rFVIIa (90 µg/kg bodyweight, n = 10) or nothing (NON, n = 10). After simulated hospital arrival at T60, animals received standard of care treatment and were euthanized at T360. Cerebrospinal fluid (csf) and blood were collected before injury (T0) and T360. We present preliminary data analysis of in-vitro quantitative determination of plasma and csf cytokines (TNF- α , IL-1 β , and IL-10) by using solid phase sandwich Enzyme-Linked-Immuno_Sorbent Assay (ELISA, Invitrogen corp., CA) according to manufacturer's instructions. Further assays (albumin, IL-4) are still underway.

Results: Results: Animals in the rFVIIa group had a more than 300% increase in csf IL-10 concentration from T0 to T360 compared to a 10% increase in the NON group ($p = 0.037$). Serum concentration of IL-10, as well as TNF- α remained constant, and there was no difference between groups. Csf concentration of TNF- α increased by 26% in the NON, and by > 400% in the rFVIIa group. Difference between groups was significant ($p = 0.109$). IL-1 β concentration in serum increased in both groups with rFVIIa group showing higher increase at T360 (69% vs. 56% in NON). IL-1 β concentration in csf was elevated in both groups at T0 (rFVIIa – 366pg/mL, NON – 446pg/mL), and there was no significant change in IL-1 β concentration at T360.

Conclusions: Preliminary data of this swine model of TBI suggests that administration of rFVIIa plays a role in eliciting both anti and pro-inflammatory cytokine response in swine csf, while minimally affecting its serum cytokine concentrations. This immunologic phenomenon needs further exploration. rFVIIa improved neurologic outcomes in our swine model of traumatic brain injury (previously reported). This suggests that rFVIIa

may play a neuroprotective role by modulating cytokine expression in csf in swine traumatic brain injury.

0290

The Use of Relationship Meetings to Overcome Social Awareness Issues Resulting from TBI

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Objectives: This presentation will review the clinical use of 'Relationship Meetings' to assist with social awareness issues that individuals with traumatic brain injury may be challenged by when they are in significant relationships. Social Awareness deficits are often a significant and devastating result of a traumatic brain injury and can severely impact the person's ability to successfully negotiate a primary relationship. This presentation will:

- (1) provide an overview of social awareness issues that individuals may have as a result of experiencing a traumatic brain injury
- (2) provide an overview of the techniques used in clinical 'Relationship Meetings' to address social awareness issues that impact a primary relationship
- (3) provide results of a qualitative study of four couples who have experienced "Relationship Meetings" for at least three years.

Method: The study of the clinical use of 'Relationship Meetings' was done by examining four measures of success for the relationship: (1) longevity of the relationship, (2) client self evaluation of the success of the relationship, (3) client evaluation of the success of the Relationship Meetings and (4) therapist evaluation of the success of the Relationship Meetings.

Results: Results will be provided regarding the qualitative study of four couples who have experienced 'Relationship Meetings' for a minimum of five years. For the four couples, the use of 'Relationship Meetings' have been used over the past three to twelve years, meeting weekly, monthly or quarterly, depending on what was deemed as needed. The clinicians who have recommended and provided these 'Relationship Meetings' have concluded that these meetings appear to be essential to the longevity of the relationships studied. In addition, these meetings provided a means for a couple where one person has experienced a traumatic brain injury to

improve social awareness issues that negatively impacted the relationship.

Conclusions: 'Relationship Meetings' when done properly provide a critical clinical means for a person with a traumatic brain injury to successfully address social awareness issues that impact their primary and significant relationship. Finally, the use of 'Relationship Meetings' appears to improve the quality of the relationships and the quality of life for the four couples presented in the study.

0291

A literature review on occupational therapy interventions to reduce the burden of caregivers of individuals with TBI.

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Objectives: Interventions in occupational therapy (OT) address the individual – environment system. Family members are an important component of the environment of individuals with traumatic brain injury (TBI). They can facilitate the social participation of person with TBI, but they might themselves experience significant burden. Occupational therapists should thus better understand what could influence the family member/caregiver' burden in order to offer evidence-based interventions that could alleviate it.

Method: A literature review was undertaken in Pubmed, CINAHL and PsycINFO databases using keywords such "burden", "traumatic brain injury", "interventions/programs" and "occupational therapy". Thirty research articles were selected on the base of their relevance for OT intervention. The articles were analyzed and the resulting evidences were classified using the Canadian occupational performance model.

Results: The caregiver burden is mainly a subjective concept, influenced among others by the coping styles and the social support of caregivers. Despite the fact that this concept has been increasingly studied in the last decade, few interventions had been proposed and shown effective in decreasing caregivers burden. Most promising interventions for OT could reside in information and community-based interventions.

Conclusions: Burden is an important concern for close relatives of individuals with TBI, that could

have a great impact on their quality of life. Because burden is mainly a subjective concept, OT interventions must go beyond strictly environmental or physical compensations to be effective. Despite close relatives burden is a relevant problematic to OT, few OT-specific interventions had been studied. More evidences are required to provide OT with evidence-based interventions to reduce the burden of close relatives of individuals with TBI.

0292

Collective capacity in community rehabilitation: A multi-level matrix for sustainability

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Objectives: The community has become a priority focus for health services, not only because it represents an important tactic in reducing pressure on an already stretched primary health system, but that it also provides the most meaningful setting for people with traumatic brain injury to rehabilitate and re-orientate their lives. Indeed, most community rehabilitation organisations are resolute in providing valuable and viable community rehabilitation programs to their clients, and there are many examples of these within Australia and internationally. Characteristically, the most meaningful community rehabilitation programs are usually organic in nature and formed in response to a real service gap, rely on champions to facilitate either within the service or local community, and are propagated and supported through word of mouth rather than systematic or formal structures. They are also often implemented by single organisations with limited funding and finite resource capacity. Paradoxically, it is for these same reasons that providing sustainable community rehabilitation programs remains a persistent challenge for the sector as well as the local communities who participate in them. This paper examines a multi-level strategy for building collective capacity in order to enhance the continued success of community rehabilitation programs.

Method: Applying a social ecological approach originally proposed in the field of organizational management (Astley & Fombrun, 1983), the rehabilitation capacity infrastructure was examined at three levels, namely the individual program, local community and health system. A capacity matrix was developed using a community rehabilitation program as a worked example.

Results: Collective capacity for community rehabilitation is a result of the reciprocal links between the

service environment, systematic strategy and social ecology. By adapting programs to each of these levels, rehabilitation organisations can create significant opportunities to maximise reach, facilitate community ownership and expand connectedness within local communities.

Conclusions: This study identifies a multi-level strategy that both delivers a sustainable solution to the 'difficult to reach and retain' community sector, and offers rational guidelines for rehabilitation organisations to build effective, meaningful collaborations with community.

0293

Naturalistic assessment of executive dysfunction: The value of event recording

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Objectives: The goal of rehabilitation is to improve everyday functioning, yet human behavior in the real world is remarkably complex and difficult to assess. Several researchers have started using event recorders to make data collection and analysis easier during naturalistic assessments. However, to the best of our knowledge this methodology has not been used in relation to naturalistic assessment of executive dysfunction following acquired brain injury (ABI). The purpose of this study is to use an event recorder to expand our characterization of errors and thus allow for a better discrimination between people with ABI and matched controls as they complete the Multiple Errands Test (MET).

The MET is a real-world measure of executive function which requires participants to complete a series of tasks and collect specific pieces of information within the constraints of a set of rules. To date the focus of investigation related to this task has been on understanding the errors people make in terms of inefficiencies or interpretation failures that interfere with achieving tasks and following task rules. To further our understanding of participants' performance problems, we are undertaking a more rigorous characterization of behaviors with the help of an event recorder. We hypothesize that this will allow more sensitive and specific discrimination between participants with ABI and healthy controls. *Method:* Twenty-seven participants with ABI (n = 14 stroke survivors, 13 traumatic brain injury survivors) and 25 healthy controls matched for age, gender and

education were videotaped as they completed the Baycrest MET. The Baycrest MET is a site-specific version of the MET that has good reliability and validity. An event recorder was then used to codify the occurrence, frequency and duration of behaviors occurring as participants attempted to complete tasks. We coded the time it took participants to complete each task, including the route they chose and the amount of time they spent at each location. *Results:* The event recorder allowed coding of multiple behaviors previously not analyzed including the amount of time participants spoke to staff and whether they changed direction in order to arrive at a certain location. We were also able to identify some interesting social rule breaks that were performed. Anticipated results are that we will identify additional behaviors that discriminate between the ABI population and healthy controls.

Conclusions: The study illustrates the utility of event recorders in documenting multiple real-world behaviors as they occur in a test situation. We anticipate that the data will highlight real-world behaviors that are particularly problematic for people with executive dysfunction as they attempt to achieve tasks on the MET and allow for a better understanding of the impact of executive dysfunction on real-world behaviors.

0296

Relationship Between Cerebral Volumes and Functional Rehabilitation Outcomes in TBI

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Objectives: Limited research has focused on factors that relate injury pathology to success of post acute rehabilitation and functional outcome following traumatic brain injury (TBI). As a preliminary investigation, a retrospective assessment was performed using functional outcome and neuroimaging data collected at various stages of recovery during post acute TBI rehabilitation. The purpose was to examine anatomical correlates of recovery and rehabilitation to assess factors that may play a role in mediating success or degree of recovery.

Method: A sample of 38 patients with mild to moderate/severe closed-head TBI were included. These patients had been admitted (either inpatient or outpatient) to a post acute brain injury rehabilitation facility. Functional outcome and imaging data

was collected at various stages of recovery during rehabilitation. Analysis of cortical and sub-cortical volumes was obtained from structural T2 volumetric MRI data. Volumes were extracted for white and gray cortical as well as for subcortical structures and examined relative to functional status measured with the Disability Rating Scale (DRS), the Centre for Neuro Skills Rating Scale (CNS), Mayo-Portland Adaptability Inventory (MPAI), Community Integration Questionnaire (CIQ), Living Status Scale (LSS), and Occupational Status Scale (OSS). *Results:* Correlation analyses were performed to examine the relation between anatomical structures and outcome measures at admission, discharge, as well as change scores. Anatomical structures that were associated with admission scores included caudate white matter (WM) and DRS Admission ($r = -.326$, $p = .046$), thalamic gray matter (GM) and CIQ Admission ($r = .358$, $p = .035$). Anatomical structures associated with change in function and outcome included parietal WM and LSS change ($r = .398$, $p = .015$) and thalamic WM and CNS change ($r = -.355$, $p = .029$). Anatomical structures associated with discharge scores included thalamic GM and DRS discharge ($r = -.429$, $p = .007$) and thalamic GM and CNS discharge ($r = .422$, $p = .008$).

Conclusions: This study extends previous human and animal findings by showing an association between various neuroanatomical structures and functional outcome measures. These associations may provide further indication certain structures including the thalamus may not only play a role in mediating cognitive function but also functional ability. These data also support the role of structural MR imaging in rehabilitation programs.

0297

Incidence of Neuroendocrine Dysfunction in a Postacute, Brain Injury Rehabilitation Setting

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Objectives: Posttraumatic hypopituitarism is an often, undetected consequence of traumatic brain injury (TBI). The symptoms of posttraumatic hypopituitarism overlap considerably with deficits commonly observed in patients with TBI. Symptoms include fatigue, decreased lean body mass, increased abdominal adiposity, reduced exercise capacity, memory impairments, inability to concentrate, anxiety and

depression. Untreated insulin-like growth factor-1 (IGF-1) and growth hormone (GH) deficiencies can negatively influence recovery from brain injury, even if the patient is undergoing intensive brain injury rehabilitation (Bondanelli et al., 2007). The objective of this study was to investigate the incidence of untreated, posttraumatic hypopituitarism in patients admitted to a postacute brain injury facility.

Method: Adults with mild, moderate or severe TBI admitted to CNS-Bakersfield in August 2008 were part of this study. After an overnight fast, venous blood levels of thyroid stimulating hormone (TSH), triiodothyronine (T3), thyroxine (T4), follicle stimulating hormone (FSH), luteinizing hormone (LH), estrogen (females only), testosterone total (males only), prolactin, cortisol (A.M. and P.M.) and insulin-like growth factor 1 (IGF-1) were sent to a laboratory for analysis. Growth hormone (GH) levels are cyclical, making direct measurement difficult. Since IGF-1 is the best marker of GH action available (Freda et al., 1998), IGF-1 was used as an indicator of GH levels. Low levels of IGF-1 increase the likelihood that GH levels are also deficient. However, 50% of adults with GH deficiency have IGF-1 levels in the normal reference range (Lissett et al., 2003). Therefore, provocative testing is required to determine if GH levels are deficient. Glucagon stimulation tests (GST) were conducted on patients whose IGF-1 levels were less than 200 ng/ml. Patients whose IGF-1 levels were below 100 ng/ml were referred to an endocrinologist for treatment (no GST was performed).

The GST provokes GH to reach its peak level within the four-hour testing period, allowing reliable GH measurements to be taken.

Results: Preliminary results indicated that 49% of patients admitted to CNS-Bakersfield had at least one neuroendocrine deficiency. The most common neuroendocrine deficiency was low IGF-1 levels, followed by low testosterone levels. The majority of these patients were male, approximately 44 years of age and were over a year post-injury. Results from patients that required a glucagon stimulation test revealed that approximately 50% of these patients had deficient GH levels.

Conclusions: There is a high incidence of untreated IGF-1 and GH deficiencies in postacute brain injury rehabilitation settings. Hormone replacement therapy has the potential to improve outcome following brain injury. Patients who have received GH replacement demonstrate decreased abdominal adiposity, increased alertness, increased cognitive processing and greater quality of life.

Screening for post-traumatic hormone deficiencies needs to become part of the standard clinical care for patients with brain injury. Multidisciplinary collaboration between case managers, endocrinologists,

neurosurgeons, psychologists and rehabilitation professionals is essential in order to maximize the potential for recovery following brain injury.

0298

Improving the Functional Communication Ability of Adults with Traumatic Brain Injury: Findings of a Randomised Controlled Trial Evaluating a New Treatment.

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Objectives: The majority of adults who sustain moderate or severe traumatic brain injury (TBI) experience difficulties communicating effectively. These communication problems are a source of ongoing stress and have a negative impact on social participation. Currently, a novel approach to functional communication intervention is being evaluated in a randomised controlled trial. The intervention was developed to facilitate the use of productive and reduce the use of non-productive communication-specific coping strategies in everyday situations.

Method: Participants are 54 adults with severe TBI who are living in the community between 1 and 8 years after injury and are continuing to experience communication difficulties. A case control procedure has been used to assign participants to treatment versus waitlist conditions. The structured treatment program incorporates procedures and principles of cognitive behavioural therapy and context-sensitive social communication therapy. Outcome measures include: the La Trobe Communication Questionnaire, the Communication Coping Questionnaire, Clinical Discourse Analysis, the CHART-SF, the Depression Anxiety and Stress Scales and a semi-structured qualitative interview with participants and family members.

Results: Treatment efficacy is being evaluated using a 2 x 4 factorial design, contrasting the waitlist and intervention groups on pre-treatment, post-treatment, 1-month and 3-month follow-up measures. Preliminary results from the first treatment-waitlist pairs on pre-treatment and post-treatment measures are promising.

Conclusions: Communication deficits after TBI place substantial ongoing demands on therapy resources. However, to date there have been relatively few controlled studies of communication interventions.

The results of this study will provide some much needed evidence in the area.

0299

“Always being left out”: The Impact of Communication Impairment on Social Living following Severe Traumatic Brain Injury

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Objectives: The ability to communicate effectively has been described as central to developing and maintaining relationships. Nevertheless, there has been surprisingly little research that has addressed specifically the role that communication outcome plays in developing and maintaining social relationships following TBI. The aims of this study were three-fold: 1) to explore how people who have sustained severe TBI experience communication in social contexts; 2) to gain insight into those aspects of social communication that are experienced as problematic by people who have sustained severe TBI; and 3) to determine the magnitude of the relationship between communication impairment and long-term social integration after severe TBI.

Method: A mixed quantitative-qualitative methodology was used to understand the relationship between communication and social integration. Thirty-one TBI participants (22 men, 9 women) with 31 close others (12 mothers, 4 fathers, 8 wives, 3 husbands, 4 sisters) were interviewed and completed the R-CHART and the La Trobe Communication Questionnaire (LCQ). TBI participants had all sustained severe injuries (PTA mean 33.5 days, SD 16.7) and were living in the community at the time of interview (mean 2.7 years after injury, SD 0.5). They were aged between 17 and 48 years at the time of injury. Transcribed interviews were coded and analysed using principles of Grounded Theory.

Results: Both self and close other scores on the LCQ made a significant contribution to prediction of social integration. Two broad themes emerged from the qualitative analysis. The first described the experience of social exclusion and the second focussed on challenging communication experiences in the social context. Overall, there was striking overlap between the qualitative and quantitative findings that shed considerable light on the nature of communication behaviours that have a negative impact on developing and maintaining social relationships.

Conclusions: The results highlight the importance of social communication in facilitating participation in

the community and building relationships to support ongoing emotional adjustment. In addition, the findings characterise the ongoing communication needs of this population from the insider's perspective and identify specific aspects of social interactions that are likely to require direct attention during rehabilitation.

0300

Interpreting Facial Expression after Traumatic Brain Injury: The Role of Visual Scanning

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Objectives: The ability to perceive the human face and interpret its emotional context is central to social interaction. People with TBI consistently perform more poorly than controls on tasks requiring interpretation of facial expression. Appraisal and determination of the emotional significance of facial expressions first requires the generation of an adequate percept of the seen face. Perception is dependent on the efficiency and distribution of gaze control and the integration of information acquired across eye fixations. A person's visual scanpath represents the pattern of eye movements and fixations that are made during visual processing, provides an index of overt attention to face stimuli and reveals the nature of information acquired from a stimulus. Visual scanpaths to facial expressions have been examined extensively in non-patient groups and in individuals with schizophrenia, autism, social phobia and focal amygdala damage. However, to date there has been relatively little exploration of the visual scanpaths of individuals with impaired processing of facial expression following TBI. In this study, our objective was to compare the eye movement patterns displayed by adults with TBI when interpreting facial expressions to the patterns displayed by neurologically normal matched controls.

Method: Participants were 10 adults with severe TBI (posttraumatic amnesia >14 days) who were at least 2 years postinjury and 10 controls matched for gender and age. All participants were required to have no less than 6/12 vision (corrected or uncorrected). Stimuli were 18 pictures of facial expressions depicting the six basic emotions (sadness, happiness, anger, surprise, fear and disgust) and 15 pictures of objects. The Tobii 1750 binocular infrared eye tracker (Tobii Technology, Stockholm, Sweden) recorded eye movements as

participants viewed stimuli displayed on the eye tracker monitor.

Results: Overall, the TBI group performed significantly more poorly than the control group on the facial expression task. In addition, the visual scanpaths of the TBI group differed significantly from that of the neurologically normal controls. Differences included increased number, duration and dispersion of fixations in the scanpaths of TBI participants. Visual scanpath differences between the groups were limited to the facial stimuli.

Conclusions: These results indicate that in some cases impaired visual scanning contributes to impaired interpretation of facial expression after TBI. Further research is underway to determine if intervention aimed at directing eye movements can improve performance empirically and functionally in cases where impaired recognition of emotional facial expressions is linked to disordered perceptual processes.

0301

Health Related Quality of Life and Life Satisfaction 6 to 15 years after traumatic brain injuries in Northern Sweden

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Objectives: Long-term outcome following a traumatic brain injury (TBI) is not yet fully understood. The objective of this study was to describe and analyse health related quality of life (HRQoL) and life satisfaction in a sample of individuals in northern Sweden that had been transferred for neurosurgical care following a TBI from 1992 to 2001.

Method: A total of 67 individuals (age 18 to 65 years of age) were assessed 6–15 years after the TBI. All individuals were interviewed and completed the Swedish versions of the Short Form (36) Health Survey (SF-36) and Satisfaction with Life Scale (SWLS), along with structured supplementary questions about their appraisal of the TBI.

Results: The time since injury was on average 10 years. The mean age of the 51 men and the 16 women was 44 years. Thirty-two individuals had a mild TBI and 35 had a moderate to severe TBI. Traffic accidents were the most common cause of

injury. The HRQoL was significantly ($P < 0.001$) lower on all of the SF-36 subscales, except the subscale emotional role functioning, compared with a Swedish age and sex adjusted general population. Life satisfaction was also significantly ($P < 0.001$) lower compared with other studies on healthy individuals. Multivariate regression analysis revealed, in accordance with other studies, that sex and injury severity were of minor importance predicting HRQoL and life satisfaction several years after injury. Working or studying was strongly related to self-reported physical health, and sustaining a TBI at an older age was the strongest predictor for better mental health. Higher rated life satisfaction was more common among those who were married and productive at follow-up, which in turn were more likely in individuals that were older at the time of injury, had more severe injuries, and perceived a relatively low impact of the TBI on their life.

Conclusions: This study suggests that current vocational situation and self-appraisal are more important than background variables such as sex, age at time of injury, and injury severity for subjective HRQoL and life satisfaction among individuals with a TBI many years after the injury.

0302

Long-term outcome after traumatic brain injuries in Northern Sweden

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Objectives: Long-term outcome following a traumatic brain injury (TBI) is not yet fully understood. The objective of this study was to describe and analyse long-term outcome of a sample of individuals in northern Sweden that had been transferred for neurosurgical care following a TBI from 1992 to 2001.

Method: A total of 88 individuals (age 18 to 65 years of age) were assessed 6–15 years after the TBI. All

individuals were interviewed and completed the Swedish version of the Mayo-Portland Adaptability Inventory (4th version; MPAI-4). The MPAI-4 provides scores for the total scale, and for the three subscales: Ability, Adjustment, and Participation. Higher scores indicate more severe problems or obstacles in the assessed aspects.

Results: The time since injury was on average 10 years. The mean age of the 67 men and the 21 women was 44 years. Forty individuals had a mild TBI and 48 a moderate to severe TBI. Traffic accidents were the most common cause of injury. Higher scores on the MPAI-4 total scale were significantly related to ($P < 0.05$): more severe injury, lower levels of education and older age at time of injury, and to ($P < 0.001$) being single/not married, and not working or studying. Less severe injuries, being married/cohabitating and productive, were significantly related to better outcome on all three subscales. To be productive was significantly related to almost all items in the scales (except the item concerning hearing problems), and along with individuals that were married/cohabiting significantly related to less problems (lower scores) on all items in the participation subscale. Time since injury was not related to any item or subscale. The results indicate that the Participation subscale of the MPAI, compared to the Ability and to a lesser degree the Adjustment subscale, has the strongest relationship with factors predicting long-term outcome.

Conclusions: This study suggests that injury severity, vocational situation and marital status are important variables for long-term outcome among individuals following a TBI whereas sex, age at time of injury and educational level are less important.

0303

Training communication partners of people with traumatic brain injury (TBI) improves casual conversational interactions

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Objectives: Communication impairments following severe TBI can lead to inappropriate social

behaviour, causing a breakdown of family and peer relationships and social isolation. Minimisation of these lifelong effects is essential to quality of life and strong relationships. Two treatments have been shown to improve communication in people with TBI: (i) social skills training for the person with TBI alone and (ii) training communication partners to deal with difficult communication behaviours. However, no research has concurrently compared these approaches. This paper reports the findings of a controlled group comparison study that aimed to determine which of the two treatments is more effective in improving everyday conversational interactions compared with a delayed treatment control. *Method:* 44 participants with severe TBI who had identified social communication impairments and their everyday communication partners (ECP) participated in the study. Based on ECP availability, participants were allocated to one of the three groups (JOINT, $n=14$; TBI SOLO, $n=15$; and CONTROL, $n=15$). For the two treatment groups (JOINT and TBI SOLO), training comprised 10 weekly 2.5 hour group sessions with an additional 1 hour, 1:1 session with the clinician. ECP participants in the JOINT group attended with their relative with TBI. The ECPs were trained in strategies to maximise communicative effectiveness of the person with TBI. The TBI SOLO participants attended a social communication training program on their own. Their program contained parallel content to the ECP program. Both treatment groups received specific conversational skills training based on previous training programs developed by Togher et al., (2004) and using strategies to facilitate elaborative and collaborative conversations (Ylvisaker et al., 1998). Fifteen pairs constituted a delayed treatment control. Five minute casual conversations were videotaped prior to training and immediately after training. Two blind raters evaluated the randomised videos on four global impression scales (Bond and Godfrey, 1997). The 9-point Likert scales measured how 'Appropriate', 'Engaged', 'Effortful', and 'Rewarding' the interactions were between the person with TBI and their ECP.

Results: Results were analysed with a 3 (Group) x 2 (Time) ANCOVA. There was a group x time interaction for three of the four rating scales. Following treatment, casual conversations were rated as significantly more Appropriate ($p=0.011$), Rewarding ($p=0.025$) and less Effortful ($p=0.043$) for the JOINT group compared to the TBI SOLO and CONTROL groups. No significant interaction or main effects were observed for the degree of Engagement observed in the interactions. For all three groups, Engagement did not improve over time.

Conclusions: Providing training to everyday communication partners improves casual conversations of people with TBI. However, in this study training people with TBI alone did not improve their conversational interactions. Involving communication partners in treatment programs appears crucial for improved communication interactions for people with severe TBI.

0304

A multicentre, randomised controlled study to validate the Abbreviated–Westmead Posttraumatic Amnesia Scale

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Objectives: Recent research has shown the measurement of posttraumatic amnesia (PTA) using the Revised–Westmead PTA Scale (R–WPTAS) is a better measure of cognitive change in individuals following mild traumatic brain injury (mTBI) than using the Glasgow Coma Scale (GCS) (Shores et al. 2008). The aim of the study is to demonstrate the Abbreviated–Westmead PTA Scale (A–WPTAS), a combined form of the GCS (orientation questions and GCS eye opening and motor response scores) and the memory items (3 picture cards) from the R–WPTAS, is capable of identifying the resolution of PTA in participants following mTBI.

Method: A multicentre randomised group design, based on the revised CONSORT guidelines. Participants, aged 18 to 65 years, who presented consecutively to the Emergency Department (ED) of three hospitals, were eligible if they had sustained a mTBI or a non–brain physical injury. Each hospital had four groups (non–brain injured control R–WPTAS, non–brain injured control A–WPTAS, mTBI R–WPTAS, mTBI A–WPTAS). Estimates from power analysis suggested a sample size of 26 per group (104 patients from each hospital giving a total of 312 patients).

Results: Hypotheses to be tested include: 1) Patients who present to an ED with a non-brain physical injury will perform better on the R–WPTAS,

A-WPTAS, and the Westmead Selective Reminding Test (WSRT) than patients with a mTBI; 2) performances on the R-WPTAS and A-WPTAS and the WSRT (the reference memory test) in mTBI patients will not be different, and 3) performances on the R-WPTAS, A-WPTAS and the WSRT will not be affected by pain severity, acute posttraumatic stress symptoms, alcohol levels and opioids. The sample to date comprises of 78 mTBI and 110 non-brain injured trauma controls.

Conclusions: The results will be discussed.

0305

Burnout among caregivers managing severely brain-injured patients recovering from coma: a Belgian study

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Objectives: In this study, our objective was to assess the presence of burnout among caregivers working in neuro-rehabilitation centers or nursing homes and managing severely brain-injured patients recovering from coma.

Method: The Maslach Burnout Inventory (French or Flemish version) was sent to 37 centers involved in the Belgian federal network for the care of vegetative and minimally conscious patients. The following demographic data were also collected: the age, the gender, the profession (i.e., physician, nurse, physiotherapist, speech therapist, occupational therapist, psychologist and social worker), the expertise in the field (i.e., less than 4 years, between 4 and 9 years or more than 9 years), the amount of time spent with the patients (i.e., hours per week) and the working place (i.e., neuro-rehabilitation center or nursing home).

Results: Our results show that 18% of the 509 participants presented a moderate to severe burnout. More specifically, the majority of these participants presented an emotional exhaustion (68%) and a depersonalization (50%). According to univariate analyses, the profession (i.e., nurse), the working place (i.e., nursing home), the amount of time spent with the patients and the age were significantly associated with the presence of burnout. Nevertheless, according to our multivariate analysis, the profession (i.e., nurse) was the strongest variable associated with the presence of burnout.

Conclusions: According to our study, a significant percentage of caregivers, and particularly of nurses, taking care of vegetative and minimally conscious patients presented a burnout. The prevention of burnout among caregivers is crucial as it often leads to a poor patients' care.

0306

Recovery-Suited Rehabilitation Programs for Brain-Injured

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Objectives: Different programs have been described for the rehabilitation of traumatic brain injured patients (TBI). Their efficiency on regard to the importance of the rehabilitation activities is discussed. They often rely on concepts of inter-, multi- or transdisciplinarity. A systemic dimension is sometimes used. Some rare programs are specifically dedicated to the assessment of arousal. Most of these programs involve the whole course of the brain injured patient, from return of consciousness until a state of autonomy allowing the return at home.

Method: We take the reverse option to define specific Programs of care and rehabilitation suited to the various stages of TBI persons: Arousal Program for patients in the early stage of return of consciousness and Post-Traumatic Amnesia (PTA); Physical and cognitive rehabilitation Program for patients at the end of PTA, more or less dependent and who need physical and cognitive rehabilitation; Neuropsychological rehabilitation and reintegration Program: dedicated to independent patients who essentially keep cognitive problems; neurological continuation Program: for conscious but dependent patients, waiting to the return to home or to transfer in an adapted accommodation and who need maintenance rehabilitation and personal activities; PVS/ MCS Program for patients in a chronic altered state of consciousness.

Patients may, according to their recovery, cross one or several programs. An assessment TBI Program is devoted to out-patients who need a brief evaluation, essentially concerning cognitive impairment.

Each program defines objectives, criteria of inclusion, exclusion and release, specific care and rehabilitation activities and specific human and technical means. The architectural dimension, of hospital or rather hotel type, is also adapted to the

need of care and rehabilitation and to the autonomy of the TBI patient.

Results: Preliminary results are presented, one year after the implementation of this new organization of care and rehabilitation in march 2009.

Conclusions: These programs intend to adapt the rehabilitation according the recovery and to reinforce the coordination between care and rehabilitation teams. Their goal is also to prepare the evolution towards a new price setting of Physical Medicine and Rehabilitation Departments in France, according to the realized activity.

0307

Cognitive rehabilitation of TBI drivers : a driving simulator approach - Preliminary Report

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Objectives: Driving is a complex activity which implies many cognitive processes, such as vigilance, selective attention and divided attention. Several disorders are observed in Traumatic Brain Injury (TBI) but most of the time TBI patients have attentional complaints. Thus, following a neurological disorder, resuming driving could represent a risk for the patient and for other drivers (Brouwer et al., 2002). Previous studies have shown that TBI patients can benefit from cognitive rehabilitation (Cicerone et al., 2000) and attention rehabilitation (Park & Inglès, 2001). However, transferability issues between trained cognitive abilities and an ecological context, such as driving, are frequently presented as a major limitation for cognitive rehabilitation.

The purpose of this work is to study whether a “driving oriented” cognitive rehabilitation with a driving simulator could be more efficient than a more “traditional” cognitive rehabilitation. Several driving scenarios have been designed with the objective to stimulate specific attentional processes (alertness, vigilance, selective attention and divided attention) involved in driving.

Method: Two methods are used: one group of TBI patients have driving simulator training and one other TBI group have computer training. Each group have 3 sessions per week (1h/session) during

3 weeks, consequently the revalidation program last about 9 hours. The participants have a pre and post-training assessment in three stages: on the road, on the driving simulator and with neuropsychological tests.

Results: It is expected that the patients with TBI will improve their performance during the training (driving simulator or computer) and will have better performance in post-training assessment compared to pre-training assessment (based on the 3 parameters used: driving on road, driving simulator, neuropsychological tests).

Finally, we expect the simulator training will be more efficient than the computer training to improve driving competence.

This paper will present two case studies of participant with TBI (in each rehabilitation programme) and healthy controls matched for age and gender.

Conclusions: The outcomes may provide a tool (simulator) to rehabilitation centres which facilitate the return to driving.

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0308

The evidence base of neuropsychological rehabilitation using single-participant research designs: how good is the research in acquired brain impairment?

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Objectives: Increasingly, single-participant designs are used to examine treatment effect in people with

acquired brain impairment. These methodological designs are well suited to this population for many reasons, including the capacity to individually tailor treatment to fit the characteristics of the patient. Nonetheless, single-participant designs have been deemed to be methodologically inferior to group methodologies and randomized controlled trials, which are regarded as the gold standard. With the introduction of the Single-Case Experimental Design scale (SCED; Tate et al., 2008), however, there is now available a practical means by which to evaluate the methodological rigor of single-participant designs. The aim of this study was to survey the methodological quality of a sample of single-participant designs reported in the brain injury literature. *Method:* We retrieved 253 single-participant designs archived on PsycBITE (www.psycbite.com), a website that contains all of the published literature on non-pharmacological interventions for acquired brain impairment (Tate et al., 2004). Methodological quality was evaluated using the 11-item SCED scale. Items from this scale represent a minimum core set of established criteria considered necessary for methodological rigor of single-participant research designs. Ten of the 11 items contribute to a method quality score (possible score range 0–10), and the scale has demonstrated high inter-rater reliability (ICC = 0.88; 95% CI: 0.78–0.95).

Results: The 253 trials spanned the range of methodological quality from 0 (1.6%) to 10 (0.4%), with scores forming a normal distribution ($M = 4.67$; $SD = 2.06$). Forty-eight percent of trials scored 4/10 or less, which indicates that less than 50% of the SCED items were passed. No single item on the SCED scale was passed by all trials. The most frequently passed item was item 2 (specification of the target behaviours, 83%). The least frequently passed item was item 8 (independent assessors, 14%), followed by item 11 (generalisation/specificity, 21%).

Conclusions: The results from this study demonstrate that there is considerable variability in methodological quality of single-participant designs in the area of acquired brain impairment. Moreover, many reports had low SCED scores, with nearly half of reports failing to meet criteria on 50% of the SCED items. This raises concerns about the degree to which readers can rely upon the results of those studies with low SCED scores. Efforts are currently being made to improve reporting standards of single-participant studies, and use of the SCED scale provides one means by which researchers can use its items to ensure that the basic criteria integral to single-participant designs are met.

0309

One-year outcome after a severe traumatic brain injury (TBI) in the Parisian area

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Objectives: About 10 Million inhabitants are living in the Parisian area (France). A prospective observational study was undertaken in 2004 to assess the care network, both at the acute and the rehabilitation stages, and the outcome one-year after a severe TBI in this wide region.

Method: Patients with severe TBI were included prospectively in the study by mobile emergency services. Criteria for inclusion were: adults with TBI and a Glasgow Coma Scale score of 8 or less before admission to the hospital. Data on injury severity, management in the acute care unit and in rehabilitation unit (if available) were collected. Surviving patients were contacted by telephone one year after the injury. Global disability was assessed with the GOS-Extended (GOS-E). Cognitive and behavioural modifications in everyday life were assessed with the Dysexecutive Questionnaire (DEX). Quality of life was assessed with the Euro-QOL.

Results: 518 patients were included from July 2005 to April 2007. The mortality rate was 45%. Among the 274 survivors, 135 (49.2%) could be contacted for the one-year follow-up interview. Most of them (87,8%) were living at home. Fifty-five patients (40.7%) had returned to work at one-year, but most of them experienced difficulties. According to the GOS-E, 18.6% were classified as « Good Recovery », 43% as « Moderate Disability », and 37% as « Severe Disability ». The most frequent cognitive and behavioural changes were the following: deficits in decision-taking abilities ; poor emotional appraisal ; poor planning abilities, impulsivity. Injury severity, as assessed with the Glasgow Coma Score, was poorly predictive of one-year disability. The most frequent impact on quality of life, as assessed with the Euro-QOL was related to mood changes and to everyday life activities.

Conclusions: This is the first prospective study of severe TBI in the Parisian area. The results showed a high level of persistent disability one year after the injury, that was only poorly predicted by injury severity measures.

0310

Improving the communication skills of paid caregivers of people with traumatic brain injury (TBI): an RCT

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Objectives: Communication impairments are common following traumatic brain injury (TBI) affecting the ability to have successful conversations and thus, to form and maintain interpersonal relationships. Little attention has been directed at providing formal communication training to paid caregivers who are known to be significant in the lives of people with TBI. Paid caregivers have multiple roles (e.g. coach, attendant) requiring complex interpersonal skills (McCluskey, 2000). Indeed, they require support and training in order to fulfil their roles with the person with TBI. This study investigated the effect of a communication training package on improving the conversational interactions that paid caregivers have with a person with TBI.

Method: Participants were 10 paid caregivers randomly selected and allocated to either a control or training group. Treatment comprised 16 hours (across 6 weeks) of a program that combined 'collaborative' and 'elaborative' procedures (Ylvisaker, 1998) with genre based activities (Togher et al., 2004). The training incorporated both didactic (e.g. discussion) and performance based approaches (e.g. role-play). Video taped casual and structured interactions were recorded pre and post treatment and at 6 months follow-up. Interactions were independently rated by two raters using the Adapted Measure of Support in Conversation (MSC) for TBI interactions (Togher et al., in press), based on Kagan et al., (2001).

Results: Results showed improvement in the structured interactions of trained paid caregivers relative to the control group. Paid caregivers were more able to acknowledge and reveal the competence of a person with TBI and these improvements were maintained for 6 months. No improvements were noted in casual conversations.

Conclusions: Communication training to paid caregivers is effective in improving the conversational interactions they have with people with TBI. This lends support to the notion of providing indirect support to the person with TBI through their communication partners. Whilst communication training had most effect on structured conversations,

this may reflect the discourse that occurs in work environments and type of interactions that occur. Certainly, communication training provided support beyond the usual on-the-job experience. It is argued that this type of training and support is necessary for paid caregivers to effectively fulfil the requirements of their job roles.

0311

Severe Acquired Brain Injuries in Italy: Datas From the Experimental National Register

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Objectives: In Italy the lack of information on incidence, severity and processes of patients with brain injury has highlighted the need of a country-wide database. In June 2008, through a research project sponsored by the Italian Ministry of Health, an on-line register was developed to connect rehabilitation centres for severe acquired brain injury, considering traumatic and non traumatic patients with GCS < 8 in first 24 hours.

Primary objectives: to evaluate results from the first year of activity of the Italian Acquired Brain Injury dataset and to outline characteristics of patients and rehabilitation practices of Italian centres.

Method: 27 Rehabilitation Centres have participated with a total number of 890 patients with both traumatic (TBI) and non traumatic brain injury (NTBI). All subjects were at their first rehabilitative admission and 70% came directly from acute wards. Data collected included etiopathogenesis of cerebral injury, demographic characteristics, indicators of burden of care, such as the presence of tracheotomy, and length of acute and rehabilitative stay. Level of initial and final disability was measured by the Disability Rating Scale (DRS).

Results: Results: 45% of patients had suffered a traumatic brain injury, 38% a severe vascular insult (subarachnoid and intraparenchymal haemorrhage), 11% an anoxic and 6% an infective or neoplastic cerebral damage. Mean age of subjects with TBI and NTBI was 40, 56 and 56

respectively. Among traumatic patients 48,6% had a tracheotomy at admission and 13,9% at discharge; the corresponding percentages among non traumatic subjects were 64% at admission and 33,5% at discharge. Traumatic patients presented with mean admission and discharge DRS scores of 16,6 and 10, while non traumatic subjects' average scores were 18,7 and 14,8. 30% of patients were in a vegetative state at the beginning of rehabilitation course, of these 5% showed a good recovery in terms of DRS score. After an average length of rehabilitative stay of 117 days, 47% of subjects with TBI returned back home in opposition to 30,4% of those with NTBI.

Conclusions: First data from the Italian register show a prevalence of non traumatic aetiologies, progressive ageing of population at time of injury and increasing case complexity. Systematical use of the DRS permits a more comprehensive analysis, a better planning of rehabilitation processes and prediction of outcome.

0312

Context-dependent responsiveness in patients with severe disorders of consciousness after brain injury

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Objectives: After a severe brain injury the consciousness may be compromised as far as the neuronal connectivity is deeply impaired. Emotional enrichment of the context may give a chance to activate larger neuronal networks. In particular, some languages from the theatre may offer several contents and expressions involving the physical, mental and emotional world. The hypothesis is that these languages may allow an easier access to the inner world, if any, of the patients by activating the dynamics of emotion and therefore may facilitate the behavioural expression of covert processing.

Method: Nine patients (8 TBI and 1 SAH) with severe disorders of consciousness (DOC) in post acute phase (3–8 months after brain injury) have been submitted to an experimental protocol of

sensory stimulation based on biographically meaningful objects with and without emotional enhancement by means of some theatre languages. The aim of the protocol is to compare the effect of different contexts in terms of number and quality of active behaviours. According to the experimental protocol, the patients' motor activity has been assessed during stimulation with a selection of their own meaningful objects in two different "vision and touch" tasks, respectively with low and high emotional enrichment. As a baseline we considered the active movements produced during morning hygienic care provided by the staff. An A-B-A paradigm was applied in order to minimize the possible effects of clinical changes during the protocol. The motor behaviours were recorded according to the Wessex Head Injury Matrix (WHIM). The T-test has been used to analyse the WHIM scores.

Results: Our results show a difference in responsiveness as a function of the context. Generally speaking, the stimulation with familiar objects seems to activate a higher number of behavioural responses than the simple motor stimulation during the daily care nursing activity. More interestingly, high emotional enrichment of the context seems to produce an increasing level of responsiveness when compared to motor requests in a neutral context, even if in both cases biographically meaningful objects were used.

Conclusions: These results can support the hypothesis that the level of responsiveness in DOCs patients may depend also on the context of stimulation and that the emotional richness and consistency of the context of stimulation can play a key role in expressing more active behaviours.

0314

Referral to rehabilitation after a severe traumatic brain injury (TBI) in the Parisian area

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Objectives: Little is known about the factors underlying the decision to refer (or not) a patient to

rehabilitation after a severe TBI. Some patients are discharged home after the acute care, without adequate support. The objective of this study was to assess the predictive factors of referral to rehabilitation after the acute care unit. It is a part of a larger prospective observational study that was undertaken in 2004 to assess the care network, both at the acute and the rehabilitation stages, and the outcome one-year after a severe TBI in the Parisian area (France).

Method: Patients with severe TBI were included prospectively in the study by mobile emergency services. Criteria for inclusion were: adults with TBI and a Glasgow Coma Scale score of 8 or less before admission to the hospital. Data on demographics, injury severity, and management in the acute care unit were collected. Patients referred to a rehabilitation facility were compared to patients directly returning home after the acute care unit. Then, the nature of the rehabilitation facility was assessed, and patients referred to a specialised neuro-rehabilitation facility were compared to patients referred to a non-specialised department. Both univariate and multivariate (logistic regression) statistics were computed.

Results: 518 patients were included from July 2005 to April 2007. The mortality rate was 45%, and 269 survivors could be included in this study. 166 patients (62%) were referred to a rehabilitation facility, that was considered as specialised in neuro-rehabilitation in 115 cases (43%), and non-specialised in 51 cases (19%). 72 patients (27%) were discharged home directly after the acute care unit, without any rehabilitation support. The logistic regression analysis showed that the following factors were significantly predictive of referral to rehabilitation: not living alone, lack of pre-traumatic alcohol abuse, a low (3–5) initial score at the Glasgow Coma Scale, a high initial Injury Severity Score, and not being referred to a general medical ward after the acute care department. Factors significantly predictive of referral to a specialised neuro-rehabilitation facility were the following: younger age, lack of pre-traumatic alcohol abuse, and a low (3–5) initial score at the Glasgow Coma Scale.

Conclusions: Patients with more severe injuries were more frequently referred to rehabilitation, and more frequently to a specialised neuro-rehabilitation facility. This is not surprising, but raises concerns about patients with apparent good recovery who are discharged home without any rehabilitation support. However, injury severity was not the only predictive factor influencing patients' referral. Patients with poor family support or with pre-injury alcohol abuse were significantly less frequently referred to rehabilitation (Odds ratio respectively 0.29 and 0.31).

0315

Cholinergic mechanism in chronic traumatic brain injury - a PET study

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Objectives: Evidence from experimental studies suggests that in TBI an initial period of cholinergic hyperactivity in the brain is followed by a more chronic state of cholinergic hypoactivity. Many studies demonstrate that TBI produces chronic changes in the cholinergic function of the brain. Several small trials have suggested that patients suffering from cognitive impairment after TBI benefit from treatment with acetylcholinesterase inhibitors (AChEIs). The aim of this study was to evaluate if cholinergic activity differs between those who subjectively benefit from AChEIs and those who don't.

Method: Brain AChE activity was studied with MP4A-PET which is a lipophilic acetylcholine analog with high AChE specificity. During the four previous weeks the subjects had been without any CNS-active drugs or used rivastigmine 1.5 mg b.i.d. 14 patients with TBI-related cognitive impairment were scanned twice; with and without rivastigmine treatment. Eight of the patients had clinically responded to rivastigmine treatment, six were non-respondents. Nine healthy volunteers served as controls (scanned once, no medication). The scans were analyzed with Statistical Parametric Mapping (SPM).

Results: In the non-medicated state, the respondent group had significantly lower AChE activity than controls widely across the cortex. The difference was most pronounced in the inferior part of left parietal lobe (16.1%, $p = 0.036$) and left posterior cingulate cortex (21.6%, $p = 0.014$). No significant differences between non-respondents in non-medicated state and controls were observed. AChE activity was significantly lower with rivastigmine treatment than without treatment in both patient groups throughout the cortex (in respondents $17.2 \pm 13.5\%$, in non-respondents $20.3 \pm 26.2\%$). No difference in the effect of rivastigmine was observed between patients groups.

Conclusions: This study supports that chronic sequels of TBI are at least partially connected with cholinergic dysfunction. The findings that TBI patients have lower AChE activity than controls and patients who benefit from AChEIs have lowered cholinergic activity supports this assumption. Expectedly, AChEI medication lowers tracer

binding, but in a similar manner in both respondents and non-respondents for AChEIs. MP4A-PET-scanning could be used to predict treatment response for AChEIs after TBI.

0316

Smoking and outcome from traumatic brain injury

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Objectives: The cholinergic system is known to be frequently involved in the chronic sequels of TBI. Nicotine is a strong modulator of the cholinergic system. The aim of our study was to evaluate whether smoking history is connected with the outcome from TBI, and whether the response to cholinergic drugs is dependent on the smoking history in victims of TBI.

Method: A questionnaire concerning the smoking and drinking history, the eventual response to cholinergic drugs and the subjective outcome from TBI was sent to all TBI patients included in a database of 1151 patients, treated at a neurological outpatient university clinic after 1.1.1993. In total, 689 patients responded. Data on injury severity (measured with Glasgow Coma Scale and duration of posttraumatic amnesia) and outcome (measured with the Glasgow Outcome Scale, extended version = GOS-E) were collected from the medical records.

Results: Smokers were more often men ($p < 0.001$), younger at the time of injury ($p < .0001$), and less educated ($p = 0.008$). Non-smokers and smokers didn't show statistically significant difference in their TBI severity ($p = 0.14$ with GCS, $p = 0.06$ with PTA) or outcome from TBI ($p = 0.08$) measured with the GOS-E. Subjective recovery between the smokers and non-smokers did not differ. Almost one-third (29%) of the smokers felt that the effect of smoking had changed due to the injury. In 80% of these the effect had become more negative, and 25% of those who had been smoking at the time of injury had stopped smoking afterwards. More than half (59%) of the study subjects had changed their alcohol use after the TBI, because of the changed effect of alcohol. To 46% of all subjects the effect of alcohol had changed to more negative and they had reduced their alcohol consumption. One-fourth (25.0%, $n = 172$) of the study population had tested AChEIs and 8% ($n = 55$) of them did use

AChEIs constantly. The response for AChEIs did not show connection with smoking history.

Conclusions: We could not find any association between smoking and outcome from TBI. A clear difficulty in this study was that smoking is intimately associated with many known predictors of TBI outcome (age, education, alcohol consumption). Many TBI patients stop smoking and drinking after the injury, and although altered financial status may have an effect, the lowered tolerance has an apparent influence. The treatment response to cholinergic stimulation does not seem to depend on smoking history.

0317

Isolated Bilateral Abducens Nerves Palsy Due to Pontomedullary Hemorrhage Following Head Trauma

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Objectives: To report a case of isolated bilateral abducens nerves palsy with traumatic pontomedullary focal hemorrhage without cervical and skull fractures.

Method: Isolated abducens nerve palsy is the most frequently encountered traumatic ocular motor nerve palsy. Such damage more often occurs unilaterally than bilaterally. Bilateral abducens nerve palsy is extremely rare and usually observed only after very severe head trauma that results from direct brainstem penetration. We report a case of isolated bilateral abducens nerves palsy with traumatic pontomedullary focal hemorrhage without cervical and skull fractures.

Results: Case report: A 51-year-old female was admitted to our hospital with a history of a traffic accident. She was diagnosed with hydrocephalus, subarachnoid hemorrhage and the left radio-ulnar fractures. On neurological examination, failure of lateral gaze was noticed, but other cranial nerves were spared. Diffusion Tensor Imaging tractography revealed disruption of the corticonuclear tract related to bilateral abducens nucleus in pontomedullary junction. After botulinum toxin A was injected in both lateral rectus muscles, lateral gaze palsy of her eyes was significantly improved.

Conclusions: Based on this case, pontomedullary hemorrhage should be considered as a cause of isolated bilateral abducens nerve palsy.

0318

The Relationship between ApoE Genetic Status and Outcome after Traumatic Brain Injury

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Objectives: In recent years there has been growing interest in the role of the Apolipoprotein (ApoE) gene in influencing outcome following TBI. ApoE plays a role in cell maintenance and nervous system response to injury. Studies have suggested that its three isoforms, e2, e3 and e4, show differing responses to brain injury; with e4 allele carriers having an altered neurochemical metabolism and reduced availability of cholesterol, potentially resulting in impaired reinnervation, greater cell death and poorer recovery. Some previous studies have found poorer outcomes in e4 allele carriers, but others have not. Most studies have had limited statistical power, however.

Method: The current study examined whether presence of the ApoE ε4 allele was associated with lower Glasgow Coma Scores (GCS), longer post-traumatic amnesia (PTA) duration and poorer long-term functional outcome measured on the Glasgow Outcome Scale-Extended (GOSE). Participants were 654 individuals with TBI (67.4% male). ApoE genotyping was determined from saliva samples by one-stage PCR method.

Results: The ApoE ε4 allele was carried by 166 (25.3%) participants, most having the 3/4 allele combination. Of non-ApoE ε4 carriers, most had the 3/3 combination. Only three participants had the 2/2 combination. The GOSE was completed a mean of 1.9 years post-injury (SD=1.3). We found the hypothesized relationship between ApoE ε status and functional outcome on the GOSE. There was no significant relationship between initial injury severity, measured by GCS or PTA duration and genetic status.

Conclusions: It would appear that the presence of the ApoE e4 allele may influence long-term functional outcome. Possible mechanisms underpinning this relationship will be discussed.

0319

Transcription regulation of gene expression in developing cerebella of rat injured by methyl mercury chloride

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Objectives: Methyl mercury chloride (MMC), an environmental neurotoxicant, can penetrate the placenta and the blood-brain barrier and as a result, large numbers of the pregnant women exposed in methyl mercury epidemics bore obvious brain-damaged neonates while no symptoms were discovered in the pregnant women. To further understand the mechanism of injury caused by MMC in the brain development, the AP-1 (c-Fos and c-Jun) expression was investigated by the experiment in vivo and vitro. DNA binding activity of transcription factors NF-κB and CREB in the cerebella of developing rat was analyzed.

Method: Pregnant Wistar rats were administered with MMC 4mg/kg body weight per day by intragastric administration from the 7th to the 10th gestational day, while the controls were with PBS. On the 1st, 3rd, 7th and 14th postnatal days, cells, tissue sections and nuclear protein extracts were prepared from the cerebella of the newborn rats, respectively. Apoptosis rate was determined by FACS. The expression of c-Fos and c-Jun was detected by immunohistochemical method. NF-κB and CREB DNA binding activity of cerebella nuclear protein extracts were done with electrophoretic mobility shift assay (EMSA).

Results: Apoptosis happened in normal cerebella development. The expression of c-Fos and c-Jun reduced in the nuclei of rat cerebella along with normal postnatal development. The DNA binding activity of NF-κB and CREB decreased along with normal postnatal cerebella development. MMC increased apoptosis of rat cerebella neurons during developing time. The percentage of c-Fos-positive and c-Jun-positive neuron nuclei decreased with postnatal development. C-Fos and c-Jun positive cells had the morphological character of apoptosis. The percentage of c-Fos-positive and c-Jun-positive neurons in the experimental groups treated with MMC was significantly higher than that in the

control groups and decreased along with the prolongation of postnatal development. NF- κ B and CREB DNA binding activity of the groups treated with MMC was higher compared with the controls.

Conclusions: MMC can induce apoptosis of rat brain neurons during developing time. C-Fos, c-Jun, NF- κ B and CREB are involved in developing cerebella injury. Over-expression of c-Fos and c-Jun and the enhancement of DNA binding activity of NF- κ B and CREB might be the key molecular mechanism of MMC injury to the fetal developing brains.

0320

The influence of NDT on erythropoietin levels and gross motor function in children with cerebral palsy

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Objectives: To investigate the value and significance of erythropoietin (EPO) as a brain-protective cytokine and the GMFM -88 items for curative effect of NDT in cerebral palsy (CP) patients with NDT.

Method: Serum samples of 31 CP children and 37 neonates ($n=37$) who suffered asphyxia and/or infection and 20 control group were obtained respectively and kept at -40°C until the time of measurement. EPO levels were measured by the enzyme-linked immunosorbent assay double sandwich method (ABC-ELISA) retrospectively. The curative effect before and after NDT for CP patients were quantitatively assessed by gross motor function measure (GMFM)-88 items.

Results: The EPO levels in serum of CP patients with NDT treatment were higher than the CP patients before they treated with NDT treatment and control group ($P < 0.01$). There was no difference between CP group before they treated with NDT treatment and control group with regard to serum EPO levels ($P > 0.05$). EPO levels in serum of neonate group are higher than control group ($P < 0.01$). The total scores of GMFM-88 items in CP children without NDT were significantly lower than in the CP patients without NDT ($P < 0.01$). The enhance value of the total scores of GMFM-88 items in CP patients less than three years old with NDT were significantly higher than

in the CP patients more than three years old with NDT ($P < 0.01$).

Conclusions: Increased levels of EPO is a instinctively protective reaction to brain injury in the central nervous system, and subsequently material conditions are accumulated in brain function reconstruction. EPO can be used as an independent biomarker that reflects the curative effect of NDT. The GMFM-88 can reflect the change of gross motor development in CP children and can be sensitively objectively quantified assessment of curative effect of NDT for CP. With EPO and GMGM-88 stems, the curative effect of CP is overall assessed. Moreover, it provides the scientific basis for treatment plans of early intervention and the neurological rehabilitation of CP children.

0322

Sleep disturbance and melatonin levels following traumatic brain injury

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Objectives: Sleep disturbances commonly follow traumatic brain injury (TBI), and contribute to ongoing disability. However, there are no conclusive findings regarding changes to sleep quality and sleep architecture measured using polysomnography in TBI patients. Possible causes of sleep disturbances include disruption of circadian regulation of sleep-wake cycles, psychological distress and/or neuronal response to injury. We sought to investigate the mechanisms of sleep-wake disturbance in TBI patients.

Method: Twenty-three participants with TBI (429.7 ± 287.62 days post injury; 22.7 ± 17.7 days PTA) and 23 age- and gender-matched controls were compared on polysomnographic sleep parameters, salivary dim light melatonin onset (DLMO) time and self-reported anxiety and depression as measured on the Hospital Anxiety and Depression Scale.

Results: TBI patients had significantly higher self-reported anxiety (HADS-A) and depressive symptoms (HADS-D), and sleep disturbance (PSQI).

Polysomnography data showed significantly decreased sleep efficiency (SE) and significantly increased wake after sleep onset (WASO) in the TBI group. No significance group differences were reported on sleep architecture. Controlling for anxiety and depression scores, TBI group showed significantly higher levels of slow wave sleep. There was no significant difference in self reported sleep timing or salivary DLMO time. The TBI group had significantly lower levels of overall melatonin production, which significantly correlated with REM sleep but not SE or WASO.

Conclusions: The lowered evening melatonin production is indicative of disruption to the circadian regulation of melatonin synthesis. The study results suggest at least two factors contribute to sleep disturbances in TBI patients: that depression is associated with reduced sleep quality, and that increased slow wave sleep is associated with the effects of mechanical brain damage.

0323

Prognostic factors in civilian gunshot wounds to the head: a serie of 110 cases

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Objectives: Despite advances in neurosurgery, the surgical management of civilian gunshot wounds to the head (GWH) has remained a controversial issue, especially concerning the prognostic factors regarding outcome. This study was carried out to focus on the prognostic factors affecting the outcome until discharge.

Method: 110 patients with GWH were studied between January 2002 and March 2005 in Recife, Brazil.

Results: The most prevalent type of wound was the penetrating injury (74.5%). Twelve out 110 (10.9%) patients presented a dilated pupil. Motor impairment was present in 24/110 (21.8%) patients. Intra-axial hematoma was present in 36/110 (32.7%) patients. There were 15/110 cases (13%) of CSF fistulae. Eleven patients developed meningitis and in nine cases intracranial abscess occurred. Nine cases presented venous thrombosis, 11 urinary infection

and 8 coagulopathy. Following the surgical procedure, 27/110 (24.5%) patients died during their hospital stay. Univariate analysis identified five preoperative predictors of poor outcome following GW H surgery: age over 40 years (OR 5.4, 95% CI 1.73–16.82); presence of unilateral pupil dilatation (OR 5.5, 95% CI 1.641–18.13); low (≤ 8) GCS on admission (OR 6.50, 95% CI 2.27–18.60) or GCS < 15 (OR 10.7, 95% CI 1.70–65.76), presence of intracranial hematoma (OR 2.69, 95% CI 1.11–6.57), and respiratory infection (OR 4.8, 95% CI 1.75–13.47).

Conclusions: When the two groups - survivors and nonsurvivors - were compared, there were significant statistical differences with respect to the age of the patient, GCS on admission, pupil size, presence of intracranial hematoma, CSF fistula and respiratory distress/pneumonia.

0324

Functional outcome after out of hospital cardiac arrest: a prospective study from the intensive care unit to the rehabilitation unit

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Objectives: Cardiac arrest survivors may experience hypoxic brain injury that results in cognitive impairments which frequently remains unrecognized; especially for those patients that recovers basic level of functioning. Their cognitive deficiencies may lead to limitations in daily life activities that cannot be assessed after a few days in a cardiologic unit. We propose a prospective study. Our aim is to describe the functional status of cardiac arrest survivors, 6 months after the onset.

Method: In this prospective study, all adult patients admitted alive after an out of hospital cardiac arrest in one intensive care unit have been consecutively included between March 2008 and March 2009. Exclusion criteria included terminal illness, psychoactive or anticonvulsive medication, known history of neurologic disease or alcohol or drug abuse. All patients were included within the first week after the cardiac arrest; follow up

consisted of regular consult with the PMR specialist. The primary outcome measure was the Glasgow Outcome Scale Extended GOS E 6 months after the cardiac arrest. Neuropsychological assessment focused on executive and memory functioning have been proposed when possible as well as behavioural assessment (DEX questionnaire).

Results: 13 patients have been consecutively included. 3 died before the 6 months assessment. At 6 months, 2 patients had a GOS E score at 3 or minimally conscious state, 2 presented with severe limitations, consistent with a GOS E score 4, 3 patients were autonomous for daily life activities but needed help for elaborate activities, score GOS E 6 and 3 patients were autonomous for life activities but presented with neuropsychological sequelae preventing them to returning to their premorbid level of functioning, notably vocational, score GOS E 7. None of the patients scores 8 that is good recovery without limitation.

Conclusions: Cardiac arrest leads to neurological sequelae that need systematic assessment. Literature is rich with trials assessing predictive factors for the bad outcome patients (deceased, chronic vegetative state, minimally conscious state). But for all the others patients, clinical retrospective studies have shown that most of them could not return to work or deal with the instrumental daily life activities.

0325

Assessment of visual neglect and navigation impairment using a virtual reality device.

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Objectives: Right brain damaged patients are subject to visuospatial neglect and navigation impairments. Virtual reality integrates real-time computer graphics, body tracking devices and visual displays that enable to assess visuospatial skills and navigation abilities. Our aims were to assess visuospatial neglect and navigation impairments using a virtual reality system.

Method: In this prospective study, right brain damaged patients and matched controls were assessed for visuospatial neglect and navigation ability with the use of a head-mounted-display virtual reality system. Subjects were asked to navigate through a virtual town, to count the targets (busstops) and to find one single target (swings in a park). Visuospatial neglect was assessed with paper and pencil tests, Catherine Bergego Scale and the number of left omitted targets in the virtual town. Navigation ability was measured as the ability to find the single target. Anatomy of the lesions, visuospatial scores (real life and virtual reality) were compared for each patients in individual analysis. Patients and matched controls were compared for their scores using the sign test.

Results: Patients differed significantly from controls in the virtual reality task assessing visuospatial neglect. Concerning navigation ability, the difference did not reach significance. Individual analysis for visuospatial assessment showed dissociations between paper and pencil test and virtual reality task that need further investigations.

Conclusions: The virtual reality system was able to assess visuo spatial neglect and navigation ability for brain injured patients and is now used for rehabilitation purpose.

0326

Out-patient Day Program for TBI Patients

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Objectives: People with TBI suffer from different problems (somatic, cognitive, neurobehavioral etc.). The rehabilitation process must be provided by multidisciplinary team of specialists in several branches of medicine (physicians, PTs, OTs, speech therapists, neuropsychologists etc). We established out-patient day programme for brain injured patients in 1999 on the department of Rehabilitation of General Teaching Hospital in Prague.

Method: The patients are accepted to the program according to the assessment of all members of the team. We discuss the aims of short and long term rehabilitation during the rehabilitation conference. We try to prepare individual programme for each client of the Day programme according to his or her needs. The programme is from Monday to Friday from 8.30 a.m. to 3.00 p.m. We have group activities as well as individual ones. The patients have

physiotherapy, occupational therapy, speech therapy, neuropsychology, musicotherapy, artetherapy, they can work in several workshops. Each client can attend the programme from 4 to 6 weeks. After finishing the programme we usually continue to work with him once or twice a week for several months. We use various tests for evaluation of rehabilitation process to follow up the results of rehabilitation. We also use ICF(International Classification of Functioning, Disability and Health)during our assessment process.

Results: We have a group of 450 patients who attended the program. We will present the results of long term rehabilitation from several points of view(results of improving in reeducation of movement patterns, FIM ,GOS and other parametres). We also compare our results from the point of view of employment of the patients. There is a huge gap between possibility to work and real employment. The biggest problem is in the assessment of disability and working potential. Almost one third of our patients were able to work according to our assessment but they got invalid pension.

Conclusions: We use our data for other assessment of long term rehabilitation and to persuade our authorities to found special neurorehabilitation departments for TBI patients as well as centers for prevocational assessment.

0327

The early clinical effect of neurodevelopmental treatment combining nerve growth factor on motor function in children with cerebral palsy

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Objectives: The aim of our research is to explore the clinical effect of neurodevelopmental treatment (NDT) combining nerve growth factor(Anewway) on gross motor function and rehabilitation of cerebral function in children of cerebral palsy(CP), and study the value of quantitative assessment before and after therapy for CP children by gross motor function measure (GMFM)-88 items.

Method: 68 cases of CP children were randomly divided into treatment group(36 cases) and control group(32 cases), the treatment group was intervened with NDT and muscle injection of

Anewway for three periods, while the control group only with NDT. We evaluated the gross motor function before and after therapy quantitatively by GMFM-88 scores of each functional and total areas.

Results: There was no statistical significance of GMFM-88 scores of each functional and total areas between treatment and control groups before therapy ($P > 0.05$). GMFM-88 scores in treatment group before therapy were obviously lower than those after therapy ($P < 0.01$), and those in control group after therapy ($P < 0.05$). Control group after therapy had significantly higher scores than those before therapy ($P < 0.05$), and also presented a significant difference with control group after therapy($P < 0.05$).

Conclusions: There are dramatic effect of NDT and Anewway treatment on CP children. The use of NDT and Anewway in combination is capable of alleviating brain injury and prompting compensation of cerebral function in CP children to a better extent than treating with NDT alone. Anewway, as the most important biological active factor in nervous system, could protect neural damage by maintaining neuron function, prompting neuron regeneration and reparation and preventing neurons from degeneration. Consequently, the early intervention of NDT and Anewway can build a favorable environment and reduce disability rate of CP children by starting the relict compensation of cerebral tissue at an early stage. Meanwhile GMFM-88 items as the best measuring scale of assessing gross motor development in CP children before and after therapy, can provide us with both basis and treatment for early neurological rehabilitation.

0328

An Evaluation of Validity of the Behavior Rating Inventory of Executive Function (BRIEF) in Israeli Children in the first year after Traumatic Brain Injury

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Objectives: TBI is known to increase a child's risk for deficits in executive functions. Those deficits are

likely to be reflected in a wide range of children's daily functioning and limit a child's ability to function both academically and psychosocially. The Behavior Rating Inventory of Executive Functions (BRIEF) was specifically developed to assess executive functions as displayed in a child's everyday activities. The BRIEF is a standardized rating scale completed by parents or teachers to characterize executive function behaviors in home and school environments. The current study goal is to estimate the BRIEF capability to recognize executive dysfunctions among children in the first year after TBI.

Method: The questionnaire was administered to parents of 13 children with TBI and 21 normal controls. In addition, the children with TBI were examined on a standardized neuropsychological computerized battery, MindstreamsTM, and on an established neuropsychological paper-based test. Results show that, in the first year after TBI, the BRIEF discriminates between TBI and healthy controls, and between different levels of TBI severities.

Results: Significant associations were obtained between the BRIEF scales and most of the Mindstreams executive function related tasks, but not with the paper-based test.

Conclusions: Whereas the BRIEF was demonstrated to identify executive dysfunctions in the patient group, as shown by its correlation with the Mindstreams. Thus it can provide useful information on the functioning of children with TBI who are in the chronic stage.

0329

Coursework on acquired brain injury via video conferencing in Norway

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Objectives: Sunnaas Rehabilitation Hospital provides specialised evaluation and treatment to patients with acquired brain injury before they are transferred to their local health care provider. There is an increased demand for more skilled training and consultation/inservicing in the area of acquired brain injury for medical personnel in the municipalities.

Challenges:

- Patients are spread over a large geographical area

- The existing training and education opportunities reach a minimal number of participants from local communities

Aims:

- Create coursework which is available for multi-disciplinary personnel in communities throughout Norway.
- Gain experience/knowledge from holding courses via simultaneous videoconferencing with multiple communities.
- Provide participants with basic information about acquired brain injury. Coursework content will also be tailored to participants without college level education.
- Coursework will allow participants to share personal experiences and discussion.

Method: Coursework via videoconferencing was provided over 6 sessions lasting 2 hours each, every 2–3 weeks. One fee per county: Unlimited number of participants per county.

Course evaluation was completed both via evaluation forms and focus group interviews.

Results: A large number of participants: 600 participants from 17 municipalities and 4 hospitals, comprising a total of 10 studios.

Multidisciplinary 17 professions (nurses/nurses aids: 55%, physical/occupational therapists 30%, other 15%). Sixty-eight percent of the participants had a minimum of college education. 32% were without college education. Good educational value: 7,25 of 10 points.

Technical difficulties occurred during the first day of the course. Minimal amount of participant discussion during the course. Participants sent in questions via e-mail and these questions were addressed the following session.

Conclusions: Courses on acquired brain injury via video conferencing reached a large population of county employees and results in positive learning value. The large number of participants was a result of courses being available locally, spread over longer period of time and inexpensive.

Results showed that having 10 simultaneous studios inhibited discussion and participant interaction. It is believed that a maximum of 3–4 studios would be ideal. Having the participants send in topics for discussion and questions before each course was beneficial to participant interaction. Future plans include making current coursework available on-line and offering consultation groups via video conferencing.

0330

Estimating the burden of Informal Care for persons with a severe Traumatic Brain Injury (TBI) in the Parisian area - France.

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Objectives: Informal Care, in opposition to professional care, is related to time and money provided by family, friends or neighbours for outpatients with chronic illness. Such private and “free” caregiving for adults with disability is neither studied nor recognized in France.

Method: This work is a part of a larger observational study on patients with severe TBI occurring between July 2005 and April 2007 : TBI patients were included prospectively by mobile emergency services in the Parisian region (Severe traumatic Brain Injury in the Parisian area, SBIP study).

We tried to assess and value Informal Care provided to TBI survivors.

Informal carers were interviewed twice:

- (1) One year after the TBI, caregivers were administered a written postal survey with SF-36 (a) Zarit (b) and questions about life adjustment
- (2) Three years after the TBI, caregivers sustaining some of the most severe outpatients (GOSE \leq 4, c) were asked on phone about time spent (thanks to RUD questionnaire (d)), family distress, quality of life, financial resources.

Results: 518 patients were included in the cohort and 269 survivors were studied one-year after the accident.

- (1) 61 informal caregivers returned the written survey : mainly women (2/3) (44% parent, 40% spouse), aged 50, for outpatients aged 36

usually after traffic-accident (71%). Both SF-36 and Zarit revealed health problems, exhaustion, stress, withdrawal from work and leisure activities. Our description of carers' burden and burn-out in France is similar to Anglo-Saxon data found in the literature.

- (2) Interviewing 12 carers orally proved that measuring caregiving time for Activity of Daily Life, Instrumental Activity of Daily Life and supervision time is tricky : major difficulties lied in taking the number and role of carers, the joint-activities, the whole-family-targeted tasks versus specific help dedicated to the patient, into consideration. Economic valuation of Informal Care remained a challenge on both methodological and practical levels : opportunity costs, proxy good and Willingness-To-Pay methods must be further discussed. We found no recent data or studies on costs of Informal Care for TBI patients in the literature.

Conclusions: TBI is a familial and financial burden for informal carers in France. Nevertheless, we need more sociological light on this invisible role of private carers in our society, and further evaluation of the economic impact of Informal Care and its monetary compensation.

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0331

Telerehabilitation in Norway

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Objectives: Sunnaas Rehabilitation Hospital provides specialised evaluation and treatment to patients with acquired head injury before they are transferred to their local health care provider.

Challenges:

- Patients are spread over a large geographical area
- Medical personnel in the municipalities need more specialised inservicing/consultation
- Need for improved services in the transition from hospital to home health care.

Method:

When necessary, Sunnaas hospital invites all relevant personnel from local home health providers, schools, and/or workplace to participate in video conferencing meetings in respect to:

- Patient admission
- Patient discharge and /or
- Patient follow up
- Develop routines and procedures for the use of telerehabilitation as a standard service.
- Electronic evaluation form
- Interviews with select patients and employees

Results: The department for acquired brain injury at Sunnaas Rehabilitation Hospital has established the use of telerehabilitation as a standard service for their patients. Video conferencing is primarily used in discharge planning for their patients. It is occasionally used for admissions planning and follow-up services. Twenty-nine percent of traumatic brain injury admitted received video conferencing with local service providers before discharge. Evaluations of the meetings were positive. The patient, family members and local health service providers exchanged important information and addressed questions. Results showed increased number of participants in video conferencing than traditional meetings. Feedback from municipalities revealed that services were better prepared and coordinated when the patient returned home. The patient and their family find it reassuring to meet personnel responsible for their continued care and that follow-up is well organized.

Conclusions: Video conferencing provides improved cooperation between patients, care givers/family members, hospital and county service providers in the discharge process. There is need for increased use of video conferencing in respect to admissions and follow-up. In order for telemedicine to be adopted as a routine service is essential to develop

policies and procedures which are integrated into the organization of each department.

0332

Care Management of Spasticity in Patients with Severe Acquired Brain Injury (ABI): A One Year Follow-Up Prospective Study

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Objectives: Management of spasticity in patients with severe acquired brain injury (ABI) of traumatic and non-traumatic etiology must begin earlier in the care setting to prevent its secondary sequelae. Even though oral antispastic agents may improve spasticity, they may be responsible of side effects involving both physical and neuropsychological functioning. Botulinum Toxin type A (BT-A) has been proven to be effective in spasticity treatment, but data on ABI patients are lacking. Aim of our study is two-fold: to evaluate the efficacy of BT-A injection in spasticity treatment after severe ABI, and to evaluate its safety in those patients

Method: A continuous series of severe ABI patients with spasticity was enrolled in the study. Exclusion criteria were: superimposed lesions of either brachial or lumbar plexus, and Levels of Cognitive Functioning (LCF) score <6.

All patients underwent BT-A (Botox) injection every 3 months, or longer according to patients clinical condition, and were followed-up for one year.

Both functional (Barthel) and spasticity (Ashworth) scales were recorded at baseline and 12 months after the first treatment.

Results: Twenty-one patients (M/F 16/5; mean age 42.19 + 16.93, range 16–76) experiencing spasticity for a mean time of 5.38 years (SD 5.43; range 0–24) were enrolled since January 2008 and evaluated for 1 year period follow-up.

At base-line Ashworth and Barthel scales showed a mean value of 12.76 + 5.8 and 64.52 + 26.16, respectively. Out of the patients, 33,3% had lower limb spasticity and 57,1% had both upper and lower limb spasticity.

All patients were treated with BT-A at least twice in one year follow-up; 11 out of 21 patients (52,4%) underwent 3 injections, and 5 patients (23,8%) underwent 4 injections.

At one year follow-up, 350 + 133.3 mean units of BT-A (range 100–600) in each injection was effective in improving both Barthel and Ashworth scores ($p < 0.01$).

When evaluating the mean changes in Barthel (mean 10.61; SD 12.84) and Ashworth scores (mean -4.52; SD 3.12) at the end of the follow-up, the BT-A treatment showed to be more effective on functional scale in those patients treated earlier after spasticity onset ($p < 0.01$).

We did not find any correlation between the injections number in one year and functional and spasticity scores improvement.

None of our patients experienced adverse events attributable to BT-A treatment.

Conclusions: In conclusion, the BT-A was effective and safe in treatment of spasticity related to severe ABI.

The lack of correlation between clinical outcome and number of injections in one year follow-up suggests, in addition to a direct inhibition at neuromuscular junction, a more distant BT-A long-term effect. In fact, it has been reported that BT-A may alter sensory inputs to CNS and induce secondary central changes.

Further studies are needed to determine whether BT-A may reduce antispastic drugs use and side effects, thus indirectly improving neuropsychological recovery in severe ABI.

0333

Improvement of the Parent-Child Interaction During the Holistic Pediatric Rehabilitation Programme for Children with Acquired Brain Injury

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Objectives: The quality of the parent-child interaction following childhood ABI is highly associated with parental and family distress. High parental distress can reduce parental warmth and responsiveness, and increase overprotectiveness and less consistent disciplinary practices. Previous research suggests that parental warmth and responsiveness facilitate the child's cognitive growth and development.

The Holistic Pediatric Rehabilitation Programme for Brain-Injured Children (HOPE) is a comprehensive rehabilitation model for brain-injured children and their families. The goals of the programme are to

increase the child's and his/her family's functioning and quality of life along with increasing collaboration with local authorities. Rehabilitation perspective is client-centered and emphasises family's resources, strengths and interaction.

The purpose of the study is to evaluate the impact of the HOPE-programme on parent-child interaction. This study is a part of a larger study evaluating the effectiveness of the HOPE-programme on functioning and wellbeing of the children with acquired brain injury and their families.

Method: The study group consisted of 24 families participating in the HOPE -Programme during the yrs 2005–2008. Ages of the children varied between 9 and 16 years. In choosing the methods the ecological validity of assessment tools was emphasised. The parent-child interaction was evaluated by a parental questionnaire describing the dimensions of interaction and the child's emotional regulation skills. Parental distress was evaluated with The Head Injury Behavior Scale. The neurocognitive status of the child was evaluated using the basic neuropsychological tests, The Five to fifteen- scale and The BRIEF -questionnaire. Classroom performance was evaluated by the child's teacher.

Results: The data indicates statistically significant improvement in parent-child interaction ($p < .01$). Parents reported increase in the child's capability in calming down, taking care of her/his outfit and personal hygiene and age-related expressing his/her emotions ($p > .05$).

Conclusions: The quality of the parent-child interaction has generally been mentioned as one of the most important single factors determining the child's social skills and emotional well-being. According to the WHO ICF -model the child's coping and social skills are determining his participation and should be taking into account when planning interventions. Parents reported increase of the positive interaction features in children's behaviour during the HOPE -Programme. Further examination is needed to confirm the preliminary findings of the improvement of the social skills and the increase of the positive interaction features in the children's behaviour during the rehabilitation process. Additional data will be gathered to confirm the preliminary findings.

0334

Outcome after acute head trauma in patients under anticoagulation needing neurosurgical intervention

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Objectives: The benefit-to-risk-ratio of oral anticoagulation (OAC) and antithrombotic agents (ATH) has been discussed over years in the medical literature. Even without any preceding trauma, anticoagulation, especially over-anticoagulation can result in an intracranial hemorrhage. In case of head trauma, several studies have demonstrated a 7–10 fold risk to intracranial bleeding. However, there is few data in literature on outcome of traumatic brain injury (TBI) patients under anticoagulant therapy needing neurosurgical intervention.

Method: This was a retrospective review on a consecutive patient series requiring neurosurgical treatment after acute head trauma. 293 patients met inclusion criteria. Age ranged between 1 and 99 years (mean 49.3 years). Regarding the use of anticoagulants, 48 patients (16.4%) had been using OAC or antithrombotic medication (group 1); the remaining 245 did not use these drugs (group 2). Follow up could be obtained in 275 patients (93.9%). Statistical testing was done by means of Fisher's exact test and a multiple logit model.

Results: Mean age in group 1 was 73.53 years, mean age in group 2 was 44.67 years ($p < 0.001$). Mean PT in group 1 was 68.85, and 77.79 in group 2 ($p = 0.008$). Comparing OAC and ATH, mean PT in group 2 was 62.44 for OAC and 75.83 for ATH ($p < 0.001$). Also status on admission was significantly different comparing the two groups, 50% comatose, 43.8% with neurological deficit and 6.25% without neurological deficit in group 1 and 55.5%, 23.4% and 20.82% in group 2. In-hospital-mortality was 52 in group 1 and 22.9% in group 2 ($p < 0.001$). Concerning type of medication, mortality was 44% in OAC patients and 60.9% with ATH. The multiple logit model was done for mortality, GOS and KPS. Age, status on admission, type of intracranial bleeding and PT turned out to be significant prognostic factors for mortality ($p < 0.001$ to 0.037) (Odds ratio 0.98–44.8) and GOS ($p < 0.001$ to 0.033) (Odds ratio 0.06–1.25). The analyses showed the same significances for KI ($p < 0.001$ to 0.033) (Odds ratio 0.07–1.3). Anticoagulation itself, however, was not significantly different in all three analyses ($p = 0.886$; 0.926; 0.934).

Conclusions: Age, status on admission and type of bleeding are still the most significant prognostic factors for outcome after traumatic brain injury (TBI). Higher age, comatose on admission, intracerebral hemorrhage, acute subdural hematomas and combined intracranial bleeding are factors predicting a worse outcome. Furthermore, the lower the PT is, the higher mortality, and the worse the outcome is. Thus, the intensity of

anticoagulation is an important factor, but not the use of these drugs itself.

0335

Therapy Intensity, Functional Change, and Progress Measurement Utilizing the Mayo Portland Adaptability Inventory (MPAI-4), and the Supervision Rating Scale (SRS) in Post-Acute Brain Injury Rehabilitation.

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Objectives: The Mayo-Portland Adaptability Inventory (MPAI) provides a brief rating scale for evaluation and outcome measurement in postacute brain injury (BI) rehabilitation. Through a series of analyses and refinements spanning almost 20 years, the MPAI evolved into the current version (MPAI-4). Rasch analyses supported the identification of a small set of items which adequately describe the broad construct of outcome after BI. The MPAI-4 may be completed by professional providers, by individuals with BI, and by their significant others. Three subscales measuring Ability, Adjustment/Activity, and Participation—reflecting the International Classification of Functioning, Disability and Health (ICF)—allow the identification of physical and cognitive impairments separately from restrictions in activity and adjustment and from societal participation. The assessment of physical and cognitive impairment is important to planning rehabilitation for those most severely injured. Conversely, the measurement of activity and participation contributes to the identification of goals for community reintegration for people at all levels of disability (mild to severe) after BI.

Method: This presentation will briefly review studies demonstrating satisfactory validity, reliability, and of factor and item structure. Additionally, a collaborative data collection and outcomes measurement project underway in the Brain Injury Division of the Pennsylvania Association of Rehabilitation Facilities (PARF) will be described. Demographic and functional change data will be provided.

Results: Results suggest improvement in function for clients receiving short term intensive therapy. Moreover, clients in long term residential settings appear to remain stable in function and participation over time.

Conclusions: The database project uses state-of-the-art technologies (e.g., secure web-based, on-line data collection). Methods for applying the MPAI-4 in clinical settings for patient and program evaluation and planning will be detailed.

0336

Positive Influence of Hyperbaric Oxygenation on Recovery from Brain Trauma

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Objectives: Hyperbaric oxygen (HBO) has been used as a primary or adjunctive therapy over the last 50 years with controversial results, both in experimental and clinical studies, and definitive established mechanisms of action are still lacking. It is not unlikely that some of the effects of HBO on neuronal survival are mediated indirectly by glial cells, which are robustly activated after brain injury and are known to play important roles in neuroprotection and neurodegeneration. Previously, we have shown that cortical lesions cause massive activation of glial cells primarily in injured cortex. Since the effects of repetitive HBO treatment on glial and immune response after stab cortical injury have not been addressed so far, the aim of this study was to compare these responses in treated vs. untreated rats.

Method: Experiments were conducted on the male Wistar rats, 10 weeks old. Surgery: The coordinates of left sensorimotor cortex stab lesion were: 2 mm posterior to the bregma, 2 mm from the midline, 2 mm deep. Sham controls (SC, SC + HBO) passed the same operation protocol but without skull injury. Two groups of animals were left intact (C, C + HBO) and served as physiological controls. HBO treatment: one hour following the surgical procedure, animals were subjected to the HBO protocol for 60 minutes (compression/decompression lasted 10 minutes), pressure applied 2 - 2.5 ATA. The treatment was performed once a day for 10 days. Posttraumatic processes in the brain were evaluated using immunohistochemical method

(antibodies used: GFAP, ED1, vimentin, CD40, CD40L, ICAM-1) and Western blot analysis.

Results: GFAP and vimentin immunoreactivity in the peri-lesioned region of injured cortex was significantly lowered in HBO-treated group, due to reduction of reactive astrogliosis and prevention of glial scar formation. Additionally, the macrophage and microglial activities were reduced as well. CD40 was expressed on activated microglia/macrophages after the lesion, being not detected in physiological and HBO conditions. Expression of CD40L was not found in physiological conditions, but after the injury was profoundly expressed on reactive astrocytes and T-lymphocytes around the lesion site. Double CD40L/GFAP labeling revealed their colocalization in reactive astrocytes confirming astrocytes as predominant source of CD40L in the brain. HBO treatment reduced the number of CD40L + reactive astrocytes in the lesioned area, shifting their morphology towards resting form, whereas CD40L + T-lymphocytes were not observed. ICAM-1 labeling of blood vessels was intensive after the lesion, while under HBO and in physiological conditions was negligible. All results were confirmed by Western blotting.

Conclusions: Results presented point to HBO-induced suppression of astrogliosis and glial scarring prevention. Additionally, considering CD40/CD40L and ICAM-1 involvement in amplification of immune response after brain injury, observed reduction of inflammatory responses after HBO, recommend HBO treatment as an attractive therapeutic tool for improving recovery from head injury.

0337

Neuroanatomy and neuropsychological changes in long-term survivors of severe non-missile traumatic brain injury: a 9 years follow-up study

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Objectives: In previous studies we investigated 19 patients who suffered from a severe non-missile

traumatic brain injury (TBI) without macroscopic focal brain lesions (Tomaiuolo et al. 2004, 2005). We found brain atrophy involving hippocampi, fornix, corpus callosum, optic chiasma and optic radiations by means of Voxel-Based-Morphometry (VBM). Furthermore, we previously demonstrated that memory test scores correlated with the volumes of some of the selected anatomical structure i.e. fornix and right hippocampus.

Method: In the present study, we followed up 12 of these patients 9 years after the TBI. High-spatial resolution T1 weighted magnetic resonance images of the brain (1 mm³) and standardized memory tests were performed again, to compare brain morphology and memory test scores 1 year and 9 years after the TBI.

Results: We found lateral ventricle enlargement and regional size reduction of the corpus callosum and cortico-spinal tract in the majority of the patients, either by visual inspection of the individual patients MRIs or by using a computational analysis that evaluates the morphological modification of individual patients. Conversely, the hippocampal structures did not show volumes reduction.

As to the cognitive data, surprisingly, the memory performance in Rey Figures Test (i.e. copy of a complex non verbalisable figure followed by an immediate and a 20 minutes delay recall) and Rey Words Test (i.e. a free recall of a list of 15 words, immediately and 15 minutes after their presentation), as well as Short Memory Test (i.e. a repetition of a short story immediately and 15 minutes after its presentation) are improved, even if not all of them reached a statistically significance. As for the functional outcome possible correlation between brain atrophy, social adjustment and quality of life were sought.

Conclusions: The combination of progressively increasing brain atrophy with improving cognitive abilities and persistent poor social adjustment seems to indicate a very peculiar readaptation and brain plasticity.

0338

ICF model in neurorehabilitation (patients with TBI)

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Objectives: The concept of disability is becoming an increasingly important problem with the development of modern medicine, especially in

neurorehabilitation, which is frequently capable of combating clinical death and is able to treat very serious, formerly fatal disorders of the organism. The concept of disability has become an umbrella term in an international context in the area of functional disorders, activities and participation.

We developed Core Sets for patients after TBI.

ICF Core Set is the list of ICF categories that are relevant to the patient with a specific health condition. It has been found that disability, is evaluated differently in the individual countries of the world. At a conference in Milan, in the 6. framework of the EU Measuring Health and Disability in Europe – MHADIE in November 2007, the European Commission, the Organization for Economic Cooperation and Development (OECD), representatives of the WHO, the UN, other European organizations of citizens with disabilities agreed that ICF would be used as a basic methodology for evaluating the functional abilities of persons with disabilities.

The aim of the project for our department was to prepare and to classify on ICF based Case Record forms for patients after TBI. The Case records forms were for the health professionals (includes Core Set) and for the patients. Core Set for TBI patients includes 37 categories from the component body functions (about 29% of all ICF body-function codes), 16 (29%) from body structures, 56 (48%) from activities and participation, and 35 (47%) from environmental factors.

Method: This study had longitudinal design. We established 3 time points of evaluation (baseline, after six weeks, after three months). The statistical methods used by our department were descriptive statistical methods, SPSS and McNemar's test. Condition-specific instruments for the patients after TBI we used FIM (Functional Independence Measurement).

Results: The total number of the patients was 100 with TBI. TBI patients range from 18 to 67 years of age, mean age 36. 65% of the patients were men, 35% were women.

The patients with a FIM score <115 were allotted to the severe group, with a score from 116 to 125 to the moderate group and with a score >125 to the mild group.

Conclusions: Core sets are useful for a patient after severe or very severe TBI, for mild and moderate patients is necessary to prepare Core sets with fewer categories or use ICF Check lists. It is possible to use ICF for everyday practice in rehabilitation settings. Multidisciplinary rehabilitation team trained in ICF is necessary for practical using ICF.

Thanks to ICF, it is possible to better define and evaluate the positive or, on the other hand, negative impacts of various aspects of the environment on the

participation of person with disability – how this environment mitigates the consequences of the disability (facilitation) or, on the other hand, how it aggravates the disability through the creation of new obstacles. The easier it is to evaluate these data, the greater the benefit and development of policy, from the local, regional and national level up to the European and world level.

0339

The Role of Hope in the Perception of the Severity of Disease in Patients with Multiple Sclerosis

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Objectives: Empirical evidence has indicated that hope is important as a buffer between risk factors and physical and psychological health status for patients with multiple sclerosis.

Hope is defined as “the cognitive set that is based on a reciprocally-derived sense of successful agency (goal-directed determination) and pathways (planning to meet goals)”.

Multiple sclerosis is a chronic neurological disease, with onset typically in early adult life. Although its course is unpredictable, potentially severe consequences may develop during the course of the disease.

The aim of the present study is to examine the buffer role of hope in multiple sclerosis, along with its consequences for perception of several illnesses in patients with multiple sclerosis.

Method: Material:

The Hope Scale (Snyder, et al., 1991), which consists of eight, items (TH), four items in agency (AH), and four items in pathways (PH) and four filler items. Patients were asked to indicate their agreement with the items on an eight point Likert scale.

One question about disease perception “What’s your perception about the severity of your illness (multiple sclerosis)”.

Methods:

280 patients with MS were recruited via their physician at a neurology department of a central hospital in Lisbon. They were eligible for inclusion in the study if they met the following criteria: diagnosis according to relevant medical criteria, between 18 and 65 years, being diagnosed at least 1 year ago, EDSS score under 7. The mean age was 40 years (range 18- 65), 71.3% were women, 61.1%

were currently married, 63% active workers, mean school level of 12 years, and scores of EDSS is 2.8
Methods: the study is cross-sectional and correlational

Results: The correlations between the perception severity of disease (PSD) and the domains of HOPE scale: Correlation between PSD and TH is ($r = 0.25$, $p < 0.05$), Correlation between PSD and AH is ($r = 0.22$, $p < 0.05$) and Correlation between PSD and PH is ($r = 0.24$, $p < 0.05$).

Conclusions: In the present study we examined the correlation between, perception of the severity of disease and hope in patients with multiple sclerosis. Results show that there are statistically significant correlations between the variables, suggesting that hope can play an important role in the adjustment to the disease.

0340

Parental Distress in Families Attending the Holistic Pediatric Rehabilitation Program for Brain-Injured Children (hope)

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Objectives: The entire family is always profoundly affected by a child’s sudden brain injury. An influence of the brain injury on parents and caregivers has been shown to be more profound compared to orthopaedic injuries. Family functioning and parental wellbeing have been shown repeatedly to be closely implicated in cognitive and behavioural outcome in brain-injured children. Yet the initial severity of ABI has been reported to correlate only modestly to parental distress level. The Holistic Pediatric Rehabilitation Program for Brain-Injured Children (HOPE) is a comprehensive outpatient rehabilitation model for brain-injured children and their families. The goals of the program are to increase the child’s and his/her family’s functioning and quality of life along with increasing collaboration with local authorities.

The purpose of the study is to examine the parental distress caused by children’s behaviour problems in Finnish families attending the HOPE program.

Method: The study group consists of 24 families participating in the HOPE program during the years 2005–2008. The ages of the children vary between 9 and 16 years.

Parental distress was evaluated with the Head Injury Behavior Scale, HIBS. Additional data were collected on each child's medical and developmental history and neurocognitive status.

Results: Parents reported reduced distress after attending The HOPE program. A statistical significance however, was not found between the baseline and follow-up measurements. The parents of the girls reported more distress compared to parents of the boys ($p < .05$). Parents of the children with post injury IQ < 80 reported significantly more distress compared to normal or within two SD:s from normal IQ ($p < .05$). Younger age at injury and longer time since injury predicted higher parental distress, however, the statistical significance was not found.

Conclusions: There are several factors affecting parental distress after child's ABI, such as gender, posttraumatic neurocognitive defects and the time since injury. Within the clinical data gathered from the families attending the HOPE model, the child's female gender and time since injury were the best predictors of the high parental distress level. Neurocognitive status of the child correlated only modestly to parental distress. Due to the small and some what selected sample, the results need to be interpreted cautiously. The tendency of diminishing of the parental distress during attendance into The HOPE model is encouraging, hence parental well-being has been reported to effect positively on child's cognitive and behavioural outcomes.

0341

Aerobic Capacity In Subjects After Severe Traumatic Brain Injury

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Objectives: Subjects after TBI show low tolerance to sustained physical activity and reduced cardiorespiratory fitness. Aim of the study was to compare aerobic capacity of subjects after severe TBI with aerobic capacity of healthy subjects exposed to submaximal physical effort with modified Balke-Ware protocol.

Method: Nine participants after severe traumatic brain injury (mean GCS 6.5, range 3–8), approximately 9.5 months (range 2–30) after injury. Average age of participants was 28 (range 22 – 45) and two of them were female. All of them reported fatigue as a problem in daily activities. The inclusion criteria for the study was absence of cardiovascular disease, no

functional motorical or balance limitation, and participants able to walk independently on the treadmill with the maximal speed of 5.3 km/h. In control group there were nine healthy volunteers, matched to participants in the study group by gender, age and life-style.

Before test all subjects in study and control group passed internistic examination, ECG and blood pressure control in supine position. Subjects then performed the modified Balke-Ware protocol, which consisted of 2-minute warm up at 0% incline with 3,2 km/h speed, followed by increase of the speed on 5.3 km/h for 1 minute and then gradual increase of inclination by 2% every minute with constant speed of 5,3 km/h, until the inclination reached 14% in eight minutes. During the test we continuously observed ECG, heart rate (HR), oxygen consumption (VO₂), minute ventilation (VE), respiratory exchange ratio (RER), oxygen pulse (O₂/HF) and ventilatory equivalent for oxygen (VE/VO₂). Indications to stop the test was subjective feeling of exhaustion, safety precautions, VO₂ reached the plateau with an increase of workload, HR over 90% of maximal predicted ($220 - \text{age}$) or RER over 1.15. We used paired comparison methods for statistical analysis.

Results: All participants but one in the study group reached the grade of inclination of 12% or 14%. Five subjects finished the test completely and their HR was 90% of age predicted in that moment and their average RER was 1.08 (range 0.96 – 1.17). The average VO₂ of those five subjects was 34.5 ml/kg/min. In three subjects we stopped the test one grade before last and reason was reaching maximal RER in two and reaching the VO₂ plateau in one subject. In one subject we stopped the test at the 6% of inclination due to almost maximal RER (1.13) and VO₂ plateau at 26.2 ml/kg/min. Preliminary results of comparison between study and control group show no statistically significant difference in observed parameters.

Conclusions: Aerobic capacity of subjects after severe brain injury in this study did not differ from those of healthy subjects. Modified Balke-Ware protocol showed to be safe for testing aerobic capacity in TBI subjects.

0342

Treatment with Combination of B Vitamins Attenuate Glial Response to Cortical Injury

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Objectives: Injury to the central nervous system is one of the leading causes of death and invalidity among all people below the age of 45 and according to some estimates will continue to worsen in the future. Despite all efforts traumatic brain injury (TBI) continues to pose a significant health care risk for which there is currently no effective treatment. Adult CNS injury leads to permanent disability, because most severed axons fail to regenerate. A phenomenon that adds to the complexity of regenerative failure is the process of glial scarring that has been considered to be one of the major impediments to neuronal regeneration. Looking for the mechanisms by which the glial scar can be reduced, we focused our attention to B vitamins which have been shown to downregulate reactive astrogliosis. The purpose of the present study was to assess the ability of B vitamins to lower extent of glial activity after TBI.

Method: The experiments were performed on adult male Wistar rats weighing 250–300g.

Surgery: Prior to the surgery animals were anesthetized with Zoletyl[®] 50 (50 mg/kg i.p.). The coordinates of right sensorimotor cortex ablation were: 2 mm anterior to the bregma, 4 mm posterior to the bregma, and 4 mm lateral from the midline. The sensorimotor cortex was removed by suction ablation through a polypropylene tip, to the depth of white matter. Sham controls (SC, SC+B) passed the same operation protocol but without skull injury. Two groups of animals were left intact (C, C+B) and served as physiological controls. Treatment protocol started 15 min after the ablation of right sensorimotor cortex and then continuously for 14 days, every 24h. The cocktail of B vitamins was given in following doses: 33 mg/kg/day (B1 and B6); 7.5 mg/kg/day (B2); 50 mg/kg/day (B3); 0.5 µg/kg/day (B12). The effects of treatment were verified using immunohistochemistry and Western blotting.

Results: Immunohistochemical analysis showed that the cocktail of the B vitamins reduced the glial scar around the lesion. Examination of the GFAP, vimentin and NG2 expression around the lesion site revealed that the cocktail significantly reduced the number of the vimentin+ and NG2+ cells and to a lower extent the number of GFAP+ astrocytes.

Conclusions: The results presented in this study revealed that the repetitive administration of vitamin B complex (B1, B2, B3, B6, and B12) reduced and delayed process of reactive gliosis; attenuated

oligodendrocyte progenitor cells activation around the lesion site and postpone glial scar formation after injury to the adult rat brain. Glial cells that proliferate were predominantly suppressed, whereas already differentiated glial cells were less affected. These findings extend and further validate the use of B vitamins as a potentially effective treatment that should be seriously considered for clinical trials in TBI.

0343

Facebook Use Among Individuals with Brain Injury: New Opportunities for Social Integration

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Objectives: Disruption in social activities and poor psychosocial adjustment following TBI are well-documented (Morton & Wehman, 1995; Oddy et al., 1985). Advancements in technology provide innovative means for increasing social participation. Social Networking Sites (SNSs), for example, present a unique opportunity for creating and maintaining social ties. Use of SNSs circumvents obstacles that prevent social participation post-TBI, e.g., financial constraints, transportation limitations, or overstimulating environments. Although research on SNSs is only beginning to accumulate and has focused on individuals without disabilities, it points to some potential benefits in terms of social relationships and social support (Steinfeld et al., 2008). With over 250 million users, Facebook is the most popular SNS. Little is known about Facebook use among individuals with TBI and about obstacles that may prevent its use. The objectives of this study are: (1) to estimate rate of use and level of familiarity with Facebook; (2) to identify perceived barriers to Facebook use; and (3) to explore the purpose of Facebook use among individuals with TBI.

Method: Ninety-seven individuals with self-reported TBI (62% female, mean age 47) completed an anonymous online survey. Participants were recruited among members of four state Brain Injury Associations (Florida, Iowa, New Jersey, and New York). The author-developed survey included questions about Facebook use and familiarity, and interest in gaining further knowledge about Facebook. In addition, non-users were asked about perceived barriers, and occasional/frequent users

were asked questions about the purpose of Facebook use.

Results: 60% of participants reported actively using Facebook or another SNS. Among non-users, the most frequent reasons for non-use were security concerns (47%), cognitive impairments (32%) and the website being confusing (26%). Other reasons included forgotten passwords and preference for connecting with people in person. 64% of non-users responded that they would like to learn how to use Facebook. 74% were open to learning to use Facebook better, and 67% were open to taking a related training course. Among occasional/frequent users, 65% reported they would like to learn to use various Facebook features more efficiently; 78% were open to taking a training course. Among occasional/frequent users, 84% reported using Facebook to reconnect with old friends, 85% to stay in touch with family and friends, and only 26% to make new friends.

Conclusions: A large percentage of individuals with TBI uses Facebook as a social networking tool, primarily to maintain social ties and less frequently to meet new people. However, a substantial percentage still refrains from using SNSs, and reports several perceived barriers. Given the potential benefits related to SNSs use, future research should focus on developing interventions that would minimize barriers and increase Facebook use in this population.

0344

Post-Injury Functioning after Mild/Moderate TBI as Reported in Focus Group Interviews – An Analysis Based on the International Classification of Functioning, Disability and Health (ICF)

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Objectives: The rehabilitation provision after mild and moderate TBI is often fragmented. At Oslo University Hospital, Ulleval a focus group interview is conducted related to a larger RCT where a systematic rehabilitation intervention program versus treatment as usual is tested. The objective of the focus groups is twofold. In a clinical context they are the first session in a “return-to-work” group intervention aiming at enhancing participant communication and awareness of problem areas. In a research context the objective is to explore and

describe post-injury problems in a biopsychosocial perspective according to the International Classification of Functioning, Disability and Health (ICF).

Method: Text from three focus group interviews with information from 9 participants (44% men), mean age 39.8 (SD 6.9), range 33–55. Mean GCS was 13.9 (SD 2.2), range 9–15, mean Abbreviated Injury Score (AIS) head was 3.4 (SD 1.1), range 2–5. The interviews had open ended questions regarding problems experienced with body functions/structures, activities/participation after the brain injury, and environmental factors as barriers/facilitators of function. Text analyses of meaningful concepts was performed based on the ICF classification according to the ICF linking rules. Preliminary results are presented as distribution of ICF categories within body functions/structures, activities/participation and environmental factors. The most frequently applied ICF categories will be presented.

Results: Altogether 705 meaningful concepts were analyzed, of which 626 concepts (89%) were given an ICF code on the second level or higher. Ninety-eight codes were used in total, covering 21 of 30 chapters in the ICF. 229 categories (37%) described problems in body functions, 285 categories (46%) described problems in activities/participation and 100 categories (16%) described environmental factors related to functioning. Of these 259 codes (41%) concerned Chapters b1 Mental functions and chapter d2 General tasks and demands, reflecting challenging aspects of post-injury mental and cognitive functioning.

Conclusions: Focus group interviews are useful in getting a broad perspective of the consequences of mild/moderate TBI and provide a diversity of relevant ICF categories. Coded concepts related to activities and participation were most often described, with mental functions as the second largest group of coded concepts. Further, the exchange of experiences enhanced the group process throughout the intervention period. Results from this study are intended to contribute to the development of the ICF core set for patients with TBI.

0345

Integrating Problem Solving and Emotional Regulation Skills in a Day Treatment Program for TBI: Case Examples

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Objectives: Traumatic brain injury often results in affect dysregulation either directly due to the nature and location of the injury, or indirectly due to the physical, cognitive and behavioral consequences related to the injury. Emotional factors commonly interfere with executive functions (e.g., planning, initiation, and self-monitoring) by either creating and/or maintaining problematic situations or by preventing effective decision-making and problem resolution. Comprehensive Day Treatment program (CDT) is an evidenced-based treatment for TBI and consists primarily of cognitive rehabilitation, psychotherapy, family involvement, and psychoeducation. This paper presents case studies to illustrate the implementation of an integrative model of emotional regulation and problem-solving embedded within a CDT and to demonstrate its importance based on clinical observations.

Method: A randomized-clinical trial (RCT) is currently in progress to test the efficacy of "Executive Plus" (E+), a CDT with a strong emphasis on remediation of attention and executive function. Two core intervention of E+ include a top-down problem-solving module and a cognitive-behavioral affect regulation module. Participants in E+ are taught about the interaction between cognition and affect, and subsequently learn to integrate problem-solving and emotional regulation skills, in order to improve cognitive and psychosocial functioning. The RCT will compare performance in neuropsychological and functional measures between participants in E+ and a traditional CDT program.

Results: Case examples are provided to illustrate the nature of the problems encountered in daily living, the functional impact of the emotional reactions to these problems, and the interventions implemented to address both the cognitive and the affective aspects of the problem. Problems in home organization, financial management, employment seeking, and interpersonal relationships are better resolved when emotional components of each situation are identified and addressed in conjunction with effective problem-solving.

Conclusions: Integrating problem-solving and emotional regulation skills within a CDT appears to improve individuals' ability to understand and deal with a range of problems of daily living. Although this conclusion is based on extensive clinical observations, further analyses will be conducted to investigate the effect of integrating problem-solving and emotional regulation on standardized

measures of executive and psychosocial functioning.

0346

The post-traumatic parkinsonism before and after L-Dopa: a neuroimaging study.

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Objectives: Head injury may cause extrapyramidal movement disorders such as parkinsonism, tremor, dystonia, and others. Survivors from prolonged traumatic unawareness may show a transient or persistent parkinsonism consisting of hypomimia, not extinguishable glabellar reflex, facial seborrhea, parkinsonian posture, rigidity and akinesia (Gerstenbrand 1967). A rigid-akinetic syndrome has been described also by other authors (French 1952, Strich 1956, Triller 1961). Dopaminergic drugs, including levodopa and dopamine agonists, are the best drugs available to treat post-traumatic parkinsonism, even if secondary parkinsonisms may respond less to these drugs as compared with idiopathic Parkinson's Disease. The aim of our study was to determine the cerebral correlates of levodopa treatment on tasks involving action representation in patients with parkinsonism after severe traumatic brain injury (TBI).

Method: Six TBI patients with parkinsonism were recruited. Each patient has been scanned before and after L-dopa treatment, by means of fMRI examination consisting of 3 tasks exploring the action-relation representations (generation of action words, mental simulation of action and mime of action) and one control task (object naming).

Results: The results showed modifications of striato-frontal network after levodopa treatment, in particular in active motor task in patients who demonstrated treatment efficacy. The clinical effect of levodopa on post-traumatic parkinsonism seems to correlate with cerebral modifications of action-related tasks.

Conclusions: Since the criticism of the anglo-american literature (Adams 1976) on the existence of the post-traumatic parkinsonism, fMRI correlates might be of some support in diagnosis of post-traumatic

parkinsonisms responders or non responders to L-Dopa.

0347

Effect of ethylc alcohol (EA) on neuropsychological functions and cerebral blood flow velocity in normal subjects

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Objectives: To verify whether Italian law limits for alcohol consumption while driving are accurate to prevent risk behaviours, due to lack of attention, executive dysfunctions and imprudence and whether a correlation between cognitive-behavioral changes and hemodynamic modifications after alcohol might be found.

Method: 32 healthy volunteers were submitted to a neuropsychological battery of tests and transcranial doppler (TCD), before and after having taken alcohol (0.5 grams per liter of blood).

Results: Verbal fluency and all the attentive functions (tonic and phasic alertness, selective, divided and sustained attention) in our subjects worsened at blood EA level of 0.5 g/l. Even if in both selective and divided attention the presence of alcohol in the blood didn't compromise the accuracy in selecting the target stimuli, we found a significance increasing of RT ($p < 0.05$) that might indicate the negative influence of the alcoholic substance on these attentive components as a whole. A statistically significant increase of cerebral blood flow velocity (by means of TCD) associated with the attention disorder was found after alcohol at the EA level equal or higher than 0.5 g/l.

Conclusions: These data showed a negative effect of EA on some neuropsychological variables, commonly involved in driving performance, associated with cerebrovascular changes.

0348

Comparison of the Mini Mental State Exam (MMSE) to the Montreal Cognitive Assessment (MoCA) in Identifying Cognitive Impairments in Stroke

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Objectives: Executive function (EF) impairments have been reported in up to 50% of persons with stroke, however items that screen for executive functioning deficits are underrepresented on typical stroke screenings. The Mini Mental State Examination test (MMSE) is routinely used in stroke patients to screen for cognitive impairment, however it is insensitive to mild cognitive problems and deficits in executive functioning. The Montreal Cognitive Assessment (MoCA) is a brief cognitive screening that uses more demanding tasks to assess higher cognitive skills and executive functions. Such deficits can limit the success of rehabilitation interventions and functional outcome.

The MoCA has been found to be more sensitive in identifying mild cognitive impairments than the MMSE in other populations (dementia, parkinsons disease), however, it has not been previously compared in persons with stroke.

The purpose of this study is to determine whether the MoCA is a more sensitive cognitive screening tool than the MMSE in persons with stroke. Secondary objectives include examining relationships between functional improvement and admission cognitive status.

Method: Stroke patients admitted to an inpatient rehabilitation unit were administered the MMSE, and the MoCA by different evaluators within 24 hours of admission. In addition, the Functional Independence Measure (FIM) was completed within 72 hours of admission and before discharge. FIM efficiency scores were used to measure functional improvement.

Results: The sample consisted of 47 persons (mean age = 69), 47% female, who were an average of 9 days post stroke.

The MMSE and MoCA were significantly correlated with each other ($r = .82, p < .000$), thus supporting concurrent validity of the MoCA. Both the MMSE and the MoCA have a maximum score of 30, with a cut off of 26. There was a significant difference between the average score of the MMSE (23.3) and the MoCA (17.6); $t = -9.5, p < .000$. The MMSE identified 64% as having cognitive deficits whereas the MoCA identified 87% as having cognitive impairments. The admission scores of the MoCA demonstrated a significant relationship with improvement in function ($.33, p < .02$) as compared to the admission MMSE (.17), which was not significant.

Conclusions: These preliminary findings indicate that the MoCA identifies more persons with cognitive impairments than the MMSE. This suggests that the MoCA may be a more sensitive screening tool in detecting mild cognitive deficits in the stroke population. The MoCA seems to provide more information on a broader range of cognitive domains, including executive function, which can often go undetected.

In addition, cognitive status at admission as assessed by the MoCA appears to be more strongly associated with functional improvement as compared to the MMSE. Although further investigation of cut off scores are needed, this study strongly suggests that the MoCA may be an important cognitive screening tool in persons with stroke.

0349

Does Terminology Influence Participant Responses to Sport Head Injury?

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Objectives: In sport head injury, the terminology concussion, mild traumatic brain injury (mTBI) and minor head injury (mHI) is frequently used. While concussion appears to be the preferred term, mTBI and mHI are often used as 'convenient synonyms', even though it has been speculated that mTBI is less familiar and suggests a less favourable outcome. In the studies presented here, we tested whether the terminology used influenced participant responses to a series of questions about sport head injuries.

Method: In Study 1 we had 255 recreational university athletes complete a questionnaire containing statements that varied in terminology (concussion vs. mTBI vs. mHI). Participants were asked to rate statements on injury occurrence, symptoms, recovery and outcome for their truthfulness and provide detail of their own sport injury history, term familiarity and subjective symptoms. Study 2 followed up Study 1 using a similar design with 150 new recreational university athletes, but only contrasted concussion and mTBI terminology and in addition measured term-related attitudes, injury history, familiarity, undesirability and subjective symptoms.

Results: For both studies, the data showed that the terminology used influenced the participant rating of the statements. As speculated, mTBI compared to concussion was regarded a less frequent injury that

had a temporally longer and potentially incomplete recovery. Ratings of concussion and mHI did not differ, and compared to mTBI, were conceptualised as a more frequent injury with a quick and complete recovery. Matching these findings, significantly less participants rated familiarity with the term mTBI and fewer self-reported a history of mTBI.

Conclusions: Our preliminary data suggests that the terminology used with sport head injuries is important. Whereas participants considered that the terms concussion and mHI were synonymous, the data showed that participants considered mTBI as more adverse and severe condition, both in their understanding of the condition and in their own self-report. Considering that research has identified negative illness beliefs to predict later post-injury outcome, we discourage the interchangeable use of concussion and mTBI.

0350

The Developing Brain after TBI: predicting long term deficits, treatment interventions, and program services for children, adolescents and young adults with brain injuries

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Objectives: Traumatic Brain Injury (TBI) is a leading cause of death and disability in children, adolescents and young adults around the world (WHO, 2009). It is also internationally recognized that TBI can have a negative impact on continued brain maturation and development in young people as they get older and grow into their adult years. A particular challenge for physicians, clinicians and therapists is accurately predicting the long term effects of TBI on young people so that services and supports can be organized before deficits worsen and/or young people fail altogether. This presentation discusses the cumulative indicators related to TBI recovery and presents Allostatic Load Theory (ALT) as a methodology to help professionals better predict the long term needs of children, adolescents and young adults with TBI. In addition, this will be further illustrated on a case study basis and the data related to the formulation of treatment interventions and program models.

Objectives:

- (1) Participants will become familiar with the international literature on the impact of TBI

on brain development in children, adolescents and young adults

- (2) Participants will study the theory of neuro-cognitive stall and its correlation with TBI in youth
- (3) Participants will learn the principals of Allostatic Load Theory and how it can be used to predict long term supports and services for youth with TBI.
- (4) Participants will understand how the theoretical model can be utilized in the development of treatment intervention and program services.

Method:

- (1) Lecture
- (2) Intercactive discussion
- (3) Case study presentation

Results: Participants will be able to understand and use Allostatic Load Theory to predict the long term deficits and treatment needs of children, adolescents and young adults with TBI.

Conclusions: Allostatic Load Theory presents a unique framework to factor medical and psychological deficits with functional problems to develop treatment interventions and effective programs for children, adolescents and young adults with TBI.

0351

Absolute quantification of brain metabolites by 1H MR spectroscopy in patients with DAI

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Objectives: To determine whether absolute quantification of brain metabolites by proton magnetic resonance spectroscopy (1H-MRS) after acute traumatic brain injury are accurate in predicting long-term outcomes of patients with diffuse axonal injury.

Method: Forty-five patients with TBI soon after injury within 1–20days were divided into mild group (GCS > 8) and severe group (GCS = 8). T2-weighted, fluid-attenuated inversion recovery, and susceptibility-weighted MR imaging was used to identify voxels as normal-appearing or as nonhemorrhagic or hemorrhagic injury. Neurologic outcome was assessed with the Glasgow Outcome Scale (GOS) and DRS at 6–12 months after injury. The healthy volunteers were served as control group.

Prospectively routine MR and 1H-MRS (single voxel in the occipital gray matter) were applied to all the participants. The main metabolites include NAA, Cho, Cr, and NAA/Cr(concentration), Cho/Cr(concentration) were analyzed by using LCModel. Logistic regression model was used to predict long-term outcome.

Results: A significant decrease in N-acetylaspartate (NAA), N-acetylaspartate (NAA)/creatinine (Cr) and increase in choline (Cho), choline (Cho)/Cr (evidence of DAI) was observed in normal-appearing occipital gray matter ($P < .05$) compared with controls. NAA, NAA/Cr decreased more in patients with poor outcomes than in those with good outcomes ($p < 0.01$) or control subjects ($p < 0.001$). Cho and Cho/Cr increased more was higher in patients with poor outcomes than in those with good outcomes ($p < 0.05$) or control subjects ($p < 0.01$). Logistic regression for prediction of outcomes showed the predictive accuracy of the model (concluding NAA, Cho/Cr and the period of primary unconsciousness) were 95%.

Conclusions: Absolute quantification of metabolites by MRS is useful for predicting long-term outcomes of patients with DAI.

0353

Effects of Post Traumatic Amnesia duration on cognitive functions 3 months after Traumatic Brain Injury

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Objectives: Evaluate how post traumatic amnesia (PTA) duration is related to cognitive function 3 months after traumatic brain injury (TBI).

Method: 61 patients, 13 – 65 years, with moderate (Glasgow Coma Scale – GCS score: 9–13) to severe (GCS score: ≤ 8) TBI, were tested with an extensive neuropsychological battery 3 months after injury. The cognitive domains examined were: executive function, motor function, psychomotor speed, attention, working memory, visual and verbal memory. We compared 32 patients with long PTA duration (≥ 1 week) and 29 patients with short PTA duration (≤ 1 week) to 44 healthy volunteers matched for age and years of education (control group).

Results: The groups were not significantly different regarding gender or education. Patients with long PTA duration were older than patients with short

PTA duration (mean: 34 vs 25 years, $p < 0.05$), and had lower GCS (mean GCS = 8.1 vs. mean GCS = 10.4, $p < 0.01$). Patients with long PTA duration were significantly impaired compared to controls in the following domains (composite t-scores): executive function (mean $T = 46$, $SD = 2.7$), motor function (mean $T = 24$, $SD = 6.9$), psychomotor speed (mean $T = 40$, $SD = 10.7$), working memory (mean $T = 44$, $SD = 8.6$), verbal memory (mean $T = 47$, $SD = 10.2$) and visual memory (mean $T = 33$, $SD = 17.2$). All p -values < 0.01 . Compared to patients with short PTA duration they performed worse on tests of visual memory (short PTA mean $T = 45$, $SD = 10.4$, $p < 0.01$), executive function (short PTA mean $T = 50$; $SD = 5.0$, $p < 0.05$), motor function (short PTA mean $T = 29$, $SD = 6.0$, $p < 0.05$), psychomotor speed (short PTA mean = 46, $SD = 10.2$, $p < 0.05$), working memory (short PTA mean $T = 50$, $SD = 9.0$, $p < 0.05$), and verbal memory (short PTA mean $T = 52$, $SD = 7.0$, $p < 0.05$). Patients with short PTA duration performed significantly worse ($p < 0.01$) than the control group on tests of executive function (control group mean $T = 53$, $SD = 3.7$, $p < 0.01$) and psychomotor speed (control group mean $T = 53$, $SD = 5.0$, $p < 0.01$). There were no group differences on the attention domain composite score.

Conclusions: Length of PTA duration was related to age, and patients with PTA duration above 1 week had lower GCS score indicating more severe TBI. Among patients with PTA above one week, significant reduction were found on measures of executive function, motor and psychomotor speed, visual and verbal memory. Patients with short PTA appeared to be less impaired on overall measures of cognitive function, but showed significantly reduced executive function and reduced psychomotor speed compared to healthy controls.

0355

Assessment of memory and metacognition following childhood head injury in a judgment of learning task

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Objectives: Traumatic brain injury (TBI) is the most common cause of death and acquired mental

disability among children in the US (Kraus, 1995). Memory deficits have been reported following TBI in children (Yeates, Blumenstein, Patterson, & Delis, 1995), and some research has linked memory deficits in TBI to impaired metacognition (Hanten, Bartha, & Levin, 2000). The purpose of the current study was to assess the memory and metacognitive abilities of pediatric TBI patients in a judgment of learning task and the long-term recovery of those abilities.

Method: The participants were 64 children with severe (GCS 3–8), 55 with moderate (GCS 9–12), and 48 with mild TBI (GCS 13–15). Children were between 5–15 years old at the time of injury and had no history of previous psychiatric disorder or head injury.

Participants were presented with a word list to memorize on three consecutive study-recall trials, followed by a fourth recall trial 2 hours later. Participants made three metacognitive judgments for each word: a judgment before the first learning trial of the likelihood of learning the word (Ease of Learning judgment, EoL), a judgment after the third learning trial of the likelihood of recalling the word after a delay (Judgment of Learning, JoL), and a judgment after the final recall trial of whether they recalled the word (Judgment of Knowledge, JoK). Participants were tested at 0-, 3-, 6-, 12-, and 24-month intervals post-injury.

Results: Recall

There were significant effects of TBI injury severity (mild > moderate > severe; $F(2,1840) = 4.04$, $p = 0.02$) and age (older > younger; $F(1,1840) = 47.97$, $p < 0.001$), as well as interactions of study-recall trial x severity ($F(2,1840) = 5.04$, $p = 0.007$) and interval x severity ($F(2,1840) = 6.05$, $p = 0.024$), with severity groups diverging in recall across successive trials within a testing interval and across intervals.

Learning Judgments

Child's prediction of number of words that s/he would recall:

There was no significant severity effect on EoL, ($F(2,272) = 0.84$, $p = 0.431$), JoL ($F(2,275) = 0.57$, $p = 0.5682$), or JoK ($F(2,274) = 4.18$, $p = 0.0163$), Age significantly affected the JoL ($F(1,275) = 5.05$, $p = 0.026$) and the JoK ($F(1,274) = 6.83$, $p = 0.0094$), with older children performing better. Accuracy of learning judgments.

There were significant effects of severity and age for EoL ($F(2,331) = 3.26$, $p = 0.04$, $F(1,331) = 5.42$, $p = 0.021$) and JoL ($F(2,335) = 5.67$, $p = 0.004$, $F(1,335) = 31.26$, $p < 0.0001$), with mild > moderate > severe, and older > younger. There was a significant effect of age for the JoK ($F(1,335) = 14.70$, $p = 0.0002$), but not severity ($F(2,335) = 2.80$, $p = 0.062$).

Conclusions: Recall and learning judgment accuracy were both worse for children with more severe TBI, however, there was no difference between TBI groups in the estimates for the number of words they would recall. The more severe TBI children thus appeared less able to take their deficit account in estimating memory span. More severe TBI children also showed less benefit from repeated study-recall trials, possibly indicating less effective use of recall strategies.

0356

Assessment of the multiple aspects of the confusional state after traumatic brain injury

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Objectives: Almost all patients who survive moderate or severe traumatic brain injury (TBI) have a period of recovery during which they are responsive but confused. Russell termed this state Post Traumatic Amnesia (PTA), but the term PTA suggests that memory disturbance is the key symptom of patients in this state. It has been acknowledged that this acute confusion also can include agitation, cognitive impairment, disorientation, fluctuation of symptoms, sleep disturbances, decreased level of arousal, psychotic-type symptoms and inappropriate mood. Recently, it has been acknowledged that the most commonly used instrument the Galveston Orientation and Amnesia Test (GOAT), fails to capture the multiple aspects of this confusional state. Our aim at a Norwegian rehabilitation unit of TBI is, to implement a better suited clinical instrument to assess the wide range of symptoms of this transient confusional state. Previous studies have found that the use of a broader assessment have implications in term of providing directions for acute management, rehabilitation and the allocation of resources (Stuss et al., 1999).

Method: The Confusional Assessment Protocol (CAP) developed by Sherer et al. (2005) provides a structured and easily repeatable method for measuring and tracking 7 key symptoms of post traumatic confusional state. The symptoms are disorientation, cognitive impairment, fluctuation in symptoms presentation, agitation, nighttime sleep disturbance, decreased daytime arousal and psychotic-type symptoms. CAP items were derived and modified from existing measures used to assess PTA,

delirium or agitation such as the Galveston Orientation and Amnesia Test, the Delirium Rating Scale-Revised, the Toronto Test of Acute REcovery after TBI, the Cognitive Test of Delirium and the Agitated Behavior Scale. An authorized Norwegian version of CAP derived from forward and backward translation was developed. Inclusion criterias: confusional symptoms after TBI; both sexes; age 18–67; adequate Norwegian skills. Exclusion criterias: difficulties attending assessment due to severe difficulties with vision, deafness or aphasia; existence of premorbid psychiatric diagnosis with psychotic symptoms.

Results: In this prospective pilot study medical data will successively be collected in a protocol with 10 included patients, along with assessment of CAP twice a week during the transient confusional period. Preliminary results from the pilot study will be presented.

Conclusions: The transient confusional state in the early recovery after TBI is characterized by complex neurobehavioural presentation of symptoms. The CAP appears as a promising multidimensional assessment tool. Improvement of the conceptualization of acute confusion following TBI may facilitate more appropriate interventions to improve outcomes for these patients in terms of better directions for acute management and rehabilitation.

0357

Do Executive Function and Aggression Influence Sport Concussion?

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Objectives: Aggressive behaviour in contact compared to non-contact sport has shown evidence of higher sport concussion incidences. Recent research has demonstrated that aggressive behaviour is associated with a reduced ability to perform in executive functioning tasks. This suggests that executive function ability may be important for understanding concussion risk in an athlete. Therefore, the present study explored the relationships between aggression, executive function and concussion in athletes from contact versus non-contact sports.

Method: A total of 150 recreational athletes from contact and non-contact sports, that had versus had

not had a concussion, underwent neuropsychological testing as part of a longitudinal study on recovery following sports-related concussion. The assessment included computerised measures of executive function, including inhibition, shifting and updating, and assessment of aggressive and antisocial behaviour using the Moral Disengagement in Sport Scale (MDSS) and Competitive Aggressiveness and Anger Scale (CAAS) questionnaires. In addition, standard measures of reaction, verbal memory recall, subjective symptoms (Postconcussion Syndrome Checklist, PCSS), pain, anxiety and depression (Hospital Anxiety Depression Scale, HADS) were also assessed.

Results: Preliminary analyses of the study suggest reliable differences between contact and non-contact athletes in aggression, and furthermore show some relationships between aggression, executive function and incidence of concussion.

Conclusions: The results are discussed in terms of how aggressiveness and executive function ability may help to predict sport concussion incidence.

0358

Empathy Changing after Traumatic Brain Injury (TBI): A Preliminary Report

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Objectives: Changing in emotional and social behavior, such as apathy, emotional lability and insensitivity, are the most frequent and debilitating consequences of a TBI (Brooks et al., 1987; Prigatano, 1992), and they can render very difficult for the caregivers the management of the patient (Kinsella et al., 1991). In particular, weaknesses of cognitive or emotional empathy may underpin many of the neurobehavioral disorders associated with TBI (Wood, 2001).

Aim of this study was to assess cognitive and affective empathy reduction in a TBI population.

Method: Three groups of subjects were enrolled for the study: 1) 12 severe TBI patients; 12 caregivers; 13 normal control subjects. The Interpersonal Reactivity Index (IRI) and a neuropsychological test battery were administered to all patients; the IRI was also administered to the control subjects. Finally, the caregivers were administered an adjusted version of the IRI (to indirectly investigate the patient's empathic self-awareness) and they were also interviewed by means of the Neuropsychiatric

Inventory, in order to assess the neuropsychiatric post-TBI disorders in all the patients.

Results: The TBI group showed significant lower cognitive, but not emotional, empathy scores than the control group. There was no relationship between empathy and executive functions, neurobehavioural consequences and the severity of TBI. We found a significant correlation between the cognitive empathy and the Glasgow Outcome Scale-Extended scores.

Conclusions: In conclusion, even if preliminary, our data show that TBI may cause a reduction of the cognitive capacity to empathize, and suggest the utility to evaluate this ability to better address the rehabilitation of the TBI patients population.

0359

The Efficacy Of Specific Manual Musculoskeletal Technique In The Sub-Occipital Region Compared To Standard Physical Therapy For The Treatment Of Post-Concussive Syndrome Following Mild Traumatic Brain Injury.

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Objectives: This study explores the interest of using osteopathic technique targeting specifically the structures of the sub-occipital triangle compared to conventional physical therapy modalities to the neck using heat, stretch, soft tissue work and exercise.

Residual symptoms such as occipital neuralgia, upper neck pain and disequilibrium (lack/loss of balance) are monitored between two samples, a study group and a control group.

Method: Selected patients are randomly included in specific musculoskeletal treatment (n = 50) or conventional physical therapy management (n = 50). Patients are examined for symptoms such as headache, lack of balance, upper neck pain following head trauma, then 1 week and 2 weeks within treatment then 1 month following the start of the modalities.

Osteopathic techniques (muscle energy combined with inhibition to the sub-occipital muscles and C0-C1 traction) are used in the study group while broader physical therapy treatments are applied to the control group.

Results: Discrepancy of efficacy is expected between the two groups when standard of care does not seem to address with any specificity the etiology of the problem (no existing guidelines) while the

combination of musculoskeletal manual techniques targets the components of the suboccipital triangle aiming at reducing the symptoms from their source. *Conclusions:* Standard of care (physical therapy) needs proper guidelines of treatment for mild traumatic brain injury.

0360

Executive functions deficits and self-awareness after Traumatic Brain Injury

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Objectives: Objective: to identify the clinical, neuropsychological and functional predictors of self-awareness (SA) in patients with traumatic brain injury (TBI).

Method: 37 outpatients were evaluated on the basis of the following inclusion criteria: 1) age ≥ 15 years; 2) diagnosis of severe TBI (Glasgow Coma Scale, GCS ≤ 8); 3) post-traumatic amnesia (PTA) resolution; 4) capacity to undergo formal psychometric evaluation despite cognitive and sensory-motor deficits; 5) absence of aphasia; 6) availability of informed consent. *Measures:* we administered a complete neuropsychological test battery. SA was evaluated by means of the Awareness Questionnaire, administered to both patients and relatives.

Results: the executive functions correlated significantly with impaired SA even when AQ subscales (sensory-motor, cognitive, and behavioral-affective) were considered separately.

Conclusions: The significant correlation found between some aspects of executive functions and self-awareness confirmed the importance of addressing this issue in order to treat SA contextually in the rehabilitation of executive functions.

0361

The effect characteristics of escin on the brain edema induced by cerebral ischemia/reperfusion in rats

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Objectives: Escin is a natural mixture of triterpene saponins which mainly possess anti-inflammatory and anti-oedematous property. It had been reported that escin can attenuate the brain edema resulting from cerebral ischemia/reperfusion (I/R). The present study evaluates the effect characteristics of escin on the brain edema induced by cerebral ischemia/reperfusion in rats.

Method: Male Wistar rats were randomly divided four groups: control group, I/R group, mannitol group and escin group. Reversible focal cerebral ischemia was produced using a model of middle cerebral artery (MCA) occlusion by inserting a nylon surgical thread. Two hours later, the MCA was reperfused by withdrawing the embolus. Seventy two hours after cerebral ischemia/reperfusion, the rats were treated mannitol (2 g/kg) or escin (1 mg/kg) by tail vein. At 2 h, 4 h, 6 h, 8 h, 12 h, and 24 h after administration, the rats were sacrificed and the injured hemispheric cortex tissues were dissected out to assay the brain water content by a wet-dry method.

Results: At 2 h, 4 h, 6 h, 8 h, 12 h, and 24 h after treatment, the brain water contents in the I/R group were (mean \pm S.D., n = 5) $81.19 \pm 2.56\%$, $81.58 \pm 2.41\%$, $82.31 \pm 2.08\%$, $82.47 \pm 1.92\%$, $82.20 \pm 2.37\%$, and $82.00 \pm 2.26\%$, respectively. There was significant difference in brain water content between the control group (data not been shown) and the I/R group ($p < 0.05$ or $p < 0.01$). Mannitol decrease the brain water content ($77.59 \pm 1.99\%$, $78.02 \pm 1.61\%$, and $78.33 \pm 2.03\%$, respectively, $p < 0.05$ or $p < 0.01$) at 2 h, 4 h, and 6 h after treatment. Escin reduce the brain water content ($78.67 \pm 1.75\%$, $79.32 \pm 2.28\%$, $78.51 \pm 1.73\%$, $78.76 \pm 2.44\%$, and $79.08 \pm 2.10\%$, respectively, $p < 0.05$ or $p < 0.01$) at 4 h, 6 h, 8 h, 12 h, and 24 h after treatment.

Conclusions: This study demonstrates that escin is a promising drug with long effective anti-oedematous property to attenuate the edema induced by cerebral ischemia.

0362

Evaluation of the needs of severely brain-injured patients' relatives: a Belgian study

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Objectives: The objective of our study was to evaluate needs such as medical information, involvement in care as well as emotional, social, instrumental and professional supports in relatives of severely brain-injured patients recovering from coma.

Method: The Family Needs Questionnaire (French or Flemish version) was sent to the legal surrogate of patients being at home or hospitalized in one of the 37 centers (i.e., neuro-rehabilitation centers and nursing homes) involved in the Belgian federal network for the care of vegetative and minimally conscious patients.

Results: We collected 98 questionnaires. The majority of the participants considered the medical information, the involvement in care, the social and emotional supports as important to very important. Few participants were entirely satisfied for the following needs: medical information (29%), social (23%) and emotional (9%) supports. Moreover, 22% of the participants presented severe anxiety whereas 16% often felt depressed.

Conclusions: The evaluation and the satisfaction of the needs of patients' relatives are particularly important in order to maintain a good relationship with the medical staff and, hence, to optimize the care of patients recovering from coma.

0363

Traumatic Brain Injury and Suicide in Veterans Health Administration Patients

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Objectives: Previous research indicates increased risk for suicide among individuals who have experienced traumatic brain injury (TBI). To date, few studies have examined this issue among United States military veterans. This study examined associations between history of TBI diagnosis and death by suicide among Veterans receiving care within the Veteran Health Administration (VHA).

Method: Veterans who received VHA health services between Fiscal Years (FY) 2001 and 2006 were included in the analyses. Veterans with TBI were identified using the following clinical diagnoses: concussion, cranial and skull fractures, cerebral contusion/traumatic intracranial hemorrhage, cerebral laceration and contusion, subarachnoid

subdural and extradural hemorrhage following injury, other and unspecified intracranial hemorrhage following injury, and intracranial injury of other and unspecified nature. Cox proportional hazards survival models for time to suicide, with time-dependent covariates, were utilized. Covariance sandwich estimators were used to adjust for the clustered nature of the data, with patients nested within VHA facilities. Analyses included all patients with a history of TBI (n = 49,626) plus a 5% random sample of patients without TBI (n = 389,053). Of those with a history of TBI, 105 were included who died by suicide during FY01-FY06. Models were adjusted for the following covariates: sex, age, Veteran Integrated Service Network, and psychiatric diagnosis (Substance Use Disorder, Bipolar Disorder, Major Depressive Disorder, Non-Major Depressive Disorder Depression, Other Anxiety Disorder, Post Traumatic Stress Disorder, and Schizophrenia).

Results: Veterans with a history of TBI were 1.5 (95% CI: 1.2, 1.9) times more likely to die by suicide than those without a history of TBI. The positive association between TBI and suicide was not explained by the presence of psychiatric disorders or demographic factors.

Conclusions: Results indicate that Veterans receiving care within VHA with a diagnosis of TBI are at greater risk for suicide than those without this diagnosis. These findings support the need for screening and assessment for TBI in all Veterans. Moreover, although it is important to assess Veterans with TBI for co-occurring mental health conditions, such as Major Depression or Substance Use Disorders, it is important to recognize that increased suicide risk among those with TBI may not be fully addressed by attending to mental health diagnoses alone. As such, providing services for other problems associated with TBI may help to decrease suicide risk. For example, common post-TBI symptoms shown to increase suicide risk for members of diverse populations include aggression and work/family disruption. Further research is indicated to identify evidence-based means of screening, assessment, and treatment for those with TBI and/or suicidality.

0364

Behavioural deficits following severe brain injury.

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Objectives: Debilitating neurobehavioural sequelae often complicate traumatic brain injury (TBI). Cognitive deficits, particularly of attention, memory, information processing speed and problems in self-perception, are very common following severe TBI.

Method: The Neurobehavioural Rating Scale (NRS) is a multi-dimensional clinical-based assessment instruments designed and validated to measure neurobehavioural disturbances following TBI. This study examined 41 patients after severe TBI. All 27 items of the NRS were assessed 6 and 12 months post-injury.

Results: Subjects after severe TBI as reflected in the initial GCS had higher overall scores on the NRS, reflecting the higher overall neurobehavioural dysfunction. NRS items did not change significantly between 6 and 12 months post-trauma for anxiety, expressive deficit, emotional withdrawal, depressive mood, hostility, suspiciousness, fatigability, hallucinatory behaviour, motor retardation, unusual thought content, lability of mood and comprehension deficit. There was a tendency of improvement for inattention, somatic concern, disorientation, guilt feelings, excitement, poor planning and articulation deficits. For conceptual disorganization, disinhibition, memory deficit, agitation, inaccurate self-appraisal, decreased initiative, blunted affect and tension even a tendency for further deterioration in the post-traumatic follow-up was detected.

Changes between 6 and 12 months post-TBI were statistically significant for disorientation (improvement), inattention/reduced alertness (improvement) and excitement (deterioration).

Conclusions: The data shows that neurobehavioural deficits after TBI do not show a general tendency to disappear over time but even get worse in the time course. Some aspects related to self-appraisal, conceptual disorganization and affect may even deteriorate, thereby presenting a challenging problem for both the patients and relatives. This is in contrast to the parallel improvement of post-traumatic sensomotoric deficits.

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Objectives: Immediate and systematic applications of adequate rehabilitation are the most important factors for restitution of impaired brain function. Integration of these applications in the intensive care makes it possible to start rehabilitation therapy directly, without any interruption. The aim of the study was to investigate the efficiency of early rehabilitation program beginning at the neurosurgical intensive care unit.

Method: In the prospective study, 29 patients (age 55.8, range 43–89 years, m : f = 1 : 1) surviving the brain injury were investigated. Early rehabilitation program started if the patients have no need of sedation, after stabilisation of cardiopulmonary functions and normalization of ICP. Early rehabilitative treatment lasted mean 19.8 (7–48) days. Therapy was adapted to the individual capability and was performed for 300 minutes each day. For the income and outcome evaluation we used the Early Reha Barthel Index (ERI). Here have been introduced aspects of functional deficits relevant in early rehabilitation patients to the Barthel Index in a separate section: state requiring temporary intensive medical monitoring, tracheostoma requiring special treatment (suctioning), intermittent artificial respiration, confusional state requiring special care, behavioural disturbances requiring special care, swallowing disorders requiring special care, and severe communication deficits.

Results: At the time of income to the rehabilitation program, the ERI was at mean –136.2 points (range –225 – +20 points), 18 of the patients had ERI of –175 points or less. At the time of discharge, the ERI reached at mean +0,34 points (range –225 – +100 points), 10 patients (one third) reached +80 points or more and were in the activities of daily living nearly independent. Only 6 patients reached only the ERI of –175 points or less.

Conclusions: The results of this project show, that already during intensive care treatment an efficient early onset rehabilitative therapy is possible. In summary we conclude that by integration into the acute clinic, complications can be treated more adequately and delays with negative consequences for the patients can be avoided. If early rehabilitation therapy can practically be established in the most of the acute units is widely depending on the future development in health-politics.

0365

Neurosurgical rehabilitation during the intensive care (Pilot study).

0366

The effect characteristics of escin on the brain edema induced by traumatic brain injury in mice

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Objectives: Traumatic brain injury (TBI) is the main cause of death and disability among children and young adults. Escin is a natural mixture of triterpene saponins. Because escin possess anti-oedematous effects, it has been used in the treatment of edema resulting from TBI. The aim of the present study is to evaluate the effect characteristics of escin on the brain edema induced by TBI in mice.

Method: Male Swiss mice were randomly divided five groups: control group, TBI group, dexamethasone group, mannitol group and escin group. The mice were given a controlled cortical impact (CCI) injury to the sensorimotor cortex, or a sham operation. Twenty four hours after CCI injury, mice were treated with dexamethasone (4 mg/kg), mannitol (4 g/kg) or escin (2 mg/kg) by tail vein. At 2 h, 4 h, 6 h, 8 h, 12 h, 18 h, and 24 h after administration, the mice were sacrificed and the injured hemispheric cortex tissues were dissected out to assay the brain water content by a wet-dry method.

Results: At 2 h, 4 h, 6 h, 8 h, 12 h, and 24 h after treatment, the brain water contents in the control group were (mean \pm S.D., n = 6) the brain water contents in the TBI group were (mean \pm S.D., n = 6) 80.98 \pm 3.47%, 81.20 \pm 2.68%, 81.73 \pm 2.37%, 82.29 \pm 2.15%, 81.70 \pm 1.99%, 82.73 \pm 2.38%, and 82.19 \pm 2.62%, respectively. There was significant difference in brain water content between the control group (data not been shown) and the TBI group ($p < 0.05$ or $p < 0.01$). Dexamethasone reduce the brain water content (77.98 \pm 1.92%, 77.74 \pm 2.62%, 77.92 \pm 2.76%, and 78.31 \pm 2.77%, respectively, $p < 0.05$) at 4 h, 6 h, 8 h, and 12 h after treatment. Mannitol decrease the brain water content (77.03 \pm 2.37%, 76.85 \pm 2.01%, and 78.92 \pm 1.56%, respectively, $p < 0.05$ or $p < 0.01$) at 2 h, 4 h, and 6 h after treatment. Escin reduce the brain water content (78.20 \pm 1.71%, 78.44 \pm 2.09%, 79.06 \pm 2.08%, 77.38 \pm 2.63%, 78.27 \pm 2.32%, and 78.46 \pm 2.57%, respectively, $p < 0.05$ or $p < 0.01$) at 4 h, 6 h, 8 h, 12 h, 18 h, and 24 h after treatment.

Conclusions: This study demonstrates that escin is a potent drug with long effective anti-oedematous property to treat traumatic brain injury.

0367

Does the Let's Not Meet By Accident Program Work? Evaluating the effects of an in-hospital trauma prevention program for adolescents.

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Objectives: Prevention is recognized as a promising strategy for reducing the individual/public health consequences of injuries secondary to MVAs and assaults. Educational programs exposing teens to the sequelae of traumatic events seem intuitively responsible and effective strategies to reduce risk taking behavior. While anecdotes of visceral reactions/memorable images among participants abound, limited data on attitude/behavior change are available. At the 2008 World Congress, we presented our prevention program entitled "Let's Not Meet by Accident" (LNMBBA). The overwhelming question by the audience related to documented outcomes. The objective of this study was to evaluate change in knowledge, attitudes and self reported risky behavior in students attending our prevention program.

Method: Since 1991, St. Francis Hospital (Hartford, CT.) offers LNMBBA, a prevention program which addresses the major causes of trauma in the teen population—motor vehicle injuries/drinking and driving/interpersonal violence. Sessions are customized for inner city and regional schools' characteristics.

For the 2008–2009 academic year, a pre-post 25 item questionnaire was developed to explore evidence of short term program impact. The survey instrument included brief demographics, 5 descriptive (e.g. depression), 6 knowledge, 5 attitude, and 9 behavior questions. Students completed the survey prior to the LNMBBA session and 3 months following the program.

Results: Students from 10 schools (n = 576) provided pre/post surveys. Data from the 6 schools that followed the 3 month protocol (baseline: n = 213 and 3-months: n = 193) were analyzed. Baseline knowledge was better than expected: e.g. 83% knew that homicide perpetrators were less likely to be strangers than known individuals, 79% that MVA is the leading cause of death in teenagers, and 75% knew harassing online could have legal consequences. There were no significant differences in the pre/post knowledge question answers. No reported risk behaviors rates changed significantly: e.g. fights within past 3 months (13% versus 14%), riding with drivers who had been drinking (31%

versus 27%), always wore seatbelts (62% versus 65%). Attitudes that speeding or drunk drivers should lose driving privileges, that 1–2 drinks was acceptable prior to driving, were not significantly different in pre/post surveys.

Conclusions: Data did not indicate a sustained demonstrable change in student knowledge, attitudes and behaviors related to injury prevention at 3 months post intervention. Resource limitations constrained our research design—e.g. parental consent requirements, that would be necessary to carry out an IRB approved, individually tracked pre-post study with controls. Our data, however, indicates that a direct association between exposing adolescents to statistics on risk taking, injury, physically injured survivors of trauma and the trauma center cannot be taken as a given. We hypothesize that trauma prevention for teens must include attention to the choice processes at the moments when decisions about risky behavior are made. We are currently developing a focus group project to inform our future sessions.

0368

TBI Training and Technical Assistance Teams: A Statewide Model to Improve School Services

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Objectives: Few educators receive sufficient preservice training to prepare them to meet the needs of students who return to their classrooms following traumatic brain injury (TBI). To fill this training gap, nine states have adopted an inservice training and technical assistance model. This presentation will describe the basic model and variations that individual states have developed to meet particular demographic and political needs. Impact and outcomes of the model will be discussed, as well as potential utility of the model in countries other than the US.

Method: The presentation will provide a description of the model and variations and adaptations developed by several US and states and provinces in several other countries. States are currently divided into administrative regions. Each region recruits

educators and support personnel who have an interest in TBI to form a TBI regional consulting team.

Team members may include:

Special educators,
Regular classroom teachers,
School psychologists,
Occupational and physical therapists
Speech/language therapists
Counselors
School nurses
Administrators
Medical rehabilitation professionals
Parents of students with TBI

Team members receive on-going inservice training in effective interventions, assessment, consultation strategies, and other topics. They are also mentored by experienced team members and the team coordinator as they implement their skills. Referrals from parents and schools are made to the state team coordinator or to the team liaison in each region, who then assigns an appropriate team member to the case.

Services provided by team members include:

School wide or individual inservice training to other educators,
classroom assessments,
provision of materials
linkage with community based resources,
attendance at IEP meetings or 504 Service Agreement meetings, and
general support for educators and families to improve school services for students with TBI.

Results: In states where the model is implemented, identification rates of students with TBI increased dramatically compared with pre-team identification rates. This indicates increased awareness of the needs of students with TBI and increased ability to discriminate TBI from other disabilities.

Survey studies indicate high rates of satisfaction for both educators and parents.

A randomized control trial is currently underway in Oregon, Ohio, and Colorado to assess the effectiveness of team intervention as students transition from the hospital back to school.

Conclusions: This is a promising model for several reasons:

- (1) It is highly adaptable to state and local needs.
- (2) It increases capacity of existing staff rather than relying on consultants and experts from outside the school system.
- (3) It provides on-going training and support which has been shown to be more effective than one-shot or short-term training models.
- (4) Emerging data show that the model is effective in meeting the needs of school personnel and improving student outcomes.

0369

Short-Term Biopsychosocial Outcome from Uncomplicated MTBI

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Objectives: Slow or incomplete recovery from mild traumatic brain injury (MTBI) is poorly understood. The purpose of this study was to examine the biopsychosocial outcome from uncomplicated MTBI at three weeks post injury.

Method: Participants were 58 prospectively enrolled patients from the Emergency Department of Tampere University Hospital, Finland (Age: $M = 36.6$ years, $SD = 12.9$; Education: $M = 13.0$ years, $SD = 3.0$) who sustained an uncomplicated MTBI (i.e., no evidence of acute intracranial abnormalities on day-of-injury CT scan or post-acute 3T MRI scan). At three weeks post injury ($M = 25.5$ days, $SD = 3.5$; Range = 17–34), diffusion tensor imaging of the whole brain was undertaken using a Siemens 3T scanner. Quantitative DTI parameters, including apparent diffusion coefficient (ADC) and fractional anisotropy (FA), were calculated symmetrically for eight regions of interest [i.e., basilar pons, mesencephalon, internal capsule, corona radiata (posterior and anterior), centrum semiovale, uncinate fasciculus, and forceps minor and for three regions of the corpus callosum (i.e., genu, body, splenium)]. Thirty healthy control participants completed the same MRI procedure for comparison. Participants were also administered a brief battery of neurobehavioral (e.g., post-concussion symptoms, depression, and fatigue) and neurocognitive measures (e.g., verbal learning and memory). These measures were also administered to 36 healthy control subjects for comparison.

Results: There were no significant differences between the patients and the controls on the five neurocognitive measures of learning and memory. Compared to the control group, the MTBI group reported a greater number of post-concussion symptoms ($p < .001$, $d = 0.53$, medium effect size) and fatigue ($p = .028$, $d = .51$, medium effect size),

but not depression. There were no significant differences between patients and controls on 35 of 38 DTI measures. There were significant differences for ADC in the corona radiata-right ($p = .02$, $d = .54$, medium effect size), ADC in the genu of the corpus callosum ($p = .03$, $d = .61$, medium effect size), and FA in corona radiata-right ($p < .001$, $d = .72$, large effect size). Although not significantly different, medium effect sizes were also found for FA in the basilar pons-left ($d = .42$) and ADC in the body of the corpus callosum ($d = .69$). For these five DTI measures, there was increased ADC, and decreased FA, in the MTBI group compared to controls.

Conclusions: Outcome from MTBI is complex and difficult to predict. Patients did not have measurable cognitive deficits at 3–4 weeks post injury. As a group, they reported increased post-concussion symptoms, increased fatigue, but not increased depression. On 35 of 38 measures of the microstructural integrity of white matter, the uncomplicated MTBI group did not differ from healthy controls. Overall, the observed changes in white matter integrity identified in this study were minimal and were not strongly associated with neurocognitive or neurobehavioral outcome.

0370

Effect of Traumatic Brain Injury on Sexuality

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Objectives: Objective of the present study is to identify the role of a severe traumatic brain injury (TBI) in referring to sexual disorders and their possible impact on the couple relationship.

Method: The Sexrelation Evaluation Schedule Assesment Monitoring - SESAMO (Boccardo e Perillo., 1996), and the Hamilton Depression Rating Scale (Hamilton et al., 1960), the State-Trait Anxiety Inventory (STAI, Spielberger et al., 1983) and the Neuropsychiatryc Inventory (NPI) (Cummings et al., 1994) will be administered to all subject in order to evaluate, respectively, the sexual, mood and behavioural disorders. Moreover, the Wisconsin Card Sorting Test (WCST) (Heaton et al., 1993) will be administered to the TBI patients in order to evaluate some aspects of the executive functions, as well as Community International

Questionnaire (CIQ) (Willer B et al., 1993) will investigate the social reintegration.

Results: High levels of disability were correlated to a poorer sense of bodily function and a lesser integration in the community.

Moreover, we found a correlation between dissatisfying couple's relationships and mood and behavioral disorders, assessed by the HDRS ($r=0.91$, $p < 0.001$) and by NPI ($r=0.67$, $p < 0.05$).

Conclusions: In conclusion, to treat sexual dysfunctions during the rehabilitation process is very important for a good personal and social reintegration of the TBI patients.

0371

Hypothermia at 10°C Reduces Neurologic Injury after Hypothermic Circulatory Arrest in a Porcine Model

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Objectives: We have previously reported that sensory, motor neocortex and hippocampus are selectively vulnerable to injury in an acute porcine model of HCA at 18°C. This study was undertaken to assess whether further cooling to 10°C can reduce neurological injury during HCA.

Method: Twelve piglets underwent 75 minutes of HCA at 18°C ($n=6$) and 10°C ($n=6$). Four served as normal controls. After gradual rewarming and 80 minutes of reperfusion, treatment animals were sacrificed and brains were perfusion-fixed and cryopreserved. Regional patterns of neuronal apoptosis after HCA was characterized by in situ DNA fragmentation using TUNEL histochemistry. Hematoxylin and eosin histology was used to characterize cell damage morphologically. TUNEL-positive cells were scored on a scale of 0 to 5. Grade 0: no TUNEL-positive cells; Grade 1: < 10%; Grade 2: 10–25%, Grade 3: 25–50%, Grade 4: 50–75%; and Grade 5: > 75%.

Results: TUNEL-positive cells indicating DNA fragmentation were scored in the motor and sensory neocortex, hippocampus, cerebellum, thalamus and medulla of animals treated with 18°C and 10°C HCA and were significantly greater than in normal

controls. Profound cooling to 10°C resulted in a significant reduction of neuronal injury in the neocortex and hippocampus.

Conclusions: This data support that cerebral protection may be better at very cold temperatures compared to 18°C hypothermia. Regions selectively vulnerable to neuronal injury are offered more neural protection by profound hypothermia. These effects are observed in the acute state, suggesting activation of the apoptotic mechanisms at early stages can be inhibited by profound hypothermia.

0372

Early intervention in patients with high risk for persisting problems after Mild Traumatic Brain Injury (MTBI).

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Objectives: To test the hypothesis that early, structured intervention directed to patients at high risk for persisting problems after MTBI has a clinically meaningful effect on self reported symptoms at three months after the injury.

Method: A randomised, controlled, multicenter study included adult patients aged 18–65 years, with surgically uncomplicated MTBI and presenting with a GCS score of 14–15 from EDs of seven regional or county hospitals in Sweden. All patients received written, educational information about MTBI. Consenting patients answered the Rivermead Post Concussion Symptoms Questionnaire at 10 day after the injury and were contacted by a study nurse. Patients fulfilling high risk criteria, defined as reporting three or more symptoms, were randomised to either a structured examination, information and further intervention as needed by a specialist in neurorehabilitation within three weeks after the injury + standard care or standard care alone. Primary endpoint was self-reported symptoms at three months post injury. Patients with low risk, i.e. fewer than 3 symptoms at ten days after injury, were also followed up to enable validation of risk criteria.

Results: In total 174 patients were included and 90 of these fulfilled the high risk criteria. 46/90 were randomised to the structured intervention and 44/90 to standard care. 75 of the randomised patients were

followed up at three months. 67/84 low risk patients were followed up. In all patients, symptom load decreased between 10 days post-injury and three months. However, in the high risk group, there was no significant difference of symptom load at three months between those exposed to structured intervention and those not. Further, a significant difference between the high and the low risk groups remained at three months lending some support for the risk criteria.

Conclusions: This study indicates that early, structured examination, information and further intervention as needed by a specialist in neurorehabilitation directed to patients at high risk for persisting problems after MTBI does not add any significant effect to initial written information on self reported symptoms at three months after MTBI. Further analysis will elucidate any effects on other variables including activity performance and sick-leave.

0373

Evaluation of the Orientation Log and Cognitive Log as Predictive Measures of Outpatient Neuropsychological Testing Performance in Cerebrovascular Accident (CVA) and Traumatic Brain Injury (TBI) Populations.

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Objectives: The present study was conducted as a partial replication and extension of the previous work of Lee, LoGalbo, Baños, and Novack (2004) that found the Orientation Log (O-Log) and Cognitive Log (Cog-Log) to have predictive value for outpatient traumatic brain injury survivor neuropsychological test performance.

Method: Archival data from a convenience sample of 60 traumatic brain injury (TBI; n=40) and cerebrovascular accident (CVA; n=20) patients were examined to provided real world support for the O-Log and Cog-Log's ability to predict outpatient neuropsychological testing. Patients included in the study received inpatient and outpatient care at a large rehabilitation hospital in Indianapolis, Indiana between June 2006 and May 2008.

Results: Results of a between-group comparison of the TBI and CVA samples resulted in no significant differences in basic demographics, time of outpatient assessment post discharge, O-Log scores, Cog-Log

scores or neuropsychological testing data, thus samples were combined throughout the remaining analyses. Twelve neuropsychological tests representing an array of functional domains were standardized (M=100, SD=50) and placed in a principal component analysis to create composites of neuropsychological test data. Hierarchical linear regression analyses indicated that lowest Cog-Log scores were most predictive of performance on measures of memory and executive functioning/processing speed accounting for 7 to 14% of the variance beyond injury type and basic demographics.

Conclusions: Based on current findings, and in accordance with previous research, the Cog-Log appears to have clinical, real-world utility for the prediction of outpatient neurological test performance. Results of the current study additionally provide support for the Cog-Log's use in CVA populations. Given the ease of administration and its ability to be administered serially throughout inpatients' stay, the Cog-Log should be considered a useful tool for inpatient assessments and for planning outpatient rehabilitation needs.

0374

The Nociception Coma Scale to assess nociception in disorders of consciousness

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Objectives: Assessing behavioral responses to nociception is difficult in severely braininjured patients recovering from coma. We here propose a new scale developed for assessing nociception in vegetative (VS) and minimally conscious (MCS) coma survivors, the Nociception Coma Scale (NCS), and explore its concurrent validity, inter-rater agreement and sensitivity.

Method: Concurrent validity was assessed by analyzing behavioral responses of 48 postcomatose patients to a noxious stimulation (pressure applied to the fingernail) (28 VS and 20 MCS; age range 20–82 years; 17 of traumatic etiology). Patients' were assessed using the NCS and four other scales employed in non-communicative patients: the 'Neonatal Infant Pain Scale' (NIPS) and the 'Faces, Legs, Activity, Cry, Consolability' (FLACC) used in

newborns; and the 'Pain Assessment In Advanced Dementia Scale' (PAINAD) and the 'Checklist of Nonverbal Pain Indicators' (CNPI) used in dementia. For the establishment of inter-rater agreement, fifteen patients were concurrently assessed by two examiners.

Results: Concurrent validity, assessed by Spearman rank order correlations between the NCS and the four other validated scales, was good. Cohen's kappa analyses revealed a good to excellent inter-rater agreement for the NCS total and subscore measures, indicating that the scale yields reproducible findings across examiners. Finally, a significant difference between NCS total scores was observed as a function of diagnosis (i.e., VS or MCS).

Conclusions: The NCS constitutes a sensitive clinical tool for assessing nociception in severely brain-injured patients. This scale constitutes the first step to a better understanding and management of pain in patients recovering from coma.

0375

Neuroprotective Effect of PPAR α Agonist, GW7647, In Global Cerebral Ischemic Reperfusion Injury in Gerbils

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Objectives: PPARs (peroxisome-proliferator-activated receptors) are ligand-activated transcriptional factor receptors belonging to nuclear receptor family and known to involve in regulation of lipid or glucose metabolism. Out of the three isoforms of PPAR (α , β/δ , and γ gamma), PPAR α and PPAR γ activation has recently also shown neuroprotective activity because of their anti-inflammatory and antioxidant effects. This study investigated the effects of a selective PPAR α agonist, GW7647 (2-[[4-[2-[[[(Cyclohexylamino)carbonyl](4-cyclohexylbutyl)amino]ethyl]phenyl]thio]-2-ethylpropanoic acid), on global cerebral ischemia-reperfusion (IR) injury in gerbils.

Method: Global cerebral IR injury was induced in male mongolian gerbils, by occluding the common carotid arteries, bilaterally, for 5 min followed by reperfusion for 96 h. Neurological damage associated with global cerebral IR injury was characterized by assessing neurological deficits, hyperlocomotion, memory impairment and selective neurodegeneration in the hippocampal CA1 region. Hyperlocomotion was recorded using opto-varimex

whereas memory impairment was observed by passive avoidance test. Hippocampal damage was assessed through histological examination of celestine blue and acid fuchsin stained brain sections. Apoptotic DNA fragmentation was observed by TUNEL (terminal deoxynucleotidyl transferase-mediated dUTP nick end labelling) assay.

Results: Global cerebral IR injury resulted in increase in neurological score, hyper locomotion, memory impairment and selective neurodegeneration in the hippocampal CA1 region. CA1 Hippocampal neurodegeneration after global ischemia was also associated with apoptotic DNA fragmentation as evident from increased TUNEL (terminal deoxynucleotidyl transferase-mediated dUTP nick end labeling)-positive cells. GW7647 treatment resulted in significant reduction in cerebral IR induced neurological symptoms, hyperlocomotion, cognitive deficits and hippocampal neuronal damage. A significant reduction in TUNEL positive cells were also observed in CA1 hippocampus region, after GW7647 treatment, in the IR challenged gerbils.

Conclusions: The present study demonstrates the neuroprotective effects of GW7647 in global cerebral IR injury and these effects may be attributed to reduction in apoptotic cell death. This study further strengthens the involvement of PPAR α in cerebral IR injury and also suggests the therapeutic potential of PPAR α agonists in cerebral ischemic-reperfusion injury.

0377

Construct of the Rivermead Post-concussion Symptoms Questionnaire (RPQ) according to a Rasch-analysis

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Objectives: to investigate how the construct of Rivermead Post-concussion Symptoms Questionnaire (RPQ) fits to the Rasch model by an analysis of data from a national cohort of patients with Mild Traumatic Brain Injury (MTBI).

Method: RPQ-questionnaire data, collected at 3 months after MTBI from 2460 patients, aged 6–96 years, were analysed according to the partial credit model.

Results: Most participants had low total RPQ sum scores and most common symptoms were headache and fatigue. Person fit was reasonably good. Estimates of item difficulty varied in a rather limited span between -0.77 and 1.34 . The mean-square (MNSQ) values in fit statistics for items were between 0.5 and 1.5 , indicating that all items were productive for measurement and reasonably predictable, although there were some weaknesses for visual symptoms. The Rasch dimension explained 48.6% of data variance. The largest secondary dimension explained 6.1% of the variance and had an eigenvalue of 1.9. Model fit improved by collapsing the original five item categories to three (no problems – little or moderate problems – severe problems). There was no differential item functioning by gender or age.

Conclusions: This study demonstrates that the construct of the Rivermead Post-concussion Symptoms Questionnaire (RPQ) fits the unidimensional Rasch model for symptoms reported after MTBI and that there is no differential item functioning related to gender or age groups above 5 years. The findings imply that total sum scores for all RPQ items are meaningful. There was some support for omitting visual items and reducing the number of severity categories.

0378

Examining Neurobiological Underpinnings of Depression Following Mild Traumatic Brain Injury

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Objectives: The purpose of this study was to examine the neurobiological underpinnings of depression following mild traumatic brain injury (MTBI). Three primary hypotheses were tested. First, patients with more serious MTBIs will be more likely to develop depression. Specifically, patients with complicated MTBIs or injuries characterized by longer periods of post-traumatic amnesia (PTA) will be more likely to develop depression. Second, patients who experience structural abnormalities to

the anterior region of their brain (i.e., frontal or temporal lobes), visible on day-of-injury CT or four-week MRI, will be more likely to develop depression. Third, patients who develop depression will have greater microstructural changes in frontal lobe white matter than patients who do not develop depression, as assessed by diffusion tensor imaging (DTI).

Method: In this inception cohort design, participants were 126 prospectively enrolled patients from the Emergency Department of Tampere University Hospital, Finland (Age: $M = 37.8$ years, $SD = 13.4$; 56.3% women) who had sustained an MTBI. At approximately four weeks post injury, diffusion tensor imaging of the whole brain was undertaken using a Siemens 3T scanner. Quantitative DTI parameters, including apparent diffusion coefficient (ADC) and fractional anisotropy (FA), were calculated for 11 regions of interest. Depression was diagnosed ($N = 26$; 20.6%) through an algorithm based on sadness, loss of interest, and eight additional symptoms from the Beck Depression Inventory-II that have the least overlap with post-concussive symptoms. A healthy control sample ($N = 30$) also underwent MRI scanning.

Results: Patients with a history of pre-injury mental health problems were more likely to be in the depressed versus non-depressed group (26.9% versus 2.0%, $p < .001$). There was a trend toward women being more likely to be in the depressed group (73.1% versus 52.0%, $p < .055$). There was no relation between duration of PTA and depression. A greater percentage of patients in the non-depressed group sustained a complicated MTBI (29.8% versus 7.7%; $p < .022$). All patients with frontal or temporal abnormalities were in the non-depressed group. On DTI, there were a small number of statistically significant differences in frontal white matter in the centrum semiovale (ADC, depressed MTBI > healthy controls), anterior corona radiata (FA, depressed MTBI < non-depressed MTBI), and uncinate fasciculus (FA, depressed MTBI < healthy controls and non-depressed MTBI). Similar DTI differences were found in the genu of the corpus callosum, posterior corona radiata, and basilar pons.

Conclusions: Depression following MTBI was more common in people with a previous mental health history. More serious MTBIs with longer PTA, intracranial abnormalities, or frontal-temporal intracranial abnormalities were not associated with depression. However, there were a small number of significant differences on DTI in several brain regions, providing partial support for the hypothesis that patients who develop depression have worse microstructural integrity in frontal lobe white matter than patients who do not develop depression.

0379

Advanced Magnetic Resonance Imaging of Mild Traumatic Brain Injury in Emergency Settings

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Objectives: Clinical computer tomography (CT) and conventional magnetic resonance imaging (MRI) techniques either underestimate or fail to detect important neuropathology of mild traumatic brain injury (mTBI), out of question for mTBI outcome prediction and recovery assessment. The available biochemical markers are either non-sensitive or non-specific enough to detect complex and heterogeneous pathoanatomical information of mTBI. Consequently, clinicians may fail to order adequate treatments that could address prolonged neurocognitive symptoms in mTBI patients. The advanced MRI techniques, including susceptibility weighted imaging (SWI) and diffusion tensor imaging (DTI), have been reported being sensitive to subtle changes of the brain after mTBI. However, there is a lack of investigation on the role of advanced MRI in mTBI detection at acute stage, especially in emergency settings. The objective of our work is to establish these advanced MR imaging techniques (DTI and SWI) as a set of biomarkers for better detection and outcome prediction of mTBI at acute stage. This report is a preliminary data summary of our ongoing effort.

Method: Mild TBI patients were directly recruited from the Emergency Department of our level one trauma hospital. They all met the definition of mild TBI by the American Congress of Rehabilitation Medicine (ACRM) with Glasgow Coma Scale (GCS) score of 13–15 at emergency entry. Before MRI scan, all patients have undergone CT scan in emergency setting. All patients were scanned in our 3 Tesla Siemens VERIO magnet. If an MRI scan was not performed due to logistic reason within 24 hours post injury, the patient would be scanned later within 10 days post injury.

Results: Seven mTBI patients were recruited in emergency setting and undergone CT scan and later MRI scan. Two patients were later excluded due to either previous head injury or other neurologic history. Among the remaining five eligible patients, three patients had MRI scan at acute stage (within 24 hours after injury) and two patients at subacute stage (within 10 days after injury). Among

three acute stage patients, CT detected extra-axial abnormalities in two patients, and SWI detected additional parenchymal hemorrhages and abnormal hyperintensities, which are not shown on CT, in these two patients. In one subacute patient, MR fluid attenuated inversion recovery (FLAIR) image detected abnormal hyperintensities in frontal white matter, which are not shown on CT. DTI fractional anisotropy also detected various signal changes in different regions of major white matter tracts in comparison with controls.

Conclusions: In addition to extra-axial injury of the head detected by CT, complicated mild TBI patients tend to have parenchymal lesions as well, which are only detectable in advanced MRI. This finding might help explain why complicated mild TBI tends to have prolonged neuropsychological problems. DTI and SWI complement to each other in mTBI detection by identifying different types of pathologies at different locations of the brain.

0380

Hemispatial neglect in far space in patient in motion

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Objectives: Background: Hemispatial neglect is a frequent problem in individuals with brain injury. Hemispatial neglect have been described as peripersonal or extrapersonal. Although many tasks are described to assess hemispatial neglect in peripersonal space, neglect in extrapersonal or far space is rarely assessed. Moreover, participation in real life situation is likely to be threatened by double tasks, such being in motion and looking for information in the environment. Objective: To study neglect in far space in patients in motion using a visual exploration task.

Method: Patients with a unilateral hemispheric brain vascular lesion (left or right) were recruited consecutively in two rehabilitation units (in Paris, France). A convenience sample of healthy matched controls was recruited. Eighteen covers of magazines were distributed at 3 levels of height on two walls of a corridor (2.30 meters wide, 20 meters long). Participants were placed at one end of the corridor, and asked to go and meet an examiner at the other end, while pointing at each of the magazine covers.

The number of omissions on each side was recorded, and compared to the presence of neglect in the Bells test, and the ecological “Catherine Bergego Scale” (comprised GEREN battery) that are routinely administered to all patients in these rehabilitation services.

Results: We recruited 26 patients with right brain damage (RBD), 16 with left brain damage (LBD), and 29 healthy matched controls. There was a significantly higher number of omissions on the left in the RBD group in the corridor task compared with the other 2 groups. Left-sided omissions were correlated with (i) left-sided omissions in the Bells test; (ii) with the ecological assessment of neglect, and more specifically with the items exploring the extra-personal space. In the LBD group, no significant increase in right-sided omissions was found.

Conclusions: An ecological task exploring neglect in far space during motion is useful to detect neglect. It allows to discriminate patients with RBD from controls and patients with LBD, and it was correlated with clinical assessment of neglect. This test is useful in clinical practice.

0381

Participatory Research, Power, and Voice among Persons with Traumatic Brain Injury

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Objectives: We conducted a community-based participatory research (CBPR) study on post-traumatic irritability among people with traumatic brain injury (TBI), caregivers and family members, and healthcare providers. Our aim was to understand the experience of irritability in TBI from all perspectives. The research question raised in this paper focuses on the process used in this research, Community-based Participatory Research, and how this process affected empowerment of participants, especially participants who are not professional researchers. We conducted this analysis to answer the question: How does

the process of CBPR affect participant power and voice in research in a medical setting? To the best of our knowledge, this is the first study to examine power relationships in this context and one of the first studies to utilize a CBPR approach to study the process of CBPR among persons with TBI.

Method: Participatory focus groups meeting monthly for 10 months discussed the role of post-traumatic irritability on issues such as family and social support, environmental barriers and communication. This research will discuss our reflexive analysis of group power interactions and dynamics between individuals with TBI, their spouses, and TBI healthcare and community providers, and our attempts to equalize the pre-existing power relationships inherent in the groups. Coding and analysis of the data consisted of a rigorous multi-step grounded theory process conducted by a coding team of researchers, people with TBI, and families members and healthcare providers of people with TBI.

Results: This paper examined shared power and voice among researcher and non-researcher participants in a community-based participatory research (CBPR) study. CBPR is used in health care settings with the goal of improving health care quality by providing care which respects the patients’ preferences, needs, and values. Proponents of CBPR might suggest that involving people with TBI into research about them would foster empowerment, give them voice, break down power relationships between the researcher and the researched, thereby finding new ways of seeing the situation, and working toward solutions. Thus, at the outset of the research we anticipated participation in the groups themselves would yield experiences of empowerment among both people with TBI and their family members. However, analysis of the group processes does not necessarily support this outcome. Analysis of group processes suggests traditional power dynamics prevail in the researcher-researched role, despite attempts to equalize this relationship.

Conclusions: Analysis of our focus group communication suggests how and where we unintentionally reinforced power inequities. Our data suggests several factors that might impact empowerment: the number of researchers, how the participants are chosen and what they are told about the study. We suggest ways of creating an empowering space in research for all participants, including people with TBI and their families, including ways to engage patient and community participants from the outset. We also discuss challenges to including all stakeholders in the CBPR including the peer review process and criteria; privacy concerns and IRB regulations; cognitive impairments among people with TBI; and the need to modify

behaviors among professionally-trained researchers. Perhaps the most important finding from this analysis is that a team of researchers, including medical, social, and behavioral researchers, health-care providers, community participants, people with TBI, and their caregivers, came together with the most positive of intentions to collectively gather information, solve problems, and equalize power in this project. We accomplished many of these goals, but encountered unexpected resistance to creating equal power and voice between researchers and person's with TBI.

0382

Relationship between Subjective Complaints and Neuropsychological Measures in Patients with Traumatic Brain Injury

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Objectives: Recently, there has been increased support for the importance of self-appraisal in traumatic brain injury (TBI) rehabilitation research and treatment as self-appraisal can assist in determining treatment as well as assessing the effectiveness of a treatment. Additionally, acquiring self-appraisals in conjunction with more objective measures of functional ability provides information regarding patient's awareness of their deficits. This paper aims to explore the relationship between subjective measures of functioning and performance on neuropsychological measures in patients with TBI. Areas of subjective appraisals included cognitive problems, affective/behavioral problems, physical/dependency problems, and fatigue.

Method: Seventeen patients with TBI underwent neuropsychological testing and completed self-report questionnaires. Neuropsychological tests assessed memory/learning, attention, processing speed, response speed, and executive functioning ability. Self-report questionnaires assessed the participants' subjective experience of cognitive, affective/behavioral, and physical/dependency problems using the Problem Checklist as well as aspects of fatigue including general fatigue, physical fatigue, reduced activity, reduced motivation to initiate activities, and mental fatigue using the Multidimensional Fatigue Inventory. Data were analyzed using bivariate correlation analyses.

Results: Results of correlation analyses between neuropsychological test scores and scores on subjective measures revealed the following. Significant negative correlations were found between performance on memory/learning measures and reduced motivation ($r = -0.47$, $p = 0.049$), between performance on attention measures and cognitive problems ($r = -0.47$, $p = 0.049$) and between performance on executive functioning measures and cognitive ($r = -0.47$, $p = 0.040$) and affective/behavioral problems ($r = -0.51$, $p = 0.025$).

Conclusions: Patients with TBI who exhibited memory/learning problems reported reduced motivation to initiate activities. Those who demonstrated problems with attention reported experiencing increased problems in cognitive domains. Patients who performed worse on executive functioning tasks reported experiencing more problems in cognitive domains as well as affective/behavioral problems. Information gathered from this study adds to the growing body of research supporting the importance of including self-report appraisals in treatment identification and assessment.

0383

An Exploration Of The Effects Of Conjoint Working Between Music Therapists and Speech And Language Therapists When Treating Patients With Communication Difficulties Due to Acquired Brain Injury.

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Objectives: To explore experiences of conjoint working between music and speech and language therapists when treating adults with communication disorders caused by acquired brain injury. The research question states, 'Is conjoint working between speech and language and music therapists an effective way of working when treating patients with acquired brain injury?'

Method: The investigation will employ qualitative survey methodology, using a multi-method approach of interview and questionnaire. Questionnaires will be sent to music and speech and language therapists in the field of neurology to recruit eight participants (four from each discipline) to interview about their experiences of conjoint working together. Grounded Theory Analysis (Glazer & Strauss (1967); Strauss & Corbin (1990; 1998)) will be utilised to allow the

researcher to explore themes from the interview transcripts.

Results: The outcome of the results found that conjoint working between speech and language and music therapists were perceived to be an effective way of working when treating patients with acquired brain injury. However, although the benefits of this type of working were highlighted the analysis of the data also showed its limitations from each disciplines perspective including affected therapeutic boundaries and differing professional opinions. In addition the analysis also provided guidance to similar and differing techniques that each discipline brought to conjoint working and how they fitted within treatment programmes. Finally, it was highlighted how the participants originally gained their conjoint working knowledge enabling to work in this way in their current working.

Conclusions: In summary the investigation has provided guidance to how to carry out affective conjoint working between speech and language therapists and music therapists. The study gives scope to further investigate whether conjoint working between music therapists and speech and language therapists is common practice in other fields of work, for example learning disabilities. Furthermore, additional exploration of conjoint working between music therapists and other health-care professionals in the field of neurology might increase the professional knowledge of what conjoint working could potentially offer.

0384

Identification of pituitary insufficiency in patients with traumatic brain injury (TBI) or subarachnoid haemorrhage (SAH).

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Objectives: Patients suffering from TBI or SAH often develop pituitary insufficiencies such as diabetes insipidus, growth hormone deficiency, SIADH, adrenal insufficiency, thyroid insufficiency and gonadotropin insufficiency. Many of these

insufficiencies have been regarded as transient, even as an adaptive biological event that does not need further exploration or treatment. However, explorative studies indicate a need for intervention in patients presenting severe clinical signs of pituitary insufficiency, like hypotension, bradycardia, hyponatremia or hypoglycaemia.

The purpose of this study is to investigate:

- (1) the prevalence of pituitary insufficiency in patients with traumatic brain injury (TBI) or subarachnoid haemorrhage (SAH),
- (2) the relation between hormonal disturbance and neurological and cognitive function during the recovery process,
- (3) the relation between hormonal disturbance and long-term outcome with regard to neurological/cognitive function, activity and participation.

Method: Patients diagnosed with TBI or SAH, 18 years or older and admitted to Neurointensive care at Karolinska Hospital are eligible for inclusion. Within ten days post injury/post SAH, a Synacthene test is performed and thyroid function (fT3, fT4 and TSH) examined. Follow-up at the Department of Rehabilitation at Danderyds University Hospital at 3, 6 and 12 months post injury/post SAH include detailed screening of clinical function according to protocol. Hormonal screening at 3 months include S-TSH, S-fT4, S-fT3 and S-Cortisol and at 6 and 12 months S-TSH, S-fT4, S-fT3, S-IGF-I, P-GH, S-Prolactin and S-Cortisol. In addition, S-Estradiol, S-FSH and S-LH are examined in females aged <50 years, presenting non-regular menstruations and not on contraceptive medication, as are S-Testosterone and S-SHBG in males.

Results: At this point of time, 38 patients have been included, 8 have been lost due to fatal outcome (7) or migration.

Until now no conclusive impairments in pituitary function have been observed. However, although most patients had a normal thyroid function, some had disturbances at day 10 (Fig 1). In addition, at three months post TBI/SAH a disturbance in cortisol secretion was seen in some (Fig 2).

Conclusions: Preliminary data from this ongoing study demonstrate the presence of thyroidal disturbances early after TBI/SAH and cortisol disturbances at three months post injury although the small study sample does not allow any firm conclusion. None of the observed abnormalities have required substitution drug therapy but some patients received corticoid therapy during neurointensive care for various other reasons. Data collection will continue until around 100 consecutive patients with TBI and SAH respectively have been included,

which will allow exploration of the possible impact of hormonal disturbances on the clinical recovery course and long-term outcome.

0385

Clinical Observation of Cerebrolysin Combined NDT on Compensation of Cerebral Function in the children with cerebral palsy

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Objectives: Cerebrolysin, a preparation derived from porcine brain, has a direct impact on the nerve cells through the blood-brain barrier. It has been widely used in the treatment of cerebrovascular diseases, traumatic brain injuries, Alzheimer's diseases and other encephalopathy, due to its neurotrophic and neuroprotective effects. To evaluate the efficacy and safety of Cerebrolysin in the treatment of cerebral palsy (CP). To explore the Clinical effect of Neurodevelopmental treatment (NDT) with Cerebrolysin on rehabilitation of Cerebral Function in the children of cerebral palsy (CP). To study the value of assessing quantitatively before and after curative effect for CP children by the Gross motor function measure (GMFM)-88 stems.

Method: A double-blind and randomized controlled clinical trial was conducted for Treating CP. Sixty of CP were randomly divided into a treatment group (36 cases) and a control group (32 cases), the treatment group with NDT and intravenous injection of Cerebrolysin for 3 periods. The control group were treated only with NDT. Their clinical therapeutic effects and recoveries of brain lesion detected by MRI were investigated. The curative effect before and after NDT and Cerebrolysin for CP patients were quantitatively assessed by (GMFM)-88 items.

Results: the total effective rate was 85.1% in the treatment group better than 70.8%, of the control group there being the significant difference ($P < 0.01$). The total scores of GMFM-88 items in the treatment group was higher than the control group ($P < 0.01$). The effective rate was higher in the treatment group of fewer than 3 years old. No adverse drug reaction was observed in Cerebrolysin group.

Conclusions: Application of Cerebrolysin can benefit obviously the treatment of CP. Cerebrolysin is efficacious and safe in the improvement of neurological function of children with CP. Cerebrolysin and

NDT can promote compensation of cerebral function in the children of cerebral palsy. The GMFM-88 can reflect the change of gross motor development in CP children and can be sensitively directly quantified assessment of curative effect of NDT and Cerebrolysin for CP. Keywords: Cerebral palsy; Cerebrolysin; neurodevelopmental treatment; Gross motor function measure

0386

Using tele-rehabilitation to address executive dysfunction and community integration after traumatic brain injury

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Objectives: Executive dysfunction resulting from frontal and prefrontal lobe injuries has been shown to affect community integration in adults with traumatic brain injuries (TBI). Recent evidence supports direct training of problem-solving strategies in real-life situations as a rehabilitation intervention for executive dysfunction. However, access to health services to receive this training is often limited especially in rural communities. It is therefore important to explore ways to deliver rehabilitation services when face-to-face intervention is not feasible while ensuring that the intervention provided is supported by research. One intervention approach that has been successfully used in a face-to-face format with adults with TBI is the Cognitive Orientation to daily Occupational Performance (CO-OP) approach. The CO-OP approach explicitly teaches the use of problem-solving strategies applied to self-identified goals related to real-life situations. The objective of the study is to investigate whether the CO-OP approach can be used effectively in a tele-rehabilitation format to promote community integration post-TBI. No previous study has used a tele-rehabilitation approach to deliver the CO-OP training.

Method: A case study of an adult male, more than 20 years post-TBI, will be presented. Neuropsychological tests of attention, memory, and executive function were used to characterize the participant. Three outcome measures were used: the Canadian Occupational Performance Measure (COPM), the Dysexecutive Questionnaire (DEX), and the Mayo-Portland Adaptability Inventory-4 Participation Index

(MPAI-P). The COPM, a standardized interview, guided the participant to identify his occupational performance issues, enabled him to develop 5 goals of which 3 were addressed in the CO-OP training, and captured changes in his self-perception of occupational performance related to his goals at pre- and post-intervention and at 3-month follow-up. The untrained goals were used to examine the generalizability of the approach. The training sessions were video recorded and analyzed to examine the integrity of the CO-OP approach when applied in a tele-rehabilitation format. Participant's feedbacks on the approach and the delivery format were gathered through an interview post-intervention. The intervention was composed of 10 weeks of biweekly 1-hour videoconference sessions that were completed through the internet at the participant's home using commercially available softwares.

Results: Webcam and headset were provided to the participant for the study. The participant required technical support to setup the computer for videoconferencing but few technical issues were experienced that interfered with the sessions. The participant's selected goals for the CO-OP training were related to his mobility, organizational skills, and leisure participation. He often commented that the global strategy taught in the CO-OP training was applicable to almost everything he did.

Conclusions: Tele-rehabilitation shows promise as a way of delivering the CO-OP approach and can have implications to promote community integration of individuals with TBI.

0388

Application of transcranial magnetic stimulation in diagnostics and treatment of patients in vegetative state.

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Objectives: We observed 26 patients after brain injury with impairment of consciousness 8–10 points by Glasgow Scale (GCS). Their age was from 19 to 54 years old.

Method: For the analysis of intracortical slowness and relief we used diagnostic transcranial magnetic stimulation (TMS) by paired stimuli with short inter-impulse intervals.

The course of rehabilitation rhythmical TMS included 10 procedures 2 times a week.

Results: In the group of patients, where we noticed the decrease in the process of intracortical slowness compared to the test ones no significant clinical differences or dynamics by Glasgow scale were seen. In the group where the processes of slowness were intense, we could see the tendency to the increase in the level of consciousness compared to the test group ($p < 0,01$), by 0,67 points on average. If patients in vegetative state do not show any signs of disorders of intracortical slowness while TMS, TMS does not purpose any significant influence on the dynamics of psychic processes, the presence of the phenomenon of intracortical slowness can be the reason to prescribe rhythmic TMS.

Conclusions: Thus, a differential approach is needed for prescribing rehabilitation MTS. The method requires further studies.

0389

Linking the Mayo-Portland Adaptability Inventory (MPAI-4) to the International Classification of Functioning, Disability and Health (ICF)

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Objectives: The International Classification of Functioning, Disability and Health (ICF) is a universal framework and an international language for describing all aspects of a disability. It can be used to facilitate the assessment and goal planning following a trauma or disease as well as improve outcome research by understanding the content of measurement tools. Along these lines, the value of linking the ICF to health-related outcome measures is increasingly recognized. Rules have been developed which enable researchers to link the contents and items of specific measures to the ICF. The aim of this study was to examine the contents of the Mayo-Portland Adaptability Inventory (MPAI-4), an instrument that assesses disability and participation after brain injury, by linking it to the ICF.

Method: The MPAI-4 contains 30 items that are scored on a five-point Likert scale and represent the

range of physical, cognitive, emotional, behavioural, and social problems that people with acquired brain injury may encounter. The MPAI-4 has three subscales: Ability, Adjustment and Participation as well as a total score. Three researchers performed the linking according to the eight ICF linking rules developed by Cieza et al. (J Rehabil Med 2005;37:212–218). Each item in the MPAI-4 was linked to the corresponding main ICF category, based on both the identified meaningful concepts and the intention of the item, i.e., what it is meant to assess.

Results: All items in the three subscales of the MPAI-4 could be linked to domains and contents in the ICF. A total of 88 meaningful concepts were identified. There were on average 2.84 meaningful concepts per item, and 65% of all concepts could be linked. A total of 216 (15%) of all the 1424 categories in ICF were linked to the items in the MPAI-4. The subscale Participation contained the highest number of concepts (89%) and most concepts addressed contents from the Activity and Participation (34%). Regarding the ICF's level of hierarchy, we assigned a majority of the concepts to the 3rd or 4th levels. Of the 258 Environmental Factors, 34 (13%) could be linked to the items in the MPAI-4.

Conclusions: This study shows that the ICF can capture all items in the MPAI-4 and that the items in the MPAI-4 can be linked to a standard coding framework. This linkage provides better definition through more concrete examples (as listed in the ICF) of the types of functions, activities, and participation indicators that are represented by the each of the MPAI-4 items. ICF descriptors, which are meant to be transcultural, may also assist MPAI-4 users throughout the world in understanding the intent of each item. Successful linkage also offers a type of construct validation for the MPAI-4 in that a relationship between the widely accepted ICF taxonomy and the MPAI-4 metric was established.

0390

Usage of the combined method of dynamic proprio correction and programmed electrostimulation in rehabilitation of patients after severe brain injury.

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Objectives: In our research we estimated the effectiveness of the combined effect of the reflex-loading device “Gravistat” and programmed electrostimulation using the computer complex “Multimiostim” on the restoration of walking function. Sabilometry was used as an objective test-diagnostic criterion of the condition of patients’ functional sphere.

Method: Dynamic proprio correction was held on the reflex-loading device “Gravistat”. The idea of the method is the impact on the brain structures of the intensified current of corrugated proprioceptive unit activity, formed in the process of the patient’s active movement in the reflex-loading device “Gravistat”. We observed 47 patients after severe brain injury with moderate and exposed paresis of the lower limb. The duration of the observation was from 3 weeks to 4,5 months. The first group of patients (36 people) in addition to the basic treatment had trainings in the suit and sessions of multi-channel stimulation, the second group – only the standard course of the restoration treatment.

Results: During the comparing analysis of the effectiveness of the patients’ rehabilitation in both groups, we received the following results:

- in the first group the figures of the length of statokinesiogram improved by 16,7% (in the second group by 5,8%)
- the average speed of the movement of the pressure centre decreased by 19,1% (in the second group by 7,3%),
- the average area of statokinesiogram decreased by 21,3% (in the second group by 9,8%).
- The location of the pressure centre in the frontal plane among the patients from the first group had a dynamics of the shift of 12,2 mm, while among the patients from the second group – 4,2mm, in sagittal plane – of 3,1mm and 1,1 mm accordingly.

Conclusions: Thus, usage of the combined method of multi-channel sessions of programmed miostimulation and dynamic proprio correction allowed us to achieve improvement in the random movements and statics in a shorter period of time, what proves that this method is more advantageous in restoration treatment of patients with movement disorders after severe brain injury.

0391

Predicting Attitudes Towards Disorders of Consciousness: a European Survey

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Objectives: The vegetative state (VS) is a devastating medical condition characterized by wakefulness without awareness. When a patient is in a VS for more than a year, medical guidelines consider treatment withdrawal (artificial nutrition and hydration; ANH) ethically justifiable. In 2002, the minimally conscious state (MCS) was formally defined, characterizing patients with more than reflex behavior who exhibit inconsistent but clearly discernible evidence of consciousness, but who lack interactive communication or functional object use. At present, there are no generally accepted standards of care for MCS patients. We here surveyed the attitudes of European doctors, paramedical professionals and non-medical professionals on end-of life decisions in these challenging patients.

Method: We presented a questionnaire on end-of-life issues to attendees of meetings in the EU on coma and disorders of consciousness. Data were obtained from 1739 respondents (mean age 40 ± 14 years, range 16–83; 51% women; 48% Belgian and 52% other EU citizens). Chi-square tests and logistic regression analyses were performed, analyzed with SPSS version 15.0 (SPSS Inc, Chicago, Ill).

Results: Nearly two thirds of all respondents (65%) considered it acceptable to stop ANH in patients in chronic (>1 year) VS (33% disagreed; 2% non-responders). A significant disagreement with ANH withdrawal was expressed by religious respondents (as compared to non-religious; $B = -.454$, $p < .0001$) and by women (as compared to men; $B = -.364$, $p = .003$). We observed no significant effect of professional background on the question of ANH withdrawal in permanent VS ($\chi^2(2,1) = .998$, $p = .607$). The vast majority (81%) of all respondents would not like to be kept alive if they themselves were in permanent VS (18% wanted to be kept alive; 1% non-responders). The majority (78%) also considered that being in a permanent VS is worse than death for the patient's family (51% considered it worse than death for the patient her/himself).

Only 29% of responders considered it acceptable to stop ANH in patients in chronic (>1 year) MCS (70% disagreed; 1% non-responders). Religious respondents were found to disagree significantly more with this statement as compared to non-religious respondents ($B = -.634$, $p < .000$). More

than two thirds of respondents (67%) would not like to be kept alive if they themselves were in chronic MCS (32% wanted to be kept alive; 1% non-responders). Less than half (44%) considered that being in a MCS is worse than VS for the patient's family (52% considered it worse than VS for the patient her/himself).

Conclusions: The sampled European respondents report different end-of-life attitudes towards VS as compared to MCS patients. These findings raise important ethical issues concerning our care for patients with chronic disorders of consciousness. In light of the high rates of diagnostic error in these patients, the necessity for adapted standards of care for MCS as compared to VS is warranted.

0392

Cerebral metabolism in the minimally conscious state with and without command following

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Objectives: Patients in a minimally conscious state (MCS) show restricted signs of awareness but are unable to communicate consistently and reliably [1]. We here tested the hypothesis that this heterogeneous clinical entity can be subcategorized in “MCS minus” (MCS-) (i.e., patients only showing non-reflex behavior such as visual fixation or pursuit or localization of noxious stimuli) and “MCS plus” (MCS+) (i.e., patients showing movements to command, or non-functional but intentional communication), each characterized by its own specific residual cerebral brain function.

Method: Using FDG-PET, we assessed regional cerebral glucose metabolism (rCMRGlu) in 13 MCS- (mean age 47 [SD 20] years; 5 traumatic) and 14 MCS+ (mean age 43 [SD 19] years; 5 traumatic). Data were preprocessed and analyzed by means of statistical parametric mapping (SPM8). Results were thresholded for significance at $p < 0.05$ corrected for multiple comparisons.

Results: Compared to MCS–, MCS+ patients showed higher rCMRGlu in Broca's and Wernicke's regions (area 45 peak voxel x y z stereotaxic coordinates –44 22 4 mm, T value = 3.99 & area 22, peak voxel x y z stereotaxic coordinates –52 –42 6 mm; T value = 3.19). Other identified areas were premotor, postcentral and precentral cortices (areas 6, 3 and 4; coordinates –30 8 56 mm; T = 3.76).

Conclusions: The differences in brain metabolism between MCS– and MCS+ was not identified in widespread frontoparietal “consciousness areas” but in language, sensorimotor and premotor areas. These findings suggest that the main difference between these two subcategories of MCS, clinically separated by the presence of command-following, is their ability to express consciousness (verbally or non-verbally) rather than their level of consciousness per se.

0393

Experience in application of mechanotherapeutic complex with biofeedback Armeo.

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Objectives: In our research we estimated the effectiveness Armeo in complex treatment of patients after brain injury.

Method: Mechanotherapeutic complex Armeo, which carries out support of the upper limb in combination with feedback and 3dimension picture of the work space allows to have functional movement therapy in the conditions of virtual reality.

Trainings on the complex Armeo have been conducted by 36 patients after brain injury, aged 17–45 years old and remoteness of the disease from 14 days to 1 year.

In the group of patients the level of the paresis was 1–4 points (Weiss scale), spasticity 1–4 points (Modified Ashworth scale of muscle spasticity), motor deficit 0–2 points (Frenchay arm test), the level of social activity 0–12 points (Barthel ADL index), cognitive functions 15–29 points (Mini-Mental State Examination).

The duration of the trainings was 20–30 minutes daily, for 20–40 days.

Results: By the end of the rehabilitation course muscle strength increased on average by 1,25 points, spasticity decreased by 1,1 points, minor

motor functions increased by 1 point, the average index by MMSE scale was from 14 to 30 points, the level of social activity increased by 3,5–4 points.

Conclusions: usage of mechanotherapeutic complex “Armeo” with biofeedback leads to the increase in the muscle strength in paraparetic limbs, decrease in the muscle tone and improvement of the social-living adaptation.

0394

The influence of complex programs of restoration treatment on the increase in the life quality of patients after severe brain injury.

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Objectives: The aim of the research : to work out a complex scheme of treatment of spasticity syndrome, including botuline therapy followed by intensive physiotherapeutic treatment among patients after severe brain injury in order to increase their quality of life.

Method: 49 patients took part in the research. All of them were after brain injury and their spastic paresis in arm was up to 3–4 points by Ashworth scale. Among them there were 18 women and 31 men, their age was from 18 to 47 years old, with the trauma of 6–24 months old. All patients were randomly distributed into 2 group – the main one and the test one. The main group consisted of 29 patients. The test group consisted of 20 patients, comparable in their sex, age, clinical development and the duration of the disease. All patients got botuline type A injections into the spastically muscles of the upper limb, in the main groups along with injections, patients had intensive rehabilitation treatment, which included medical electrostimulation, acupuncture, medical classic massage, orthesing, mechanotherapy, using a cyclic device Theravital (Beka Hospitek, Germany) and training devices for passive development of joints, kinesiotherapeutic training, ergotherapy and trainings on the robot-manipulator “Apmeo” (Hocoma, Switzerland). The complex of the rehabilitation treatment was held daily 6 times a week. The duration of the observation was 8 months. Kinesiotherapy – continuously during the whole period of observation, physiotherapy took place fractionally, according to the generally accepted method. The effectiveness of the offered treatment

was estimated by a 5-point Ashworth scale (Ashworth, 1964), methods of anthropometry and valid scales ADL and focal disability.

Results:

- (1) The decrease in the level of spasticity by 1–2 points by Ashworth scale in the main group and by 1 point in the test group.
- (2) According to the data of goniometry – increase in the volume of movement by 15–20° in the shoulder joint in the main group and by 5–10° in the shoulder joint in the test group.
- (3) Barthel ADL: before the beginning of treatment – 30–40 points, in the main group – 60–70 points, in the test group 45–55 points.
- (4) FIM: 70–78 points, 100–108 points and 80–88 points accordingly.
- (5) Nottingham Ten-point ADL index ^ 40 points, 80 points and 60 points accordingly
- (6) NINE-HOLE PEG TEST: 8–10 sec, 4–5 sec and 6–8 sec accordingly
- (7) Action research Arm Test: 22–26 points, 40–46 points, 34–38 points accordingly
- (8) Frenchay Arm Test: 1–2 points, 3–4 points and 2–3 points accordingly

Conclusions: Thus, we noticed that botuline therapy supplemented by rehabilitation treatment is more effective. The research showed the increase in the quality of life of patients after brain injury due to the increase in the rehabilitation potential and possibility of forming of compensatory skills, social and living adaptation in the period of effective decrease in the pathologically increased muscle tone.

Conclusion: complex treatment of botuline therapy, followed by intensive physiotherapy aimed at the decrease in spasticity in the injured arm among patients after brain injury leads to the increase in the rehabilitation potential and the improvement of patients' life quality.

0395

New approaches in the rehabilitation of patients after a severe brain injury with the disorder of equilibrium function.

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Objectives: One of the main tasks in the rehabilitation of patients after a severe brain injury is restoration of

equilibrium function. Search of the new methods of restoration of postural control remains urgent.

Method: 30 patients, aged 20 to 44 in the intermediate period of the brain injury had rehabilitation in our centre. The injuries were located in cortico-subcortical structures of the brain.

In 100% of the cases patients had disorder in the equilibrium function (the research was held on the dynamic stabiloplatform “Balance Manager”, Neurocom, USA). According to the results of the sensory organization test (SOT), the equilibrium score before rehabilitation was on average 33,6%, which is 39,4% lower than the average characteristics of the age group.

Functional condition of the vestibular analyzer was measured with the help of visioboard. Horizontal spontaneous nystagmus was exposed in 55% of cases. The patients were divided into 4 groups, similar by sex, age and neurological deficit. In addition to the traditional course of rehabilitation 7 patients (group A) out of the general number had rehabilitation sessions on dynamic stabiloplatform (on average – 40 training, 30 minutes long), 8 patients (group B) had translingual electrostimulation with “Brain Port” (40 procedures, 20 minutes long).

10 patients (group C) had rehabilitation on stabiloplatform and stimulation with biofeedback “Brain Port”.

In the test group D (5 people) patients had only basic rehabilitation.

Results: According to the results of SOT after the course of rehabilitation sessions the average indicator of the effectiveness of equilibrium work increased by 28,5% and reached 62,1% which is just 9,9% lower than the average characteristics of the age group.

In group A the positive dynamics was 34,4%, in group B – 30,8%, in group C – 37,6%. Spontaneous nystagmus was absent in 100% of the cases.

In the test group, the positive dynamics of equilibrium score was 13,7%, spontaneous nystagmus remained, although lessened in 45% of the cases.

Conclusions: From the results above we can see that the application of methods using Brain Port among patients after brain injury leads to the faster restoration of equilibrium function. In addition, the combined application of both methods was most effective.

0396

Is visual fixation indicative of cortical network activity in otherwise “vegetative” patients?

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Objectives: Assessment of visual fixation is commonly used in the clinical examination of patients with disorders of consciousness. However, different international guidelines seem to disagree whether fixation is compatible with the diagnosis of the vegetative state (i.e., represents “automatic” subcortical processing) or is a sufficient sign of consciousness and higher order cortical processing.

Method: We here studied cerebral metabolism in ten patients with chronic post-anoxic encephalopathy and 39 age-matched healthy controls. Five patients were in a vegetative state (without fixation) and five presented visual fixation but otherwise showed all criteria typical of the vegetative state. Patients were matched for age, etiology and time since insult and were followed by repeated Coma Recovery Scale-Revised (CRS-R) assessments for at least 1 year. Sustained visual fixation was considered as present when the eyes refixated a moving target for more than 2 seconds as defined by CRS-R criteria.

Results: Patients without fixation showed metabolic dysfunction in a widespread fronto-parietal cortical network (with only sparing of the brainstem and cerebellum) which was not different from the brain function seen in patients with visual fixation. Recovery rates did not differ between patients without or with fixation (none of the patients showed good outcome).

Conclusions: Our findings suggest that sustained visual fixation in (non-traumatic) disorders of consciousness does not necessarily reflect consciousness and higher order cortical brain function.

0397

Open Flow Microperfusion: A novel method to continuously evaluate and quantify modulations in the hippocampal microenvironment

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Objectives: Severe traumatic brain injury (TBI) is associated with a massive loss of brain cells due to mechanical tissue disruption, bleeding and secondary insults such as oedema and cell necrosis. TBI mediated damage of the hippocampus leads to memory loss and problems in spatial orientation. Furthermore, one of the sites of neurogenesis in the adult brain is the dentate gyrus of the hippocampus. The hippocampus is therefore a potential source for brain repair following brain damage. To investigate the time dependent changes of the hippocampal microenvironment following cerebral damage resulting in inflammation and/or regeneration an innovative methodology, the open flow microperfusion (OFM), was established. OFM allows the continuous sampling of substances from cerebral interstitial fluid without limitations due to molecular size, protein binding, charge or lipophilicity. The aim of the project was to establish this new method and to evaluate in a first step the impact of the OFM transplantation (minor trauma) on the cerebral micro environment.

Method: Female Sprague-Dawley rats between 200–250g were used. OFM catheter was stereotactically implanted into the hippocampus. Microperfusion was performed using Miniplus 3 Peristaltic Pump (Gilson). Samples are taken at defined time points (4, 8, 12, 16, 20, 24 hrs, than daily for 2 weeks). 24 hours before implantation of the OFM BrdU (500mg/kg) was injected intraperitoneal. Protein samples were shock frozen and analysed for S100 β , BDNF, IGF and estradiol using ELISA. Rats were sacrificed and transcardially perfused with 4% PFA + 1% picric acid. Brains were removed and fixed over night and then transferred to 15% sucrose. Tissue was cut and slices stained using antibodies against BrdU.

Results: Implantation of the OFM was successfully established in hippocampus of living rats as verified in magnetic resonance imaging and MicroCT. Free movement of the animals with negligible stress was maintained by using specially designed cages. S100 β protein levels increased rapidly within 8 hours following implantation of the OFM catheter (80,1 ng/ml). Subsequently, S100 β levels declined significantly to control levels during the 24 hours observation period (10,4 ng/ml). During one week observation S100 β proved to be a very sensitive marker for cerebral modulations. An immediate

increase of S100b was observed following minor infections or minor hemorrhagic insults due to the implantation of the catheter. There was a negligible increase in BDNF observed after 24hrs following OFM implantation probably due to the minor cerebral trauma. A slight increase of the number of BrdU positive cells was observed within the first week following catheter implantation, indicating an induction of primary neurogenic responses by the catheter induced trauma.

Conclusions: Standardised continuous OFM sampling allows for the analysis of all proteins without limitations in the hippocampus and will be a valid method to analyse the inflammatory and neurogenic sequel following more severe traumatic injuries such as lateral fluid percussion induced blunt trauma.

0398

Physical Activity Levels of Children with and without Brain Injury

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Objectives: The U.S. Surgeon General and the U.K. Expert Consensus Group recommend at least 60-min of moderate intensity activity/day for children. Compliance with those guidelines is objectively assessed via accelerometers which provide information on both activity volume (e.g., time active) and intensity (e.g., time in moderate activity intensity). Accelerometers also provide information on activity pattern (activity variability = AV). Activity pattern is important as individuals with a similar activity level may accumulate their activity differently. No study compared objectively adherence to physical activity (PA) recommendations and the PA levels of children with brain injury (CwBI) and typically developed children (TDC).

Purpose: (1) to assess the percentage of CwBI and TDC achieving health-related PA recommendations, and (2) to describe activity levels of CwBI and TDC.

Method: Participants wore the accelerometer (Actiwatch-Mini) for seven days. Activity intensity was stratified as low [>1 metabolic equivalent (MET) to <3 METs], medium (> 3 METs to <6 METs) and high (>6 METs)]. Percentage of time spent at each level was calculated. The intensity categories were calculated for each child based on his/her accelerometer counts during at least 30-min in which the child was awake and sedentary.

Results: Eight CwBI and two TDC measured. For the CwBI there were no significant differences between the seven measurement days in any of the measured activity profiles. CwBI were active 57.39% of the day with 107% AV (coefficient of variation). TDC were active 65.88% of the day with 122% AV. CwBI peak and mean activity levels were $2527.86 + 898$ and $268.2655 + 106.32$ accelerometer counts, respectively. In comparison, TDC peak and mean activity levels were $5057.86 + 3247.96$ and $544.38 + 320.26$, respectively. In the great majority of the day CwBI engaged in low activity intensity (82.99% of the day), whereas the TDC spent only 55.5% in low activity intensity. High activity intensity in CwBI's correlated with percentage of the day active, peak activity intensity, mean activity, and percentage of the day in medium activity intensity. Only one CwBI did not achieve the recommended PA during all the measurement days. The TDC achieved the PA recommendations throughout the week.

Conclusions: Seven measurement days captured the PA levels of CwBI. Despite the brain injury related impairments, the majority of CwBI achieved current PA recommendations. However, the activity level of CwBI was considerably lower than that of TDC. Percentage time active of CwBI and TDC is fairly similar. However, the manner in which the two groups accumulated their activity is considerably different in terms of activity intensity, variability, and peak activity.

0399

Predictors of Competitive Employment Outcomes after Services in State-Federal Vocational Rehabilitation Program Clients with Traumatic Brain Injury.

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Objectives: To determine the relationship between vocational rehabilitation services, and competitive employment outcomes in a sample of 340 Midwestern state-federal vocational rehabilitation clients whose cases were closed in fiscal years 2006 and 2007.

Method: Retrospective data analysis using a hierarchical multiple logistic regression model.

Results: After controlling for age, gender, race/ethnicity, socioeconomic status, receipt of disability benefits at application, residency (urban/rural), and

severity of disability, the odds of achieving competitive employment increased significantly for vocational rehabilitation clients with traumatic brain injury who received job placement and on-the-job supports. For clients who were of minority background, received disability benefits at application, or had lower socioeconomic status (based on income, education and pre-service work status), these odds significantly decreased.

Conclusions: Service variables were stronger predictors of competitive employment than demographic variables. Job placement and on-the-job supports are effective services for vocational rehabilitation clients with traumatic brain injury to become competitively employed.

0400

The Application of Transcranial Doppler and Optic Nerve Sonography in the Non-invasive Evaluation of the Intracranial Pressure in Adult Brain Injury

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Objectives: The anatomic continuity between the subarachnoid spaces of the brain and optic nerve renders the optic nerve sheath diameter (ONSD) sensitive to elevation of the intracranial pressure (ICP). We investigated whether measurements of the ONSD were correlated with simultaneous invasive and non-invasive measurements of the ICP in brain-injured adults.

Method: From the 134 critical care patients (73 males, 49 ± 18 years old) who participated in the study, 74 suffered from brain injury, whereas 60 had no intracranial pathology and served as control individuals. Initially, brain-injured subjects were evaluated clinically (Glasgow Coma Scale, GCS) and using a semiquantitative (I to VI) neuroimaging scale (Marshall scale, MS). Thereafter, brain-injured patients were divided into those with moderate ($MS = I$ and $GCS > 8$, $n = 31$) and severe ($MS = II$ to VI , $GCS \leq 8$, $n = 43$) brain injury. All subjects underwent non-invasive measurement of the ICP (estimated ICP, eICP) by transcranial Doppler sonography, and synchronous measurement of the ONSD by optic nerve sonography. Finally, invasive

ICP measurement was performed in patients with severe brain injury.

Results: ONSD and eICP were both significantly increased (6.2 ± 0.4 mm and 27.5 ± 7.4 mmHg, respectively; $P < 0.0001$) in patients with severe brain injury as compared with patients with moderate brain injury (4.2 ± 1.1 mm and 12.4 ± 3.3 mmHg) and with control individuals (3.7 ± 0.7 mm and 11.3 ± 3.9 mmHg). In subjects with severe brain injury the ONSD measurements were strongly correlated with eICP values ($r = 0.81$, $P < 0.0001$), as well as with the neuroimaging scale results ($r = 0.83$, $P < 0.0001$). In the same subjects, ONSD measurements correlated with invasive ICP values ($r = 0.67$, $P = 0.003$). The best cut-off value of ONSD for predicting elevated ICP was 5.8 mmHg (sensitivity = 75%, specificity = 100%).

Conclusions: ONSD measurements correlate with invasive and non-invasive measurements of the ICP, and with neuroimaging findings in brain-injured adults. Optic nerve sonography and transcranial Doppler sonography can alert for the presence of elevated ICP, whenever invasive ICP evaluation is contraindicated and/or is not available.

0401

Reliability and Minimal Detectable Change of the 10-metre Comfortable Walk Test, 2-minute Walk Test and 6-minute Walk Test in Children with Brain Injury-Pilot Study

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Objectives: Brain injury effects a substantial number of children worldwide. The 10-metre walk test (10MWT), 6-min walk test (6MWT) and 2-min walk test (2MW) are increasingly being used as measures of 'functional ability' in children with brain injury (CwBI), despite a lack of published evidence that they are reliable for young children with traumatic brain injury. Similarly, data on the minimal detectable change (MDC) of the 10MWT, 2MWT and the 6MWT among CwBI are not available. Knowing the MDC is important in order to establish whether an intervention resulted in a true change in walking ability.

Purpose: to assess the reliability and the MDC of the 10MWT, 2MWT and 6MWT in CwBI at least three months post-injury.

Method: Participants engaged in two testing sessions within two weeks. The testing sessions consisted of

three 10MWT and one 2MWT and 6MWT measurements. Subjects walked at their comfortable speed over a 10-meter flat tiled walkway. A two meter “flying start” was used to allow acceleration/ deceleration. Thereafter, subjects walked for 2 and 6-minutes using a previously standardized protocol. During these tests the participants walked 2 or 6-minutes as far as possible at their comfortable pace. The distance covered was recorded. Participants used their customary orthotics and assistive devices and were allowed to stop walking and stand in place, if needed. The 10MWT was assessed simultaneously by two raters, whereas, the 2MWT and the 6MWT were assessed by one rater. Inter-observer reliability of the 10MWT was analyzed using Bland-Altman plots and by determination of the intraclass correlation coefficient (ICC). Intra-observer reliability of the 10MWT, 2MWT and 6MWT was assessed with the ICC. The MDC of the three tests was assessed at the 95% confidence level.

Results: Study participants consisted of six CwBI (mean age $12.2 + 2.68$ years). Participants’ comfortable 10MWT gait speed ranged from 0.69 to 1.29 m/s. Seven typically developed children (TDC) mean age = $11.66 + 3.95$ years. The inter-observer ICC for the 10MWT of the CwBI and TDC were, respectively 0.85 and 0.90 with Bland and Altman plots demonstrating a high degree of repeatability. The intra-observer reliability for the 10MWT of CwBI was 0.78, as compares to 0.818 of TDC. CwBI 2-, and 6MWTs intra-observer reliability was 0.87 and 0.85, respectively. CwBI, 10MWT, 2MWT, and 6MWT MDC were, respectively 0.21 m/s, 26m, and 54m.

Conclusions: the 10MWT, 2MWT, and 6MWT are reliable tests for CwBI. However, among CwBI with mild-to-moderate gait impairment (habitual gait speed greater than 0.64 m/s), the 2MWT and 6MWT demonstrated higher reliability than the 10MWT. It appears that the 10MWT, 2-, and 6MWTs are more reliable for TDC than for CwBI. However, both reliability and MDC may vary based on the subjects’ characteristics in terms of brain injury severity, age, and time from injury.

0402

Using Photovoice to Elicit Lived Experience with Brain Injury and Raise Awareness among Survivors, Providers, and the Public

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Objectives: Brain injury can affect many aspects of a survivor’s life, from cognitive functioning, to emotional, psychosocial, and physical well-being, ability to work and participate in the community, socioeconomic status, and perception of self. These consequences pose challenges to eliciting and understanding the brain injury patient’s perspective on living with their injury. Project purposes were to provide opportunities for participants to reflect on their lives, employ a variety of cognitive skills, and raise awareness about brain injury.

Method: This study used the participatory visual research method “photovoice” with eight “chronic” adult brain injury survivors between the ages of 40 and 60. Six participants were traumatic brain injury survivors, and two had survived brain tumors. Using photovoice, they took photographs of their lives with brain injury, discussed their photos in a group, wrote captions for selected images, identified themes, and prepared two exhibits. The original project had 10 weekly sessions lasting 2 hours each, from September to November 2006.

Results: Group discussions and the process of identifying exhibit themes was an iterative process that inspired new photo-taking, selection of photos for discussion, and caption content. Project products have opened opportunities for participants to tell their personal stories of living with brain injury and increase awareness of brain injury among family members, friends, health practitioners, and the community. Project binders allowed participants to share their personal view. An informal exhibit, with one favorite photo and caption from each participant, has provided a flexible product for display at libraries. A more “formal” exhibit with 50 photos and captions grouped into categories: The Journey, Lost Dreams, Chaos, Challenges, Strategies, My Advocacy Story, Comfort and Support, Acceptance, and Hope for the Future, has reached research and policymaker audiences at conferences, hospitals, government venues, and via the Internet on brainline.org. Several participants are now acting as mentors for a modified photovoice project with new support group members.

Conclusions: Photovoice was effective at eliciting the perspective of brain injury survivors on living with their injury. The project provided participants with opportunities to share their personal stories and resulted in a group narrative that takes a “storied” form. There is danger in perceiving healing from brain injury as a sequential process, as implied in their exhibit and its themes. Further experience with the method is needed to understand whether participation in a photovoice project could consistently motivate brain injury survivors to participate in outreach and awareness efforts and take on mentor roles with their peers.

0403

Academic experiences of adults with and without traumatic brain injury using the College Survey for Students with Brain Injury (CSS-BI)

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Objectives: The purposes of this study were to: 1) compare the college academic experiences of adults with traumatic brain injury (TBI) to adults without TBI, and 2) to examine the internal structure of the academic experiences on the College Survey for Students with Brain Injury (CSS-BI, Kennedy, Krause & Turkstra, 2008). A preliminary study using the CSS-BI found that the number of cognitive effects strongly predicted the number of reported academic experiences by adults with TBI, whereas psychosocial effects predicted these to a lesser extent.

Method: Forty-one adults with TBI and 36 healthy controls anonymously completed the CSS-BI electronically. Adults with TBI reported being unconscious for an average of 33.6 days ($SD = 44.5$) and being hospitalized ($M = 11.9$ weeks, $SD = 12.9$). Seventy-six percent received rehabilitation after their injury. Respondents also indicated the extent to which they agreed with 13 statements describing academic experiences since their injury using a 5-point rating scale (1 = strongly disagree to 5 = strongly agree), e.g., "I have to review material more than I used to."

Results: Adults with TBI reported significantly more cognitive (e.g., memory problems, difficulty making decisions, $p = .001$), psychosocial (e.g., anger, depression, $p = .017$), and physical (e.g., fatigue, problems with legs, $p = .000$) effects than controls. Average ratings of agreement for each of 13 academic experiences were compared across groups. Chi-square analysis showed that adults with TBI rated 9 experiences significantly higher than controls. However, there were 44 significant correlations ($p < .05$) among these experiences by adults with TBI and 37 significant correlations for controls. The data were reduced using principle component analysis with varimax rotation. Three factors of academic experiences emerged for adults with TBI. Factor 1, studying/learning, accounted for 27.6% of the variance and included reviewing material more, forgetting what was said in class, being overwhelmed in class, and being overwhelmed while studying. Factor 2, time management, accounted for 21.6% of the variance and included

being late to class and trouble managing time. Factor 3, relating to others, accounted for 16.3% of the variance and included having fewer friends and thinking that others do not understand my problems. These three factors accounted for 65.4% of the variance. A four factor model accounted for 72.4% of academic experiences reported by controls, but with fewer experience and different experiences loading onto each factor.

Conclusions: Adults who attended college after TBI not only reported more effects from their injury, but also reported having more academic challenges than controls using the CSS-BI. The academic experiences listed on the CSS-BI explained the range of experiences in this TBI population sample, suggesting that it is a clinically useful tool for documenting these kinds of experiences. Future research includes validating responses with interviews and standardized assessment and using survey responses to predict academic performance.

0404

Traumatic Brain Injury Screening and Negative Psychiatric Outcomes in Veterans Seeking Mental Health Services

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Objectives: History of traumatic brain injury (TBI) has been associated with poorer psychiatric outcomes, and increased psychological and behavioral sequelae. In order to increase understanding regarding relationships between brain injury and cognitive, behavioral, and psychological functioning, and to provide the most appropriate treatment, means of identifying those with a history of TBI are indicated. As those with psychiatric and behavioral symptoms associated with a history of TBI may seek care within more traditional mental health settings, brief, sensitive and specific screening measures are needed to assess history of TBI. Since 2007, four TBI screening questions (Traumatic Brain Injury-4) have been included in the local mental health intake form. This study will examine initial descriptive findings regarding veteran responses to the

Traumatic Brain Injury-4, and compare psychiatric outcomes of those who screen positive and negative for a history of TBI.

Method: To date, approximately 1,800 veterans have completed the TBI-4 as part of their mental health intake. Data regarding TBI-4 responses and psychiatric outcomes (e.g., psychiatric hospitalization) are being obtained from VA medical records. Regression models will be used to analyze outcomes of interest.

Results: Data is being collected and preliminary results will be available for the meeting.

Conclusions: It is hoped that findings from this study will provide clinically relevant information aimed at identifying lifetime exposure to TBI within a mental health setting, and evidence (i.e., psychiatric outcome data) aimed at encouraging increased TBI screening.

0405

The Application of Transcranial Doppler Sonography with a Transorbital Approach in the Confirmation of Cerebral Circulatory Arrest in Brain-injured Patients

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Objectives: Transcranial Doppler sonography (TCD) provides accurate confirmation of cerebral circulatory arrest (CCA) in brain death (BD), but is unfeasible in with absent temporal bone windows. We added the transorbital approach in the TCD protocol for the diagnosis of CCA and compared findings to angiography. Furthermore, we evaluated whether reporting the angiographic and sonographic confirmation of CCA to relatives of brain dead patients improves their comprehension and satisfaction with the medical information provided.

Method: Sixty-four clinically brain dead subjects underwent four-vessel angiography, TCD of the basilar and middle cerebral arteries, as well as transorbital Doppler sonography (TOD) of the internal carotid arteries. Relatives were randomly allocated to 32 in whom BD was presented as a clinical diagnosis (group A) and to 32 in whom BD was presented as a clinical diagnosis confirmed by TCD and angiography (group B). Comprehension

and satisfaction of the relatives were assessed by an interview and a completion of a questionnaire.

Results: Both angiography and TCD verified CCA in all cases ($k=1$). In 9 patients with failure of the transtemporal approach, CCA was confirmed by the transorbital recordings. The addition of TOD enabled 16.5% more cases of CCA to be diagnosed by TCD. Group B exhibited improved comprehension and satisfaction rates ($p < 0.05$).

Conclusions: The addition of TOD increases the efficacy of TCD in confirming CCA in BD. Reporting confirmation of CCA to families of brain dead patients may improve their comprehension and satisfaction with the medical information provided.

0406

Challenging Behaviors Following Brain Injury: The Lack of Systems of Care

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Objectives: Cognitive and emotional problems are among the most disabling consequences of brain injury. Unfortunately there is no system of care to treat these problems in much of the world. This is due, in part, to what others have called a “mindless neurology” and a “brainless psychiatry.” The Virginia Commissioner for the Department of Rehabilitative Services charged the Virginia Brain Injury Council (VBIC) to draft a statewide consensus statement on this problem; the author chaired the Council’s Neurobehavioral Committee, which drafted the report. This presentation will summarize the consensus process, describe its major recommendations, and attempt to stimulate discussion on best practices. The views otherwise expressed here are solely those of the author.

Method: A total of 15 members were appointed to the Committee. Each person was a recognized leader in the post-acute care of people with acquired brain injuries. Members included clinicians, community and regional service providers, the state affiliate of the Brain Injury Association of America, and former or current members of the Virginia Brain Injury Council. There were several starts and stops to an inclusive process that ultimately took over 2 years to complete.

Results: We found that there are at least 250,000 people over the age of 18 living in Virginia with the long-term consequence of stroke and traumatic brain injury (TBI); that the neurobehavioral problems of

this population are an unrecognized epidemic; that there is a desperate unmet need for better care; and that the population at greatest risk for under treatment is post-acute non-geriatric adults with acquired brain injuries who otherwise lack financial supports. The lack of a system of care relates to psychosocial isolation; imprisonment or housing at added cost and/or in violation of basic constitutional rights; and poorly trained providers. A systematic effort was made to identify evidence-based research, best practices and professional consensus to address the neurobehavioral problem. The approved Executive Summary recommends a systems of care approach with 3 dedicated neurobehavioral levels of care that are non-linear: 1) Intensive neurobehavioral programs for high needs; 2) Residential neurobehavioral programs for moderate needs; and 3) Community-based programs for low needs. Funding for a demonstration program to generate outcome data was also recommended along with the need for greater partnerships within and outside government.

Conclusions: The author concludes that this inclusive statewide consensus effort is part of health care reform in the United States; consistent with the newly approved US Mental Health Parity act; relates to comparative efficacy measures; focuses on the whole person; promotes least restrictive environments; and is part of the effort to provide universal coverage for some of the most vulnerable people in Virginia.

0407

Use of Sinemet (Levodopa/ Carbidopa) to improve arousal in an 8 months old infant with low level of consciousness after severe brain injury

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Objectives: Case reports have shown an improvement in level of consciousness after therapy with dopamine enhancing medications such as Sinemet, Bromocryptine and others. One case series included children between the ages of 8–19 with prolonged low response states of more than 30 days. The average duration of treatment was 39 days. A literature review showed no reports of this therapy in children with traumatic brain injury less than two years of age.

Method: This is a case report of an eight months old baby with severe non-accidental brain injury that showed improved environmental awareness after being treated with Levodopa-Carbidopa 100/25 for 10 weeks.

Results: Case Report:

This previously healthy infant suffered a severe diffuse cortical injury and visual impairment due to a non-accidental injury at 6 months of age. She was transferred to a pediatric rehabilitation facility and remained in Level 4 on the Pediatric Rancho Los Amigos Scale (“gives generalized responses to sensory stimuli”) for 2 months. Sinemet was started 77 days post injury at a dose of ¼ tablet daily and increased to a full dose of ½ tab QID (25.8 mg/kg/day). Two weeks after achieving full therapeutic dose, the level of consciousness had improved to level 2 (“demonstrates awareness of environment”) with emerging skills in level 1. Visual skills assessment had to be discounted due to severe visual impairment. The patient remained on antiepileptic medication during the trial. Laboratory and clinical monitoring showed no evidence of side effects.

Conclusions: The use of dopaminergic medication in infants less than one year old seems both effective and safe. Although it is uncertain whether improvement is attributable to natural history versus drug effect, our observations suggest that it may be worthwhile to consider a trial of dopaminergic medication in young children with catastrophic brain injuries and persistent low levels of responsiveness. Close clinical monitoring is important. Further clinical trials are recommended.

0408

Psychosocial Outcome Following Acquired Brain Injuries

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Objectives: The annual incidence of Acquired Brain Injuries (ABI) among the pediatric population in Canada is estimated to be about 167/100,000 (McDougall et al., 2006), representing significant long term health implications. Individuals who have sustained an ABI often suffer cognitive, social and physical impairments that can become lifelong disabilities. One important area of long term development is progression through various psychosocial stages that can influence general life satisfaction in terms of productivity and integration into family and community milieus. Various theories predict that interference in the earlier stages of psychosocial

development have the potential to disrupt the outcome of later stages, influencing one's general sense of meeting social and personal milestones. The aim of this study is to determine the influence of early brain injury on social and cognitive variables influencing psychosocial outcomes in adulthood; this study will also investigate whether these long-term effects are different for adults who sustained their injuries as children versus adolescents.

Method: All participants are adults who had sustained brain injuries of moderate severity before the age of nineteen years. A total of 46 participants completed surveys to date. Measures evaluating various variables related to psychosocial development (SWLS, BNSQ, PANAS, and the MPSS) were administered in a 30 to 45 minute telephone survey.

Results: Evaluation of the data to date indicated that those who suffered a ABI prior to adulthood showed no difference in their responses on various measures regardless of the age of injury, allowing for the data in both groups to be collapsed. Respondents did demonstrate lower mean ratings on measures of life satisfaction compared to ratings typically found in the general population. It was also noted that this sample of participants who sustained an ABI before adulthood showed higher scores on measures evaluating level of experienced negative affect when compared to scores found in the general population.

Conclusions: The results of this study indicate that on measures related to psychosocial development there did not appear to be any difference in respondent's ratings on various measures, suggesting age of injury prior to adulthood stages of development result in similar responses on various psychosocial outcome variables. The current data indicates that individuals with an ABI tend to exhibit less satisfaction with life and more negative affect compared to the non-injured population, consistent with previous literature indicating some improvement in psychosocial adjustment may be evident in people who have an ABI in adulthood, a trend that may not be evident in people who have acquired their injuries in childhood. Thus, greater long term disruption of psychosocial development may be apparent in individuals who sustain their injury prior to adulthood, supporting the theory that early disruptions have more negative impact on long term psychosocial outcomes than adulthood injuries.

0409

Short distance walking speed and timed walking distance: redundant measures for children with brain injury? Pilot study

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Objectives: The 10-metre walk test (10MWT), 6-min walk test (6MWT) and 2-min walk test (2MW) are frequently employed as primary outcome measures in clinical settings. The literature had suggested that velocity over a short distance (10MWT) and the distance walked over a fixed time (2MWT and 6MWT) assess different facets of walking ability. However, no study evaluated whether the 10MWT, 2-, and 6MWT provide similar information in children with brain injury (CwBI). Because the 2- and the 6MWTs indirectly assess walking speed, it may be questioned whether these tests provide complementary information.

Purpose: To assess whether the 10MWT, 2- and 6MWTs provide complementary information in typically developed children (TDC) and in CwBI at least three months post-injury.

Method: Children conducted the 10MWT, 2- and 6MWTs at their comfortable pace. Repeated measures ANOVA was used to assess differences in velocity in the three walking tests and between the walking speeds employed for each 60-metres interval in the 2- and 6MWTs. Correlations were performed to evaluate strengths of association between the tests. Differences in correlation strengths were evaluated with Fisher's Z test.

Results: Study participants consisted of six CwBI (mean age 12.2 years) and seven TDC (mean age 11.66 + years). For CwBI the velocity used for the 10MWT was similar to that employed in the 2MWT (1.13 and 1.07m/s, respectively) but faster than that used in the 6MWT (1.13 and 1.02m/s, respectively). 10MWT velocity significantly correlated with the distance walked in the 2-($r=0.81$) and 6MWT ($r=0.71$). However, the correlation between the 10MWT and the 2MWT was significantly stronger than the correlation of the 10MWT with the 6MWT. The velocity employed for each 60-meters interval during the 2- and 6MWTs remained the same. The 2- and 6MWTs resulted in a 41 and 61% increase in heart rate (HR), respectively. Among TDC, 10MWT velocity (1.54 m/s) was significantly faster than 2- and 6MWTs velocities (1.24 and 1.25, respectively). Accordingly, the 10MWT velocity did not correlate with the distance walked in the 2- and 6MWTs. Among TDC from baseline to the end of the 2- and 6MWTs HR increased in 30 and 41%, respectively.

Conclusions: Among CwBI, the 10MWT and 2MWT provide comparable information whereas the 10MWT and the 6MWT may represent different constructs. Children maintained their walking pace throughout the timed walks. Furthermore, participants adjusted their pace according to the task

(slower velocity in the 6MWT compares to the 10MWT and the 2MWT). Although the CwBI completed the 6MWT without reducing their velocity, 6MWT increased HR in 61% which may be due to poor stamina and/or neurological related impairments. Therefore, the 6MWT may be a more credible measure than the 10MWT and the 2MWT of walking speed and fatigue encountered over more functional distances and participation in the community.

0410

Head Injury Prediction: Accident Reconstruction of Real-world Crash Cases

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Objectives: Motor vehicle crashes remain one of the leading causes of traumatic brain injury (TBI) accounting for 20% of the total number of cases in US. In order to develop strategies to reduce the incidence and severity of these injuries, a better understanding of the biomechanical causal mechanisms involved in brain injury is required. Recently, advanced finite element (FE) models of the human head/brain have been used to study underlying brain injury mechanisms by correlating the localized tissue strain/stress with injury location. The objective of the current effect was to reconstruct the real-world crashes cases and compare the predictability of injury between two computer models of human head.

Method: Eight real-world motor vehicle crashes, where the occupant sustained at least one brain injury, were reconstructed using full-scale crash test facilities. The severity and anatomical location of the brain injuries varied in each case and were documented in patients' medical record. The reconstructed eight crashes included no head injuries or mild concussion, an Abbreviated Injury Severity (AIS) 3, an AIS 4, an AIS 5, multiple brain injuries and a fatal injury. In order to ascertain that the reconstructions accurately represented the real-world crashes, the crashed vehicle and the injury assessment reference values from the test dummies were compared to the actual vehicle and the patient's injuries respectively. The measured head kinematic data were then used as input for two FE models of the brain: the Simulated Injury Monitor (SIMon) model and the Wayne State University Head Injury

Model (WSUHIM). The WSUHIM consisted of 22 anatomical structures while as the SIMon has four major anatomical components. The model predictions were compared to the actual brain injuries sustained by the occupant.

Results: WSUHIM correctly predicted all concussion cases and diffuse brain injury at various locations in all cases. SIMon predicted half of diffuse brain injury cases. WSUHIM predicted most of the contusion cases except for the fatal case and the location of AIS 3 whereas SIMon failed to predict four out of eight cases. WSUHIM over/under-predicted two acute subdural/subarachnoid hematoma cases whereas SIMon over-predicted injuries in five cases.

Conclusions: Approximately half of all brain injuries were correctly predicted by the SIMon model, while almost all brain injuries were accurately predicted by the WSUHIM. Furthermore, the WSUHIM was capable of predicting the anatomical location of the injury. The results from this study provide additional verification to support the initial premise that real-world crash reconstructions can be used to further validate computer models. Further studies using FE modeling of animal TBI are required to establish volumetric strain-based threshold for quantifying injury extent and neurological outcomes. It is anticipated that this sophisticated and validated computer model can be a useful tool to assist in designing improved head protective devices.

0411

Neuroprotective Effect of PPAR γ Agonists (Pioglitazone & GW7845) on the MPTP Model of Parkinson's Disease

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Objectives: PPAR-gamma have been shown to modulate oxidative and inflammatory responses in the brain, and their agonists might have potential in the treatment of neurodegenerative diseases. In the present study we have investigated neuroprotective potential of PPAR γ agonists, pioglitazone (chemically a TZD) & GW7845 (chemically a non-TZD) in the experimental model of Parkinson's disease.

Method: Male Sprague Dawley rats were used for induction of Parkinson's Disease using MPTP model. PPAR γ agonists, Pioglitazone (10mg/kg, orally, once daily) or GW7845 (3mg/kg, i.p. twice daily) were administered starting from 3 days prior to MPTP injection up 7 days after MPTP

administration. Animals were observed for battery of behavioural and biochemical alterations.

Results: We have observed that after bilateral intranigral administration of MPTP produces a significant decrease in the muscular coordination and spontaneous locomotor activity as compared to the sham group indicating development of PD. These effects were found to be associated with increase in oxidative stress and degeneration of the neurons in the substantia nigra. We have observed that chronic treatment with the PPAR γ agonists has attenuated these PD related alterations in the animal's behaviours and these results with found to be associated with reduction in oxidative stress and nigral cell damage.

Conclusions: This study further strengthens the involvement of PPAR γ in Parkinson's Disease and also sheds light on the fact that even non-thiazolidinedione class of PPAR γ agonist show neuroprotective properties.

0412

The Relation between Community Integration, Life Satisfaction and Substance Abuse in an ABI Population

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Objectives: It has been estimated that 475,000 Americans under the age of 14 have an Acquired Brain Injury (ABI) (Langlois, Rutland-Brown and Thomas, 2005). These individuals can demonstrate lower levels of community integration due to physical, cognitive and psychological impairments which can affect the sense of general life satisfaction. Community integration outcomes are worse for individuals who sustain injuries while their brain is developing compared to adults who sustain injuries when development is complete. The purpose of this study is to compare community integration outcomes of adults who acquired an ABI before the age of 19 to adults who acquired one after the age of 19, as well as, to determine if there are any correlations between these results and subjective life satisfaction. It is hypothesized that overall the group with age of injury before 19 will have an overall worse outcome of community integration. It is also hypothesized that the younger individuals in under 19 group, as well as, the older individuals in the over 19 group, will demonstrate lower integration within their

respective groups. We will also investigate the influence of current and past substance abuse on the level of community integration of an individual. *Method:* Subjects consisted of 46 individuals who suffered an ABI before the age of 19. Through a 30 to 45 minute phone interview, data from the following questionnaires was acquired: Community Integration Questionnaire (CIQ), Satisfaction with Life Scale (SWLS), The Alcohol Use Disorders Identification Test: Self-Report Version (AUDIT), and (8) the Drug Use Questionnaire (DUQ).

Results: There were no significant differences found between subjects age 10 and under compared to subjects age 11 and over on any of the scales related to community integration measures and substance use. However, there was a significant positive correlation found between satisfaction with life and productivity scales ($r=0.735$; $p=0.00$) as well as social integration subscales ($r=0.477$; $p=0.001$) of the CIQ. There was no relationship found between drug and alcohol use and other community integration variables.

Conclusions: Overall, lower levels of community integration and life satisfaction were found for individuals with documented pediatric brain injuries compared to non-brain injured populations. The correlations between the social integration and productivity subcategories of the CIQ and the SWLS indicate that greater integration and productivity leads to greater life satisfaction. The absence of a correlation between the SWLS and CIQ scales, and the AUDIT and DUQ scales suggest that substance was not related level of community integration. Life satisfaction is closely linked to one's social life and productivity, highlighting the importance of long term outcomes with successful community reintegration for individuals with ABI.

0413

Task Analysis as a Quantitative Tool to Measure the Efficacy of Rehabilitation

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Objectives: It is estimated that 500, 000 people sustain an acquired brain injury (ABI) each year (O'Reily et al. 1990). The rehabilitation process can be lengthy and costly, therefore it is important to demonstrate efficacy and quality of treatments (Watson et al., 1995). One significant focus in

inpatient rehabilitation is the patient's performance levels on activities of daily living (ADL). Commonly used standardized ADL scales are criticized for their lack of applicability among the ABI population because they focus primarily on physical deficits and do not adequately capture the supervision/cueing levels observed in more descriptive methods such as Task Analysis (TA) (Greenberg, 2007). The objective of this study is to validate the use of TA in measuring progress in ADLs in an inpatient ABI population through comparison with three validated and standardized measures of ADLs. The relative change in ABI patients' level of disability and supervision needs was also measured to evaluate correspondence to functional changes over the course of treatment.

Method: Participants consisted of 24 individuals with a moderate to severe ABI receiving treatment on an inpatient unit. The efficacy of TA was evaluated on showering and dressing routines. Measures were administered within 72 hours of admission, 4-weeks after admission and within 72 hours before discharge. Independent evaluation, (SRS and DRS), were evaluated against outcome ratings, FIM, BI, KB, and TA, which were also compared against each other to establish the validity of TA.

Results: Results reveal a significant decrease in patients need for supervision and disability ratings over the course of inpatient rehabilitation. Also, all correlations between FIM, BI, KB, and TA were significant and positive; indicating similar patterns of scores, consistent with improvements in level of disability and corresponding need for supervision. Overall, BI showed the least strength in association with the independent measures, while FIM and TA showed the strongest and most consistent relationship with the SRS. For dressing activities, pair-wise comparisons among the dependent measures revealed a main effect of time between admission and discharge. For showering, pair-wise comparisons revealed that scores on each dependent measure were significantly different between admission and four weeks and between admission and discharge.

Conclusions: This study demonstrated that significant changes in supervision requirements and disability ratings over the course of inpatient rehabilitation were consistent with improvements shown on ADL tasks of showering and dressing. TA proved to be a valid measure of showering and dressing, reflecting functional changes in supervision and disability. In addition, TA appeared to be more sensitive to levels of supervision/cueing required by ABI patients. Above other measures, TA is able to provide direction concerning the level of cueing required by

ABI patients due to cognitive and behavioural limitations, allowing for better treatment and long term resource planning.

0414

Non-invasive Monitoring of Brain-injured Patients by means of Optic Nerve Sonography

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Objectives: We investigated whether the alterations in the optic nerve sheath diameter (ONSD) correlated with brain computed tomography (CT) findings in patients with brain injury.

Method: From the 128 critical care patients (87 males, 46 ± 18 years old) who were evaluated, 74 suffered from brain injury, while 54 had no intracranial pathology and served as control individuals. ONSD was measured by means of sonography. During their hospitalization, control subjects underwent a single measurement of the ONSD upon admission, while brain-injured patients underwent 3 repeated measurements of the ONSD combined with synchronous brain CT scans. Based on the severity of the neuroimaging findings, the CT scans were classified according to a semi-quantitative (I to IV) scale (Marshall scale).

Results: Forty-three patients progressed to brain death, while 31 patients demonstrated gradual clinical improvement. Upon admission, brain-injured subjects exhibited significantly increased ONSD (6.1 ± 0.4 mm) compared with the control subjects (3.6 ± 0.7 mm). In brain-injured patients alterations in the ONSD were significantly correlated with neuroimaging scale on 3 repeated evaluations ($r = 0.68$, $r = 0.71$ and $r = 0.74$, respectively, $P < 0.001$). An ONSD > 7.0 mm (specificity = 64% and sensitivity = 75%, $P < 0.01$) and a 2.4 mm increased ONSD between repeated measurements (specificity = 71% and sensitivity = 82%, $P < 0.01$) were associated with a poor prognosis.

Conclusions: Alterations in the ONSD strongly correlated with neuroimaging findings among brain-injured patients. However, monitoring of ONSD exhibited a low predictive value for brain death.

0415

The use of the Bruininks-Oseretsky Test of Motor Proficiency (second edition) as a Tool to Document Motor Performance in Children with Brain Injury

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Objectives: The Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) assesses motor performance in children with brain injury (CwBI). In 2005 a new version of the BOTMP was published, the BOTMP, second edition (BOT2). Several reports focused on BOTMP ability to characterize motor deficits of CwBI. BOT2 ability to detect motor deficits in comparison to published norms and to distinguish between various brain injury etiologies and severity is unknown. It is cardinal to evaluate the performance of the BOT2 among CwBI as this information will validate the test for CwBI and will identify the motor domains in which these children are lacking.

Purpose: (1) to assess whether motor performance deficits can be documented using the BOT2, (2) to establish whether deficits in specific domains of motor performance can be identified when comparing their performance to that of children in published norms, and (3) to examine the BOT2 ability to distinguish between children with different brain injury etiologies and severity.

Method: All subjects were at least three months post injury, medically stable, and capable to ambulate 10-meters independently. Participants were tested on five subtests of the BOT2: upper limb coordination (ULC), balance, strength, running speed and agility, and bilateral coordination. BOT2 standard scores were derived from the summed point scores of each of the subtests. The number of subjects with performance above/ below expected level was compiled. Age equivalents calculations were obtained for each subject's performance on each subtest. A cutoff point of two standard deviations below the mean was used to establish the presence of deficits. One sample t-test was used to compare the results to norms.

Results: twenty-four children (mean age = 10.47 years) were recruited. Eleven children sustained moderate-to-severe brain injury [Glasgow comma scale (GCS) range = 3–9] and 13 children were after posterior fossa tumor removal (PFTR). CwBI demonstrated deficiencies in all tested subtests. Compared to published norms, motor performance was significantly lower in balance, running speed and

agility, and ULC subtests. In regards to brain injury etiology, motor performance of children after PFTR was significantly lower in balance, running speed and agility, and ULC subtests. Brain injury severity (as determined by the GCS) did not correlate with any of the five subtests. The ULC subtest score of children with GCS of 6–9 was significantly higher than that of children with GCS of 3–5.

Conclusions: The BOT2 successfully identified motor performance deficits in CwBI. Furthermore, the test distinguished between children with different injury etiologies. ULC subtest was found to be more sensitive than the other subtests to brain injury severity. Consequently, BOT2 is a valid measure of physical performance for children with brain injury.

0416

A New Measuring System to Quantify Head Kinematics in a Rodent Model of TAI

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Objectives: Marmarou and his colleagues developed a device that can reliably produce significant diffuse axonal injury without concomitant focal contusion and skull fracture. Biomechanically, impact energy applied to the rat head and resulting head kinematics in response to impact determine the pathology of traumatic injury. However, up to now the mechanical characteristics of this impact-acceleration model have not been quantified. This information is essential to determine the mechanical correlates to the pathological outcome involved. The drag and frictional force in the plexiglass tube during free fall may affect impacting velocity, thereby confounding the variability of the mechanical input from test to test, therefore the resulting injury outcome. This paper describes a new rodent head impact system that was designed to improve the consistency and repeatability of the impact acceleration apparatus. The addition of a dynamic measuring system enables the quantification of the head kinematics during impact-acceleration injury of various severities.

Method: The new 450-gram weight was made of two segments. The top segment was an aluminum cylindrical tube 51 mm in diameter and 126 mm in height. The inner compartment provides room to house a miniature accelerometer (Kistler-8044) to record the impactor motion. A high-speed video camera (10kfps) was used to measure the impact speed/head motion. A lightweight accelerometer

(Endevco-7269) and angular rate sensor (DTS-AR12k) were glued to the skull of an anesthetized rat 5 mm anterior to the helmet to measure the linear and angular responses of the head.

Results: For 2m free fall test ($n = 16$), impact velocity and energy measured with the new system was $6.13(\pm 0.06)$ m/s and $8.44(\pm 0.18)$ J compared to $5.96(\pm 0.04)$ m/s and $7.99(\pm 0.13)$ J for the original device. The peak impactor acceleration was $68(\pm 18)$ g. The peak linear acceleration and angular velocities ($n = 8$) in the sagittal plane ranged from 425 to 1,339g and from 120 to 181rad/s. The head rotated from 42° to 60° in the first 10ms of impact. The linear acceleration was found to be inversely proportional to the angular velocity ($R^2 = 0.95$), suggesting mechanical injury is a consequence of a synergistic effect of translational and rotational motion of the head.

Conclusions: A modified impact-acceleration model of TAI provides documentation of consistency, reproducibility and reliability in terms of impact energy and the mechanical response of the head. This is the first report of quantification of impact force and linear and angular motion in this model. These developments will help in the standardization of this model across research institutions, and assist in interpretation of injury severity. Furthermore, the correlations between cellular injury and mechanical response that can be achieved with this model will provide new insight into the biomechanical basis of TAI. These measurements will also provide essential data to validate a computer model of rat head and to develop tissue strain thresholds for TAI.

0417

From prevention to intervention: interprofessional concussion care at the Montreal Children's Hospital

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Objectives: The management of children and adolescents who have sustained concussions also known as mild traumatic brain injuries (MTBI) poses an interesting challenge for clinicians, parents, coaches, and teachers. The Montreal Children's Hospital (MCH) developed the first Pediatric Neurotrauma Program in Quebec in 1989. The MCH Trauma mandate was expanded several times over the years and a comprehensive, proactive, inter-professional

approach to the prevention and management of concussions has been developed, implemented and modified in keeping with the most recent evidence and based on clinical expertise. This presentation will introduce this innovative model of concussion prevention and management.

Method: Both prevention and intervention activities were conceived with an understanding of the challenges of the targeted population and of the elements where one could expect to have an impact. All activities were designed after reviewing available literature, making explicit the intervention theory and planning of subsequent evaluation.

Results: Five main components comprise the model: 1) an accessible and user-friendly website where prevention and management information is available; 2) outreach prevention activities with partners in schools, community organizations and sports teams; 3) the Concussion KIT, an educational initiative to increase the awareness of parents, athletes, coaches and sporting associations with respect to preventing, recognizing and managing concussions in sports for coaches and families; 4) a comprehensive Emergency Department management algorithm with appropriate referrals to neuro-trauma specialists if necessary; and 5) a concussion/return to sports clinic where pediatric athletes and children who are slow to recover are provided with individualized management. Details of all these components as well as research activities will be discussed with the participants.

Conclusions: Challenges inherent to the establishment of any interprofessional initiatives were encountered during the process of development and implementation of the concussion care model. A commitment to excellence in trauma care and injury prevention contributed to the success of the endeavor.

0418

Neuropsychological Function In Relation To Early MRI Findings In Moderate To Severe Traumatic Brain Injury

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Objectives: To explore the effects of different types of traumatic brain injury (TBI) on cognition three months after injury in patients with moderate to severe head injury.

Method: Patients were participants in a prospective cohort study of patients admitted to a level I trauma centre, with moderate (Glasgow Coma Scale (GCS) score 9–13) and severe (GCS score 3–8) head injury. Patients aged 13–65 who underwent neuropsychological testing three months post-injury ($n = 62$) were included if MRI demonstrated traumatic lesion ($n = 61$).

Median days to MRI were 8 (range 1–120) post-injury. Types of injury were contusions ($n = 17$), diffuse axonal injury (DAI) in combination with contusions ($n = 29$) and pure DAI without MRI evidence of contusions. ($n = 15$).

Patients and 44 age, education and gender matched controls were assessed with a comprehensive neuropsychological test battery. Mean T-scores (composite scores) were calculated for the following domains: executive function, psychomotor speed, attention, verbal and visual memory, working memory and motor function. Within the domains, results of single tests were explored and when differences were detected at α level = 0.01, effect sizes were computed based on pooled variance.

Patients were assessed with Glasgow Outcome Scale Extended at the time of testing.

Results: In patients with DAI, deviations from controls were similar in patients with pure DAI and patients with DAI in combination with contusions. These two groups of patients with DAI were subsequently collapsed. For patients with DAI mean T-scores were significantly lower than in controls in all domains except attention (all $p < 0.05$). Composite score differences were most pronounced for visual memory ($p < 0.001$) and psychomotor speed ($p < 0.001$). For raw scores on single tests, large effect sizes (Cohen's $d > 0.8$) were found for several subtests of executive function and for all tests measuring psychomotor speed. For tests in other domains, effect sizes were typically moderate ($d = 0.5$ – 0.8).

Patients without DAI had significantly lower mean T-scores than controls in the domains of executive functions ($p = 0.02$) and psychomotor speed ($p = 0.03$). According to the predefined α level, patients performed worse than controls only in the Delis-Kaplan Executive Function System™ Trail Making Tests 4 ($p > 0.001$); $d = 1.15$.

Patients with DAI more often had severe injury according to initial GCS ($p = 0.01$), but median GOSE score concurrent with testing was not significantly different.

Conclusions: Patients with DAI were impaired in most cognitive domains, regardless of whether DAI

was found as the only primary lesion or in combination with contusions. Psychomotor speed appeared to be most severely affected, taking results from composite scores as well as raw scores of single tests into account. In patients without DAI, but still with visible contusions in the brain parenchyma, test results were closer to that of controls.

0419

Assessment of the Severity and Outcome of Head Injuries: The Use of GCS, Brain CT, GOS and Serum S-100 B Protein Level

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Objectives: The aim of the present study was to assess the severity and outcome of patients with head injuries using a new serum marker which is the level of S-100 B protein, in addition to the use of GCS, Brain CT and the GOS.

Method: The study was conducted on fifty patients with head injury. Ten healthy adult individuals of both sexes were chosen as a control group when measuring S-100 B protein level by ELISA Technique.

Results: The age of patients ranged from 15–60 years with a mean of 33.7 ± 14.2 years. Road traffic accidents constituted the main cause of head injury (74.0%). More than half the patients (58%) had open head injuries, while 42.0% had closed head injuries. Severe head injury was encountered in 84.0% of patients, while moderate head injury was evident in 16.0%. More than one quarter of the patients (26.0%) had skull fractures. Brain lesions demonstrated by CT scan was found in 86.0% of the patients while normal CT brain was reported in 14.0%. In patients with head injuries, S-100B protein level ranged from 0.7 to $4.5 \mu\text{g/L}$ with a mean level $1.8 \pm 1.5 \mu\text{g/L}$, which was significantly higher than the mean serum level of the control group (0.1 – $0.02 \mu\text{g/L}$). A significant rise of serum S-100B protein level was related to severe head injuries assessed by GCS, posttraumatic amnesia (PTA) more than one week, absence of spontaneous ventilation, abnormal brain findings by C T scan, and associated injuries especially thoracic trauma. More than half the patients showed poor outcome by GOS (60.0%), while those with good outcome accounted for 40.0%. Serum S-100B protein level was significantly higher in patients with poor outcome than in those with good outcome using GOS.

Conclusions: The study concluded that the admission level of S-100 B protein is a useful early predictive marker in determination of the outcome after head injury.

0420

Hematoma Evacuation in Large Traumatic Basal Ganglia Hematoma

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Objectives: Traumatic basal ganglia hematomas (TBGHs) are uncommon events in patients with closed head injuries. The overall prognosis is poor, particularly when large hematoma exists. This study was designed to evaluate the effect of surgical evacuation in large TBGHs.

Method: Fourteen consecutive patients, admitted between July 2002 and July 2007 with following criteria, were included in this prospective study: closed head injury and post traumatic basal ganglia hematoma more than 25 ml. Patients, who died of extracranial injuries, were excluded. Seven cases were conservatively managed and 7 underwent hematoma evacuation through a transylvian transinsular approach. The patients' outcomes were assessed according to the Glasgow Outcome Scale for at least 6 months of follow-up.

Results: There were no significant differences between conservative and surgical groups for sex ($p = 0.50$), mean age (18.4 yrs v 20.9 yrs, $p = 0.525$), mean admission GCS (8 v 7, $p = 0.615$), and mean of TBGH volume (33.4 ml v 39.3 ml, $p = 0.079$). Although the surgical group showed 2.5 times the favorable outcome patients (5, 71.4%) as the conservative group (2, 28.6%), but the difference was not still statistically significant ($p = 0.143$). Three cases (42.9%) were severely disabled or had vegetative state in conservative group but no one (0.0%) in surgical group. Two patients died in each group (28.6%).

Conclusions: According to this study, it appears that hematoma removal through a transylvian transinsular approach may have a positive effect on the favorable outcome of large TBGHs.

0421

Electrophysiology and functional MRI reveal cerebral dysfunction after mild traumatic brain injury

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Objectives: Individuals who sustain mild traumatic brain injury (MTBI) generally have cognitive symptoms in the weeks and often months following their injury, but few objective markers of these cognitive complaints exist. We recently showed a reduction in dorsolateral prefrontal cortex (DLPFC) activity using functional magnetic resonance imaging (fMRI) in concussed athletes during performance of a task measuring monitoring of information in working memory. To date, no studies have investigated the effects of MTBI using event-related potentials (ERP) and fMRI during the same cognitive task, which may be an extremely sensitive indicator of brain dysfunction associated with MTBI. The aim of the present study was to measure brain activity with ERP and fMRI in individuals who sustained an MTBI to detect and understand cerebral dysfunctions.

Method: Thirty subjects (16 women; mean age: 30.4 ± 11.9 years) at an average time post MTBI of 7.1 ± 7.3 months were tested with ERP and fMRI in two separate sessions and compared to 28 controls (15 women; mean age: 28.1 ± 9.1 years). They performed a working memory task known to be sensitive to DLPFC function and results were compared to a baseline control task. Two frontal (N200 and N350) and two posterior (P200 and P300) ERP components were measured, as well as BOLD signal changes in each region of interest.

Results: No group differences were found for either reaction time or accuracy in working memory condition. In ERP, a significant Group x Condition interaction was found for the N350 amplitude ($p < 0.05$), with the control group having a larger discrepancy between working memory and control conditions than the MTBI group. In fMRI, lower activation in the right DLPFC, the caudate nuclei and the right putamen was found in MTBI compared to control subjects ($p < 0.05$). No correlation was found between ERP and fMRI results. The magnitude of the BOLD signal change in the right DLPFC combined with the N350 amplitude was the most discriminant

combination of variables measured in this study. No correlation was found between number of previous MTBI, delay after injury and ERP or fMRI characteristics.

Conclusions: In the present study, we used a unique approach to investigate the consequences of MTBI by combining ERP with fMRI. Our results confirm that MTBI can produce functional consequences that cannot be explained by single factors such as number of previous MTBI sustained or delay after injury.

0422

Functional Benefits of a Non-pharmacological Treatment for Adult TBI

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Objectives: Traumatic brain injury (TBI) is a leading cause of death and disability in the United States, particularly in young adults. Few effective non-pharmacological treatment methods are available for TBI survivors, especially for treating chronic deficits, so recovery is often incomplete. The current study investigates the effects of acupressure, a treatment method in which acupoints are stimulated with fingertips rather than needles, following TBI. Acupressure has shown efficacy as a treatment for other neurological conditions, including stroke. This non-pharmacological treatment could be especially beneficial for TBI because of its low potential for side effects and because self-administration can be learned, rendering it an accessible treatment without the need for a practitioner, funds, or insurance.

Method: A randomized, placebo-controlled, single-blind design was used to determine the effects of acupressure on neurobehavioral function in adults with mild TBI, using a battery of neuropsychological tests. Neurophysiological function was further assessed using event-related potentials (ERP) collected during Stroop and Auditory Oddball tasks. After baseline assessment, participants were randomly assigned to receive 8 treatments of either active or placebo acupressure (twice weekly for 4 weeks). Following the treatment series, the same measures were repeated to assess treatment-related changes.

Results: Acupressure-treated individuals showed significant improvement in components of the

neuropsychological test battery compared to those receiving placebo treatments. On the Tactual Performance Test (total time in minutes), active treatments were associated with a faster total time (mean change = -3.60 , $SEM \pm .85$) in comparison to placebo treatments (mean change = -1.35 , $SEM \pm .57$), $t(23) = 2.22$, $p = .036$, Cohen's $d = .88$. There was also a significant difference in Digit Span (furthest span forward + furthest span backward), such that those in the active group increased their span (mean change = 1.23 , $SEM \pm .38$) significantly more than those in the placebo group (mean change = $-.08$, $SEM \pm .47$), $t(24) = 2.16$, $p = .041$, Cohen's $d = .85$.

Conclusions: Significant improvement in cognitive function was seen following active acupressure treatments compared to placebo acupressure treatments, specifically on the Tactual Performance Test and Digit Span. Treatment-associated changes in neurophysiological function via ERP will be discussed. Overall, these results suggest a role for acupressure in the non-pharmacological treatment of chronic TBI-associated deficits.

0423

Pertab et al. (2009): Were Prior Mild TBI Meta-Analytic Results Refuted or Replicated?

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Objectives: Pertab, James, and Bigler (2009) reanalyzed data reported in two prior meta-analyses on mild TBI (Binder, Rohling, & Larrabee, 1997; Frencham, Fox, & Mayberry, 2005), with the primary objectives of examining (1) the mechanism of the injury, (2) diagnostic criteria employed, (3) assessment tools utilized, and (4) symptomatic groups, claiming to have restricted their analyses to data gathered 3-months or greater post mTBI. Their expressed purpose was "...to clarify opposing conclusions in the mTBI literature..." Pertab et al. reported that the effect of mTBI was larger than previously claimed (Binder et al., 1997; $g = -.12$), with a weighted mean difference effect size equal to $-.31$. The present study reanalyzes the Pertab et al. data.

Method: We acquired Pertab et al.'s (2009) data file and recalculated all of the effect sizes for

Binder et al. (1997), Frencham et al. (2005) and doubled checked their computations and methodology.

Results: Multiple coding errors were apparent in Pertab et al., with the most critical error being the inclusion of data gathered prior to their 3-month post mTBI exclusion criterion. When all coding errors were corrected, those data gathered prior to the 3-month cutoff generated a weighted mean difference effect size of $-.43$ ($n=18$ samples). By contrast, those data gathered 3-months or greater post mTBI generated a mean difference effect size of $-.02$ ($n=17$ samples).

Conclusions: We conclude that the results of the Pertab et al. mTBI meta-analysis were the product of coding error; specifically including <3-months outcome data with data collected => 3-months. This coding error helps explain some of the puzzling results reported by Pertab et al., for example, significant effect sizes for Digit Span contrasted with non-significant effect sizes reported for Trail Making B. When analyzed properly, focusing on data collected => 3-months post mTBI, the results of Binder et al. (1997) and Frencham et al. (2005) showing no significant chronic effects of mTBI are replicated.

0424

Italian National Consensus Conference: Rehabilitation of Persons with Disability from Severe Brain Injury and their Families After Discharge from the Hospital

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Objectives: The rehabilitation of persons with severe acquired brain injury (sABI) requires a continuum of interventions, from the acute phase to the community reintegration phase. Post-discharge

interventions play a crucial role in enabling the persons to re-engage with life as fully as possible. Considerable differences in the organization of services were observed in Italy, and consensus about which approaches would be considered more appropriate was lacking. Therefore, a Consensus Conference (CC) was held in Italy on June 2005, with the aims of establishing good-practice criteria on the post-discharge rehabilitation interventions for persons with sABI and their families.

This paper describes the organization and the methodology of the CC, and summarizes the recommendations issued by the jury.

Method: The organization of the CC started in 2003; it has been promoted by the Italian Society of PM&R (SIMFER), together with a Family Association (FNATC) and a private non-profit organization (Opera Don Calabria). The CC was given the title: "Rehabilitation of persons with disability from severe brain injury and their families, after discharge from the hospital". A Steering Committee and three working groups were created; the latter were asked to review the current knowledge and practice in areas related to theme of the CC. A jury, including professional experts and non-professional members, has been asked to answer a series of questions related to the good-practice criteria in the field. The jury issued the final document with recommendations after examining the reports of the groups, and after a one-day open meeting in which the relevant issues and the questions were presented and thoroughly discussed.

Results: The recommendations issued by the jury suggested good practice criteria in the following areas:

- Epidemiology
- Models of rehabilitation interventions
- Planning and implementing rehabilitation interventions
- Classification and organization of facilities and services
- Return to work
- Families
- Information
- Welfare system

Conclusions: The Italian version of the final document of the CC has been diffused since the beginning of 2006 through journals, conferences and websites. This widespread diffusion improved the attention and the awareness of patients and families, professionals, policy makers and other community members toward these issues, and is contributing to reduce variability in the terminology and in the models of intervention after discharge. Politicians

and policy makers took into account the recommendations of the CC when defining some new regulations, laws and norms concerning the persons with disability after sABI.

0425

Chiropractic Cranial Treatment Protocol Increases Successful Outcome of the Multidisciplinary Care Model for Traumatic Brain Injury (TBI) Patients.

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Objectives: Notoriously, all traumatic brain injury creates challenges that have negative impacts on the patient's life and family. Since often the prognosis of patients with TBI is dismal, a method of care that has low risk, reasonable benefit, and biological plausibility, is preferred. This article seeks to share a novel manner of multidisciplinary care which incorporates the fields of allopathy, chiropractic, psychology, acupuncture, neurorehabilitation, and nutrition to help increase the quality-of-life for the patient.

Method: A focal point of this multidisciplinary care at this clinic is Sacrooccipital Technique (SOT) cranial manipulation protocols along with specific neurological rehabilitation training and home exercises. Home therapy focuses on physical, mental and emotional balance which increases efficacy of treatment. The care model is implemented for a minimum of 1-year with most patients remaining for 5-years.

Results: A 28-year-old female suffered TBI from a violent attack, diagnosed with chronic migraines and informed she would need prescription medication the rest of her life. Headaches were reduced immediately with care and 2-years later (1 treatment per week) headaches occurred only once every 2-weeks lasting 12 hours. She is off her 10 prescription medications and currently is tapering off a final, living a more normal life and is involved in activities with her 8-year-old daughter.

A 30-year-old female sustained a TBI from a motor vehicle accident. PETscans noted decreased bilateral occipital lobe metabolic activity. She had chronic headaches (2-year duration) with transient paralysis of her left extremities and short-term memory loss. She was informed by her neurologist that due to her post concussion syndrome duration, no recovery was expected. After 5-years of

treatment (1 treatment per week) she is headache free, without short-term memory loss or paralysis episodes.

A 70-year-old male suffered a TBI from a stroke causing complete paralysis of the right upper/lower extremity, swallowing difficulties and speech problems. His neurologist informed him he would never work again and need assistance to walk and have compromised use of his right hand. After 9-months of care he returned to full time work without paralysis, speech or swallow difficulties. Following 5-years of care (1 treatment per week) there were no symptoms associated with the left parietal lobe infarct despite brain-MRI scans showing sustained damage.

Conclusions: Success was measured based on improved quality-of-life and return to activities-of-daily-living along with decreased subjective and objective symptomatology. Barriers to successful outcome included patient non compliance to treatment plan and patient financial challenges. The temporal nature of the patient's response to care and their gradual worsening of symptoms prior to treatment at this clinic suggest the patient's conditions would have worsened. This care model gives greater hope for those suffering from TBI as well as gives the health care professional greater options with better prognoses.

0427

Reliability and diagnostic characteristics of the JFK Coma Recovery Scale-Revised: Rater's level of experience matters.

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Objectives: Diagnosis of patients in the Vegetative (VS) and Minimally Conscious State (MCS) requires repeated evaluations by skilled clinicians who use reliable assessment tools. Reliability and diagnostic utility of the Coma Recovery Scale-Revised (CRS-R) was studied using an authorized Norwegian translation of the CRS-R. The effect of rater's level of experience was explored by including raters with varying levels of experience with the scale.

Method: Thirty-one patients with disordered consciousness were recruited from 6 Norwegian hospitals and assessed with the CRS-R and the Disability Rating Scale (DRS). Two highly experienced raters

(A & B) who had examined >30 patients with the CRS-R prior to this study, examined all patients. One less experienced rater (C) assessed the patients at each of the participating facilities. The 6 C's were aggregated into one rater C. The C's were further divided into 2 subgroups; 2 were "moderately experienced" having assessed 10–20 patients before the study, while 4 C's were "newly trained", having assessed <10 patients. The patients were examined on three consecutive days. Rater A scored CRS-R on days 2 and 3, B on day 2 and C on days 1 and 3. DRS was scored on day 3. Scores were compared across raters (interrater), assessment days (test-retest) and rater's level of experience. Diagnostic agreement and sensitivity/specificity was calculated for VS and MCS.

Results: Interrater agreement was good both between the highly experienced raters A and B on day 2 ($\rho = .77$) and between A and C on day 3 ($\rho = .66$). Test-retest reliability was $\rho = .83$ for rater A and $\rho = .77$ for rater C. Test-retest diagnostic agreement was very high for both raters A (Cohen's $\kappa = .94$) and C ($\kappa = .80$), but diagnostic agreement was higher between raters A and B ($\kappa = .77$) compared to A and C ($\kappa = .48$). The moderately experienced C's attained test-retest ($\rho = .87$) and interrater ($\rho = .71$) reliability comparable to raters A and B. The newly trained C's attained lower (.57 and .49) and non-significant test-retest and interrater reliability. Diagnostic agreement with rater A was 88% for the moderately experienced C's and 50% for the newly trained C's. The sensitivity (range .47–.62) and specificity (.88–1.0) analyses confirm that the CRS detects more patients in the MCS than the DRS.

Conclusions: This study confirms that the CRS-R has adequate interrater and test-retest reliability. The sample being non-English speaking suggests that CRS-R item content is cross-cultural. Earlier findings are extended as the results suggest that rater's level of experience with the scale affects both interrater and test-retest reliability. There might be a threshold level at which rater's experience is sufficient to yield reliable CRS-R scorings. The reliability of the CRS-R will be highest when employed by clinicians who are knowledgeable about the diagnostic criteria and well acquainted with the CRS-R.

0428

Approaching rehabilitation of severe Acquired Brain Injury patients: neurophysiological screening

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Objectives: Disorders of consciousness (DOC) may evolve in a non or minimally-responsive state in which no communication is possible between patient and other people or the environment (e.g. vegetative state, minimally conscious state, locked in syndrome). Brain Computer Interfaces (BCIs) are devices that allow users to send messages or commands through brain activity signals (e.g. P300) without using the brain motor output pathways. P300 is an Event-Related Potential (ERP) related to the processing of the stimulus context and levels of attention and arousal. Monitoring of P300 signal during the clinical evolution of DOC patients is a first step toward the possibility to introduce the BCI technology as an additional choice for communication and interaction.

Method: A passive oddball paradigm, previously validated in healthy subjects, including duration deviants and subject own name (SON) presented as a novel, was applied in 7 severe brain injury patients (two traumatic, five hemorrhagic) in post acute and chronic stage. The patients were diagnosed as vegetative state (VS, $n = 2$), minimally conscious state (MCS, $n = 4$) and locked in syndrome (LIS, $n = 1$), mainly based on the JFK Coma Recovery Scale-Revised.

Results: Cognitive potentials showed preserved P300 responses in 6 patients (two VS, three MCS, one LIS patient). One patient with MCS failed to show any significant cerebral activation. Responses were even observed in patients with a lack or low behavioural responses.

Conclusions: These preliminary findings suggest that such screening is useful to reveal clinically masked residual cognitive activity and point out cognitive resources required to start using BCI as rehabilitative intervention.

0429

Adapting Dialectical Behavior Therapy (DBT) Skills for People with Brain Injury to Reduce Emotional Reactivity and Improve Coping Skills within the Context of a Structured Behavioral Plan: A multidisciplinary approach

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Objectives: Persons with brain injury often experience lasting functional problems which impact their overall quality of life including cognitive impairments, physical difficulties, behavioral problems and mood instability. Behavioral problems may include lack of motivation, inhibition, poor self-monitoring, irritability, apathy, aggressiveness, depression, anxiety, lack of awareness, restlessness, sexuality issues, and substance abuse. Although some problems are resolved relatively early post-injury, deficits have been known to persist for nearly a decade or more. Mood instability and poor coping skills impact ones ability to participate and succeed in brain injury rehabilitation, maintain sobriety and develop and sustain interpersonal relationships. Dialectical Behavior Therapy (DBT) was developed for use with persons with Borderline Personality Disorder and uses cognitive-behavioral techniques to reduce emotional reactivity and improve coping skills with the use of mindfulness, distress tolerance, and acceptance. Brain injury rehabilitation professionals share similar goals as DBT therapists; to improve mood stability and ultimately create a life that is worth living.

Method: This presentation will provide information regarding a case study of a 36 year old female, 20-years post brain injury with ongoing substance abuse, mood instability, poor coping skills, lack of awareness, and relational issues. Dialectical Behavior Therapy techniques were adapted within a structured behavior analytic approach to assessing ongoing behavioral issues and awareness deficits after brain injury. The adapted DBT program and structured behavioral phase plan data elements will be presented and discussed.

Results: Combined use of a structured behavioral phase plan and adapted DBT techniques proved successful in progressing this client through a community-based, post-acute, therapy-intensive brain injury rehabilitation program. Outcomes included successful progression through the adapted DBT program, improved self-monitoring, increased coping skills, successful completion of a highly structured behavioral phase plan, sobriety maintenance greater than nine months, return to volunteer work and increased independent living.

Conclusions: This unique approach to multidisciplinary post-acute brain injury rehabilitation could prove useful to other persons with behavioral and emotional instability after brain injury. Improvements in coping, emotional and behavioral instability, sobriety and overall awareness could make strides in improving ones overall quality of life post-injury.

0430

Timing is everything: Parents' informational and support needs following their child's sports-related concussion

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Objectives: Concussion is an important issue in youth hockey and parents play a key role in supporting children through their recovery, return to play, and involvement in other life activities. Understanding parents' experiences along with insight into their informational and support needs is essential to support families following a sports-related concussion. Although research exists in the area of caregiver needs following a concussion, little information is available about the evolution of parents' needs through time and circumstances (e.g. at the time of injury, when interacting with the medical system, returning home, returning to play, etc.). The objective of the current study was to qualitatively examine the time-specific information and support needs of parents of youth hockey players following a hockey-related concussion.

Method: Study participants were nine parents of youth hockey players (9–14 years) who sustained a hockey-related concussion within the previous three years. A purposive sample representing male and female players was targeted in recreational and competitive leagues. Potential participants were informed of the study via an email invitation letter sent through the listserv of hockey organizations. This study used semi-structured one-on-one interviews and applied a framework analysis to analyze data. The timing aspect of the research drew upon the Timing it Right (TIR) Framework and its main premise: addressing time-specific informational and support needs can generate the greatest benefit.

Results: Parents expressed the need for information and supports to enable three key roles: making decisions, minimizing risks and caring for the child. The needs varied according to the specific circumstance surrounding their child's injury. Supports from the medical and the school systems were crucial in the child's recovery and facilitating return to meaningful activity. Supports from the hockey community were essential for preventing concussions and facilitating return to play.

Conclusions: As health care providers, policy makers and hockey organizations develop supports and services to meet parents' needs, they must consider a number of factors. Recognizing that needs

fluctuate over time and circumstance, and adapting interventions accordingly, can improve care for youth recovering from concussion. Furthermore, a greater understanding of the time-specific information and support needs of parents of youth hockey players who experience a concussion can facilitate safer return to play and enhance the experience of both players and parents.

0431

Ciliary Neurotrophic Factor As a Treatment for Neuroendocrine Abnormalities Associated with Traumatic Brain Injury

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Objectives: Among the most common yet under-recognized and under-studied disabilities associated with traumatic brain injury (TBI) is hypopituitarism with concomitant disruptions of salt and water balance leading to diabetes insipidus (DI). DI contributes substantially to the early morbidity observed in TBI victims and up to 26% of all TBI victims develop DI in the early aftermath of the injury. Additionally, up to 14% of TBI victims suffer from the syndrome of inappropriate antidiuretic hormone release that include profound hyponatremia resulting in cerebral edema, and an increased occurrence of seizure activity. Thus, fully 40% of all TBI victims suffer from problems related to dysfunctions of the pituitary gland and its controlling hypothalamic neurons, and these areas of the neuroaxis appear to be selectively vulnerable to TBI. Clearly, development of intervention strategies which can stabilize the neuroendocrine axis in the acute post-TBI period are of high clinical importance. Furthermore, there is currently no animal model available for replicating the conditions under which pituitary abnormalities occur in the human population as a result of TBI. Our proposed injury paradigm provides an innovative model with which the pathological outcomes of neuroendocrine injury can be investigated. Therefore, our long term goal is focused to determine the response of the MNS in the acute post-TBI period and the mechanisms underlying the effects of neuroprotective agents during acute post-TBI periods.

Method: We utilized an instrument designed to deliver replicable variable amounts of force to the infundibular nerve with induction of DI, followed by

metabolic analysis of polyuria, polydipsia and urine osmolality in conjunction with stereometric assessment of neuronal survival and axonal sprouting in CNTF-treated vs non treated animals in vivo and using organotypic cultures of the neuroendocrine system in vitro. Quantitative Western blot, Lunminex Bioassays and immunocytochemical analyses were used to determine the cell signaling pathways activated by acute injection of CNTF and their localization to immunophenotypically-defined cell types, respectfully.

Results: Our results demonstrate that rat recombinant CNTF promotes survival of axotomized neurons and extensive axonal outgrowth from neurosecretory neurons in organotypic cultures of the MNS nuclei. Furthermore, acute infusion of recombinant CNTF in vivo results in differential activation of multiple phenotype-specific signaling pathways in astrocytes and associated magnocellular neurons including, STAT3, PI3-Akt, MAPk and NF-kB in vivo.

Conclusions: Thus, the clinical impact of this novel model of TBI-induced neuroendocrine dysfunction and its direct application to the patient population lies in the rapid advancement of defined therapeutic strategies which are designed to reverse the prolonged decline in neuroendocrine viability associated with the post TBI period, while providing insight into the underlying mechanisms of action of neuroprotective factors.

0432

Acute Neurologic Deterioration Following MTBI: Timings, Etiology, and Outcomes

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Objectives: Mild TBI (mTBI) complicated by an intracranial hemorrhage (ICH) is a common cause of hospital admission following blunt head trauma. Most patients are treated non-operatively, remain neurologically stable and are discharged following a short hospital stay. They rarely require an intervention and have a low mortality rate (<1%). A small percentage of patients however suffer an acute neurologic deterioration. Little is known about the incidence of acute neurologic deterioration following a mTBI complicated by ICH as well as the timings, etiology, and outcomes.

Method: We performed a retrospective review on all adult patients (age ≥ 18) with mTBI (GCS ≥ 13) and ICH who presented to a Level 1 trauma center

over 53 consecutive months. Patients who were initially treated non-operatively and had a subsequent acute neurological deterioration (GCS drop ≥ 2) were identified. Demographics, neurologic status, CT scan results, and outcome data were collected to determine the incidence, timings, cause and outcome of acute neurological deterioration.

Results: Of the 907 patients who presented with a mTBI complicated by an ICH, 89 (9.8%) were immediately treated operatively. Of the 818 patients who were managed non-operatively, 31 (3.8%) suffered from an acute neurological deterioration. Average time from arrival to deterioration was 11 hours (± 14.2 range 1- 62 hours). Ninety-four percent of patients deteriorated within the first 24 hours from arrival. Average GCS drop was 5.2 points (± 3.8). Average hospital LOS was 10.5 days (± 9 days, range 1 –37 days). Upon discharge the average GOS was 3.3 (± 1.5) and mortality rate was 22%. Patients were subdivided based on CT scan findings following deterioration; worsening in ICH (n=21) or no change in ICH (n=10). When comparing both groups, patients with worsening in ICH had higher rates of neurosurgical intervention (24% vs. 0%), mortality (33% vs. 0%), unfavorable GOS (52% vs. 20%) and longer LOS (13 days ± 9 vs. 8 days ± 6).

Conclusions: The incidence of acute neurologic deterioration following mTBI with an ICH is low and occurs mostly within the first 24 hours. It is associated with high mortality and poor neurologic outcome. Two-thirds of patients deteriorate due to worsening ICH while the remaining deteriorate due to other causes. In patients with a neurologic deterioration, worsening ICH is associated with higher LOS, lower GOS, and higher mortality compared to those resulting from other causes. Further research is needed to identify risk factors.

0433

Including the Assessment of Mood and Fatigue in Concussion Management Protocols.

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Objectives: Multiple protocols exist for making return to play or return to duty decisions post concussion or

mild traumatic brain injury (mTBI). Typically, protocols include the assessment of symptoms and often include assessing balance and cognition. Assessing mood and fatigue has not been a standard part of post-concussion protocols. A recent study at the University of Toronto investigated the independent contribution of assessing cognition to return to play decisions. This study employed the Automated Neuropsychological Assessment Metrics (ANAMTM) test battery configured similarly to the ANAMTM battery being used by the US Department of Defense for pre-deployment baseline testing. This configuration included a mood scale along with cognitive measures. The results from their study indicated that assessing cognition affected return to play decisions independent of symptom assessment and that combining dimensions of mood and cognition increased the sensitivity of the cognitive battery to the effects of concussion. The objective of the present study was to further assess mood and fatigue in post-concussion assessment.

Method: Participants (N=67), ages 18–64, were recruited from an urban Level I trauma center following mTBI. Participants were administered ANAMTM at 7–10 days post injury. Admission GCS scores along with results from the Galveston Orientation and Amnesia Test (GOAT) were used to classify the concussion/mTBI as mild. Results from the Balance Error Scoring System (BESS) were also available on a subset of patients. Patients were divided into two groups: those with 4 or greater post-concussive symptoms and those with 3 or fewer. These two groups were compared on various scores from the cognitive tests included in the ANAMTM battery, mood scores from the ANAMTM battery, the total error score from the BESS, and on scores from the General Wellbeing Schedule.

Results: At 7–10 days post injury, there was no difference among subjects in the two symptom groups (4 or greater; 3 or fewer) with respect to BESS scores or on the neurocognitive portions of the test battery. The two groups did differ on measures of mood and wellbeing. Specifically, significant differences were noted on the Depression, Anxiety, and Fatigue Scales of the ANAM Mood Scale and on the Depression, Anxiety, Self-Control, and General Health scales of the General Wellbeing Schedule. Analyses were based on independent samples t-tests.

Conclusions: Data obtained from patients admitted to a civilian Level I trauma center are concordant from those obtained in sports medicine and support that inclusion of measures of mood and fatigue in concussion management protocols.

0434

Pilot Test Results of a New Comprehensive Measure for Minimally Responsive Individuals

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Objectives: The Association for the Rehabilitation of the Brain Injured (ARBI) in Calgary, Canada, is a non-profit organization, founded in 1978. ARBI delivers individualized, long-term rehabilitation to individuals with the most severe brain injuries. The therapy team (Occupational Therapy, Physiotherapy, Speech-Language Pathology), who have extensive experience in this area, found that the existing standardized measures used to assess the behaviour of vegetative and minimally conscious individuals were not sensitive enough to quantify the subtle changes that were often observed in this population. To address this need, the “Comprehensive Assessment Measure for Minimally Responsive Individuals” (CAMMRI) was developed as a basis for clinical management. The CAMMRI helps to define the level of consciousness and provides outcome measures during the rehabilitation process. CAMMRI is an integrated, functional measure developed to objectively identify and quantify the incremental changes in adults with minimal responsiveness to their environment as a result of severe acquired brain injury. CAMMRI is divided into three major areas:

- (1) Response to the environment: sensory assessment of responses to the environment that includes: visual, olfactory, auditory and arousal responses.
- (2) Motor Control: assessment of the best motor response in: head, upper and lower extremities.
- (3) Communication and Swallowing: assessment of the ability to: follow commands, communicate and use augmentative devices.

The objective of this presentation is to briefly describe this new tool, and to discuss the results of Phase I pilot testing.

Method: The methodological design used a standard sequence for developing a new measurement consisting of content validity based on literature review, construct validity with similar scales in the standard battery, test-retest and inter-rater reliability through pilot testing. The target population consists of adults who have experienced severe brain injury secondary

to trauma, anoxia or cerebral vascular accident and who currently function at Level II or III on the Rancho Los Amigos Scale of Cognitive Levels.

Results: Data analysis for Phase I of the pilot test was completed with twelve (12) subjects. Inter-rater reliability averaged 0.9 but varied somewhat between the 12 subscales. The correlations between CAMMRI and the other standard assessment measures of similar constructs were between the low to moderate range of > 0.4. The measures used for comparison were: Western Neuro Sensory Stimulation Profile (WNSSP), the Johnson Rehabilitation Institute Coma Recovery Scale (JFK) and the Chedoke-McMaster Activity Inventory. Comparative qualitative data indicated the CAMMRI had the highest scores for relevance and importance of the information obtained.

Conclusions: Preliminary results show that the CAMMRI measures the various key areas tapped by other scales and provides a more comprehensive evaluation of minimally responsive individuals. This may allow professionals to be better equipped to evaluate and develop treatment techniques for more effective rehabilitation.

0435

Biomechanical Responses of Impact Acceleration induced Traumatic Axonal Injury – Rat Head Model Development and Injury Localization

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Objectives: The primary mechanism of traumatic brain injury (TBI) is mechanical in origin in that rapid mechanical deformation dictates the response of neural tissue directly at the time of trauma and is believed to contribute to secondary injury leading to subsequent neurological disability. Finite element (FE) modeling of TBI is an effective approach to compute the mechanical response and develop tolerance criteria for injury protection. A few FE models of rodent TBI have been developed to simulate focal brain injury. These models either lack regional details for injury localization or are incapable of simulating widespread axonal injury resulted from impact. The objectives of this study were to develop and validate an anatomically inspired high-resolution 3D FE model of rat head to correlate tissue strain response with the foci of axonal pathology in the impact-acceleration TBI model.

Method: The head geometry of an adult Sprague Dawley (395g) was acquired from the MicroCT images and T2-weighted MRI images (4.7 Tesla). The skull and brain structures were segmented, differentiated and meshed with 3D hexahedral elements. The rat head model consisted of the sandwich skull, dura, arachnoid-pia, olfactory, cortex, corpus callosum, hippocampus, cerebellum, ventricles and brainstem. The regional heterogeneity of mechanical properties for various brain tissues was differentiated accordingly. The cortical displacement and head acceleration measured from dynamic cortex deformation (DCD) tests and impact-acceleration tests respectively, were used to validate the rat head model. The tissue strain response was related to magnitude of DAI assessed by beta-APP immunohistochemistry.

Results: The FE rat head model consisted over 810,000 elements at resolution of 0.1–0.2mm. The skull thickness between the bregma and lambda region varied from 0.6 to 1.0mm with thickness ratio of the outer table, diploe and inner table being 2:1:1.2. The model predicted peak displacement fell well within the experimental results in DCD tests. The predicted peak head acceleration (980g) matched average test results from 2-m impact. High principal strains (0.35–0.42) were found in the majority of the corpus callosum and brainstem with the highest strain in the pyramidal tracts (0.57), and medial lemniscus/deccassation (0.49). These outcomes agree with relative magnitude of DAI seen in the live anesthetized rats, with DAI counts being higher in brainstem than in corpus callosum.

Conclusions: An anatomically detailed FE model of an adult rat head was developed and validated against brain deformation and head kinematics measured directly from in vivo experiments. The validity in modeling of impact acceleration TBI enabled a thorough analysis of the mechanical response elicited by trauma in the entire brain, which has never been demonstrated. The preliminary correlation of high tissue strain with the region of histopathological damage in white matter shows promise that a validated computer model can improve understanding of pathogenesis of brain injury.

0436

Prospective Longitudinal Follow-up of Patients with Severe Head Injury

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Objectives: Consequences of traumatic brain injury for patients encompass activity limitations, increased dependence on environment and decreased degree of participation in society.

The purpose of this study was to make prospective and longitudinal follow-up a cohort of patients suffering severe head/brain injury.

Method: The patient population consisted of 25 patients with severe traumatic head injury consecutively admitted to the Umeå University Hospital (Glasgow Coma Score 3–8 on admission; mean 5.8). During the acute stage, in addition to appropriate neurosurgical measures the patients were treated with volume targeted therapy of increased intracranial pressure according to the Lund concept. Functional Independence Measurement (FIM), Glasgow Outcome Scale (GOS), Community Integration Questionnaire (CIQ) were used to follow up the patients. FIM were made 3, 6, 12, 18 and 24 months post-injury, while GOS and CIQ were assessed only once 3–4 years after the trauma.

Results: Complete follow up data were obtained for 17 patients (10 men, 7 women, age: mean 16–65 years, range 16–65) since 3 subjects died, 1 subject was excluded, 2 subjects were not followed up with FIM at all, and 2 subjects were only followed up with FIM once. In general, high values of FIM were obtained (max value was reached altogether by 4 patients 3 months post-injury, by 8 patients 6 months post-injury and 11 patients 24 months after the trauma). Two years after the trauma 11 patients exhibited GOS 3 (good recovery), 3 patients GOS 4 (moderate disability) and 3 patients GOS 5 (severe disability). At the same CIQ was also assessed (mean: 19.04 + 5.9, range 6–27). FIM and GOS were correlated to each other ($r = 0.940$; $P < 0.001$). In contrast, no correlation was found between FIM and CIQ ($r = 0.269$; $P = 0.313$).

Conclusions: The outcome was very good for the majority of the patients. The results stress the importance of employing several different types of instruments in order to grasp different dimensions of consequences of severe traumatic brain injury.

0437

Association Between Self-Reported and Performance Based Balance Four Years After a Mild Traumatic Brain Injury

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Objectives: Balance problems are commonly reported physical symptoms following mild traumatic brain injury (MTBI). The long term course of these problems are rarely characterized. The objective of this study was to assess the frequency of self-reported balance problems one and four years after MTBI, and to explore the association with performance-based balance tests after four years.

Method: Subjects: Patients with MTBI, 19 men, 10 women.

Design: Prospective follow up and cross sectional study.

Methods: Self-reported balance problems were measured with Rivermead Post Concussion Symptoms Questionnaire (RPQ) at one and four years post injury. Performance-based balance tests were performed at four years' post injury. The test battery consisted of posturography (normal stance with eyes open and closed, tandem stance with eyes open and dual task), the Dynamic Gait Index (DGI), normal and maximum walking speed tests, and the 6 minute walking test.

The frequency of self-reported balance problems was analysed by a 2x2 table. The associations between self-reported balance problems and performance-based balance tests were assessed using Spearman's rho correlation coefficient and the Fischer exact test with a significance level of $p = 0.05$.

Results: Self-reported balance problems were reported by 28% and 31% of the participants at one and four years post injury respectively. Dual task test on the balance platform and maximum walking speed test had medium and large correlations with self reported balance problems. The other performance based tests had medium to small correlations with self reported balance problems. The DGI had a ceiling effect in this population.

Conclusions: The results indicate that balance problems may be a long term consequence after MTBI. The performance based tests indicate that persons with MTBI have difficulties with dual tasks which may be due to reduced attention and processing capacity. When challenged on walking speed, they may have adopted a slower and more conservative gait strategy to maintain stability. The dual task- and gait speed tests can characterise the subtle balance problems experienced several years after MTBI. The DGI is not suitable for measuring balance problems in this population.

0438

Salivary cortisol as a stress marker at the Neuro Intensive Care Unit, a first case report.

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Objectives: Brain injury (TBI) can cause disturbances in the hypothalamo-pituitary-adrenocortical (HPA) axis. Studies have demonstrated a 30–40% occurrence of pituitary dysfunction involving at least one anterior pituitary hormone following a moderate to severe TBI or subarachnoidal hemorrhage (SAH). Normally, cortisol is secreted with a distinctive daily pattern called a “circadian rhythm” with cortisol levels peak in the morning and decrease to substantially lower levels late at night.

Still little is known about the cortisol pattern early after a severe brain injury and the correlation between stress and outcome is still unknown. The Lund Concept for the treatment of severe brain trauma was introduced at the Neurointensive care unit (NICU) in Göteborg 1992. This treatment includes clonidin to reduce the catecholamin levels. The aim of this pilot study was to study stress reactions at the NICU by monitoring blood pressure (BP), heart rate variability (HR) and salivary cortisol.

Method: This male, at the age of 41 years, suffered a severe TBI because of a bicycle accident, resulting in a traumatic SAH and contusions in the left hemisphere. MRI verified diffuse axonal injuries in corpus callosum and the brain stem (grade III).

The patient received NICU-treatment including pharmacological treatment with thiopental, and dopaminergic and noradrenergic agents to normalize the blood pressure (BP). BP and heart rate were continuously recorded by non-invasive automatic monitoring. Four samples of saliva were obtained during 24 hours, on the morning (7.00–8.00 h) on the afternoon (14.00–15.00 h) on the evening (18.00–19.00 h) and at 02.00h for two days. The nurses noted subjective observations about the patients behavior/reactions. For this subject the series of salivary cortisol were sampled at 9 and 10 days and 3 months after the injury.

Results: The patient was in a vegetative state. There was no circadian rhythm. The cortisol levels were in the normal range at the first occasions but generally higher as compared with at 3 months when the levels were generally low. The BP varied between 100/60 and 130/80 at the first occasions and between 170/80–60 at 3 months. HR was 100–120 at the

first occasions but around 60 at 3 months. The nurses did not observe any stress reactions.

Conclusions: The relations between blood pressure and salivary cortisol +HR for this case were inverse. The medical treatment at the NICU may have “masked” stress reactions and this, as well as the TBI, may have an impact also on the cortisol levels. The pilot study gave us important information for planning of the main study.

0440

Precision Teaching in Pediatric Post Acute Brain Injury Rehabilitation: Applications and Efficacy in the Classroom

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Objectives: Precision teaching (PT) is a particularly precise method of collecting and analyzing student performance data for the evaluation of instructional tactics and curricula. PT interacts with instruction to become a central part of the learning process. PT requires observable, countable measures to reflect changes in frequency and fluency related to educational goals; it provides a reliable means to monitor students’ daily progress in the classroom for both learner and teacher. Although PT has gained recent attention as a promising approach in teaching children with autism and other developmental disorders, the technique has been used for years in a large pediatric post acute brain injury rehabilitation (PABI) program in Arkansas. This paper describes the philosophy and methodology of PT, offers examples of PT application in pediatric PABI, and investigates results from one specialized program. Descriptions of outcomes and a discussion of the efficacy of this educational approach with pediatric ABI cases are offered.

Method: Educational data from the use of precision teaching were reviewed and analyzed for 41 children and adolescents ages 6–18. All subjects were residential clients in a JCAHO/CARF-accredited pediatric PABI program with on-site publicly accredited classrooms. Performance data were analyzed to determine typical rates of goal attainment across a range of skills. Examples of simple goals included holding an object, tracing lines, naming and locating colors, and naming letters and numbers. More complex goals included reading comprehension

(oral and written responses), spelling, mathematics, and science content mastery. Progress reports and standard celeration chart data were analyzed to determine the range of outcomes and descriptions of typical academic advancement, which were compared to published outcome data for other educational populations. Selected individual records were scrutinized to identify possible factors affecting results.

Results: Celeration chart curves for this group of CNS-involved students were found nevertheless to frequently reflect excellent skill attainment exceeding results for some other educational populations. Progress reports typically reflected sharp increases in frequency and fluency that often translated to rapid grade level advancement.

Conclusions: PT was found to be a potentially effective and efficient teaching strategy for PABI students across a wide range of disability, age, and educational achievement levels. Limitations of the current study are discussed. Additionally, methodological issues in the analysis of celeration chart data are identified and possible solutions offered.

0441

Level of agreement between informants and individuals with brain injury: A case series

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Objectives: The present study aimed to address the relationship between self- and informant reports on the Behavioral Rating Inventory of Executive Function-Adult (BRIEF-A) and the Neurobehavioral Functioning Inventory (NFI). We hypothesized that BRIEF-A and NFI self- and informant report ratings would be moderately correlated.

Method: Participants were selected from a current prospective community-based pilot project providing rural rehabilitative services via technology to individuals living with brain injury in Southwest Virginia. This 12-month intervention project (CLiC: Community Living Connection) represents a collaborative research effort with Brain Injury Services of Southwest Virginia (BISSWVA), VA TECH Assistive Technology, and Radford University

Psychology and Communication and Sciences Disorders researchers. Researchers completed a comprehensive baseline neuropsychological battery including neurocognitive, neurobehavioral, adaptive, and quality of life measures in the participant's home during a 3–4 hour session. Four out of 10 CLiC participants had significant others living in their home who completed several outcome measures during the same baseline evaluation, including the NFI and BRIEF-A instruments—the focus of the current study. Two of the four participants were female, and the average age of participants at baseline was 38 years (range 36–43). Two participants acquired a brain injury and two experienced a traumatic brain injury. All four participants were more than one year post injury (range 2–7 years) with baseline IQs in the borderline to high average range (WASI Mean SS: VIQ 99.5; PIQ 90.5; FSIQ 95). Significant others included sister, husband, wife, and mother.

Results: To examine the relationship between self- and informant reports of everyday executive functioning, Pearson correlations were calculated for each pair of corresponding scales on the NFI and BRIEF-A (e.g., self-report Inhibit with informant report Inhibit) across pairs and groups. Moderate to large correlations were found between reports on both the BRIEF-A (average correlation $r = .84$) and NFI (average correlation $r = .78$). Inspection of BRIEF-A scores revealed participants were more likely to report clinically significant executive dysfunction than their informants, whereas participants were less likely to report clinically significant neurobehavioral symptomatology compared to their informants on the NFI.

The level of interrater agreement was further analyzed with Kappa statistics across items on the BRIEF-A and NFI. Agreement levels appeared related to injury specificity/severity, item specificity, and item content. Additionally, intercorrelational analyses looking at convergent and divergent validity of the BRIEF-A and NFI were conducted.

Conclusions: Concordance between self- and other report of neurobehavioral symptoms (NFI) and executive functioning (BRIEF-A) was moderately high overall, but varied across the four pairs, and by scale/domain and item. Inconsistent with previous research, this case study series shows that individuals living with brain injury do not lack awareness or insight about their neurocognitive and neurobehavioral deficits. Clinical implications of these findings and follow-up analyses will be explored.

0442

Predicting Outcome in Anoxic Brain Injury. An Assessment of Early Prognostic Indicators.

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Objectives: Anoxic Brain Injury (ABI) is a syndrome of diverse aetiology, which is not clearly defined. Most published case series relating to rehabilitation outcomes have been confined to ABI of a single aetiology, or to limited numbers of patients. Although there is extensive research data relating to prediction of survival following ABI, information relating to prediction of functional outcomes following moderate to severe ABI is limited. Identification of prognostic indicators would enable physicians to give valuable and reliable advice to patients relatives and carers, and to estimate the workload and effectiveness of rehabilitation programmes.

Method: We performed a retrospective analysis on all patients who required hospital admission for rehabilitation following ABI over a 14-year period. Excluding those with pre-existing neurological impairments, we identified 93 cases, and made statistical comparison based on demographic data, clinical details, and measures of functional and cognitive outcome.

We used discharge destination, duration of hospital admission and the FAM (Functional Assessment Measure) as outcome measures of independence. FAM data was assessed in terms of total scores and component scores grouped into categories of mobility; self-care; and cognition/communication. To be deemed independent, patients had to achieve the equivalent of total FAM score of 180/210 or to be discharged to their own home. To identify potential early indicators of prognosis we analysed outcomes according to patient age; sex; cause of ABI; premorbid psychosocial factors; Glasgow Coma Scale (GCS); ventilation requirement; cognitive, visual, speech or motor impairments; or seizure occurrence.

Results: As 75% of those assessed required ventilation due either to the severity of their brain injury, or for management of the cause of their ABI, GCS; ventilation requirements or duration of retrograde or anterograde amnesia were not useful as predictors of outcome.

New onset seizures in the first week after injury was the most sinister prognostic indicator, with none of those 14 patients affected being independent at time of discharge, and none being discharged to their own home. Inability to complete the Mini Mental State Examination, or to score greater than 20/30, at the time of transfer to rehabilitation services was associated with a six-fold increase in risk of dependence. Presence of expressive or receptive dysphasia; dysphagia; visual field impairments; quadriparesis or ataxia were all associated with at least a twofold, statistically significant risk of dependence.

Increasing age, and female sex were associated with poorer outcomes. On comparing those in the three largest aetiological groups, those with ABI due to cardiac arrest were 1.5 times as likely to be independent or be discharged to their own home than those with ABI due to hypoglycaemia or asphyxia. Those whose ABI arose from overdose of alcohol or drugs, from a suicidal attempt, or was associated with past medical history of treated neurosis, drug or alcohol abuse were approximately 50% less likely to be independent or to be discharged to their own home, although these differences were not statistically significant.

Conclusions: Once patients with ABI are sufficiently clinically stable to be assessed in relation to rehabilitation potential, it is possible, using criteria based on impairments of cognition, speech, visual perception and mobility, and development of seizure, to estimate prognosis in relation to future potential for independence, or discharge to own home. Age, gender, premorbid psychosocial history and aetiology of ABI may also be predictors of outcome. The validity of these results is influenced by the fact that they are based on retrospective data.

0443

Prognostic Indicators of Severe Traumatic Brain Injury, Their Alteration in Time and its Relationship with the Functional Outcome in Patients with Severe Traumatic Brain Injury

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Objectives: Prospective Study

Introduction: The main aim in rehabilitation of severe TBI is prediction of the functional outcome.

Objective: To record the prognostic indicators, 2 and 4 weeks post injury, of patients with severe TBI and to correlate them with their functional outcome.

Method: Patients - **Methods:** 70 consecutive patients who suffered from severe TBI were followed up to 6 and 12 months. Patients' Glasgow Coma Scale (GCS), age, duration of coma, post traumatic amnesia, brainstem reflexes (pupil reflex, doll's eye reflex), CT findings and secondary injuries were recorded 2 and 4 weeks post injury. Functional outcome was estimated with the Glasgow Outcome Scale (GOS) and the Functional Independence Measure (FIM). Independent sample t-test was used for the correlation of the consecutive conditionals. Fisher's exact test was used for the correlation of the forward conditionals.

The multiple logistic regression model was used to see which of the prognostic indicators, from those that seemed to have a significant correlation, affect the functional outcome in 6 and 12 months.

Results: 2 weeks post injury, if a patient's GCS Motor response raised in 1 unit and he had not an intracerebral haemorrhage this patient seems to have 2.07 and 7.09 times, respectively, possibilities to become independent in the 6 month functional outcome.

2 weeks post injury, if a patient's GCS Motor response and his age raised in 1 unit this patient seems to have 1.78 and 0.94 times, respectively, possibilities to become independent in the 12 month functional outcome.

4 weeks post injury, if a patient's GCS Motor and Verbal response raised in 1 unit this patient seems to have 1.9 and 2.9 times, respectively, possibilities to become independent in the 6 month functional outcome.

4 weeks post injury, if a patient's GCS Motor response raised in 1 unit this patient seems to have 2.1 times possibility to become independent in the 12 month functional outcome.

Conclusions: In patients with severe TBI, the study of the alteration of the prognostic indicators with time may reveal some useful indications about the functional outcome of these patients.

0444

Systems Analysis of Health and Community Services for Acquired Brain Injury in Ontario, Canada

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Objectives: Approximately 500,000 people in Ontario live with Acquired Brain Injury (ABI). ABI is a complex chronic disorder that can affect an individual's ability to function physically, cognitively, and socially throughout his or her lifetime. In the current climate of decentralized health service delivery in Ontario, it is essential to describe these services, specifically, service distribution, provision, access, and coordination, as well as gaps in care. Thus, the overall objective of this research is to describe and analyze the scope and nature of ABI services across the continuum of services and across the lifespan.

Method: The current systems analysis involves a mixed methods approach. An environmental scan of the formal and gray literature as well as consultation with key stakeholders was carried out (Local Health Integration Networks (LHINs) Liaison Office, Ministry of Health and Long Term Care, service providers) to inform the development of an interview guide. Telephone interviews with 68 different stakeholder groups, including community-based organizations, community associations, rehabilitation and acute care hospitals, as well as the LHINs will be carried out.

Results: Consultations with key stakeholders and the results of the environmental scan revealed relevant areas for the interview guide, including approach to service delivery (e.g., vision, framework), access to services, wait for services, capacity, and data/indicators tracked. Findings from the environmental scan on gaps in services were also included in the interview guide, and stakeholders will be asked to identify the areas relevant to their association/organization/hospital. Gaps identified included unmet service needs (e.g., psychological/mental health services, lifeskills in the community), information/communication (e.g., information for carers), education (e.g., for patients, in the community), issues specific to children and adolescents (e.g., developmentally appropriate services), family/caregiver support, tailored intervention approaches/services specific to ABI versus generalized services, continuum of care (e.g., aligning program structure with patients' functional needs by increasing

outpatient services), structural issues (e.g., program evaluation imbedded in organization), appropriate program/services, and funding. Qualitative and quantitative data from the interview guide will be compiled and analyzed.

Conclusions: The impact of an ABI on a person's life, his or her function, and his or her ability to be meaningful participants in society is significant. The need for service over the long term is substantial and represents a sizeable portion of health care costs. Planning for and providing the timely, accessible, and appropriate services will enable individuals with an ABI to achieve better outcomes, reintegrate into society more effectively, and experience an enhanced quality of life. Having an accurate picture of the system, including its gaps, will assist policy makers, planners, and providers as they move forward with developing a provincial framework to address ABI as a complex chronic disease across the lifespan.

0445

Blast Injuries and Traumatic Brain Injury

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Objectives: Current clinical practice includes screening for traumatic brain injuries (TBI) after explosive blast exposure. The objective of this current study was to conduct a systematic review of the literature relating to interventions used to treat those who have sustained a TBI during blast exposure.

Method: The following databases were searched for articles related to brain trauma resulting from a blast injury: MEDLINE/PUBMED, CINAHL, EMBASE, and PsycINFO. We also considered information from on-line military websites and official government websites.

Results: No specific clinical interventions were presented in published studies available by our review date. Most studies discussed the physical effects of blast injuries on individuals. Current estimates suggest that up to 20% of troops serving in conflict zones have sustained a mild TBI resulting from an explosion. Reliable data for those who

sustained a moderate to severe TBI were not yet available.

Conclusions: While it is difficult to ascertain the number of individuals injured, it is relevant to describe the nature and severity of traumatic brain injuries sustained during blast exposure. It is equally important to capture the nature and effectivity of any clinical interventions used and to document their success or failure. Due to the paucity of current data available, this review is only a preliminary compilation that reflects an evolving issue. Future review will focus on these topics in greater detail.

0446

Role of Nitric Oxide System in the Cerebellum of Aged Rats Submitted to Hypobaric Hypoxia

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Objectives: Nitric oxide (NO) is a molecule that plays a key role in the cerebellum, taking part, among others, in mechanisms of synaptic plasticity. Furthermore, and depending on its concentration, NO can have a dual neuroprotective/neurotoxic function. This molecule is also involved in the aging process; thus, the oxidative-stress theory points to free radicals and NO as the main factors responsible of aging. The pathologies related to hypoxic processes, which are characterized by a diminished oxygen contribution to tissues, occur with the highest incidence in old individuals, and numerous studies have, moreover, shown the involvement of NO in these pathologies.

Considering this background, we analyse the implication of NO in the cerebellum of adult and old rats submitted to an experimental model of hypobaric hypoxia that reproduces a hypoxic situation which has not been studied previously in old individuals, despite that hypoxic pathologies show up with greater frequency in old individuals.

Method: In this study, we investigate the expression (by means of western blotting technique) and activity (measured by NADPH-diaphorase histochemistry) of nitric oxide synthase isoenzymes (NOS); the amount of NO (measured as nitrate/nitrite); and the level of cell damage caused by NO (studying the protein nitration) in the cerebellum of old rats subjected to hypobaric hypoxia followed by several reoxygenation periods.

Results: Our results show that hypobaric hypoxia involves certain changes in the NO/NOS system.

Thus, in the old rat cerebellum, augmented NOS activity is detected. This greater activity, reported by other authors in adult animals as well, appears to be due mainly to eNOS, since greater eNOS expression appears to run parallel to augmented NOS activity. However, and as a differentiating factor in aging, it is noteworthy that the response of this isoform, which exerts a vasodilator role, occurs later in the old animals.

Conclusions: In short, in our model of hypobaric hypoxia, the NO/NOS system response would be delayed by the effect of aging.

0447

Positive Outcomes Following Long-Term Rehabilitation for Individuals with Severe Traumatic Brain Injury

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Objectives: Association for the Rehabilitation of the Brain Injured (ARBI) is a pioneer in community-based rehabilitation for individuals with severe brain injury. These individuals are often given little hope of recovery. We believe that every individual deserves to live their best possible life following severe brain injury.

Individuals are referred to ARBI by physicians and rehabilitation professionals approximately 2 years post-injury. This presentation will highlight: 1) ARBI's unique cost-effective service delivery model 2) positive outcomes for individuals with severe traumatic brain injury.

Method: We reviewed outcomes in 23 clients with average age of 29. Severe traumatic brain injury was defined as: 1) Initial Glasgow Coma Scale III-IV 2) Requiring 24 hour care 3) impairment in physical, communicative, and/or cognitive abilities. Clients were medically stable without risk-related behavior. Comprehensive assessments were conducted by Physiotherapy, Occupational Therapy, Speech-Language Pathology using discipline specific standardized measures and functional outcome measures: Rappaport Disability Rating Scale, Chedoke-McMaster Activity Inventory, Rancho Los Amigos Cognitive Levels Scale. Annual surveys included scores reflecting ARBI's impact on quality of life.

Each discipline developed and provided a written personalized rehabilitation program that was demonstrated and recorded on DVD. Volunteers and staff

received intensive training to properly implement the rehabilitation programs that clients participated in 12–15 hours/week.

Follow-up assessments were conducted at least annually dependent on the client's status. Clients needed to demonstrate functional improvement to continue in program.

Results: Outcomes for 13 discharged and 10 active clients were compiled. 94% felt that ARBI has positively impacted their quality of life.

The average length of stay at ARBI is 7 years for discharged clients and 3.9 years for active clients. On admission many of the clients reside in hospitals or long-term care centers. At discharge the majority of clients reside in personal care homes or their own homes. Participation in the community increased from admission (0–1 time per week) to discharge or present (2–3 times/week).

The Rappaport Disability Rating Scale scores reflected severe disability at admission with moderate-severe disability at discharge or at present.

Rancho Los Amigos scores increased from an average of 5.3 to 6.1 for discharged clients and an average of 5.6 to 5.9 for active clients.

The Chedoke-McMaster Activity Inventory scores increased from an average of 32 to 45.5/100 for discharged clients and an average of 33.6 to 38.6/100 for active clients.

Conclusions: Individuals who have survived the most severe brain injury continue to demonstrate functional improvement for years following injury allowing them to reside in their own homes or personal care homes in the community. With long-term, intensive rehabilitation and support individuals can experience an enhanced quality of life and once again enjoy active participation in their communities.

0448

An Update of the Systematic Review of the Rehabilitation of Moderate to Severe Acquired Brain Injuries-V5

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Objectives: To conduct a systematic review of the rehabilitation literature of moderate to severe acquired brain injuries (ABI) from traumatic and non-traumatic causes.

Method: The following databases: MEDLINE/PUBMED, CINAHL, EMBASE, and PsycINFO were searched for articles relating to the interventions used to assist individuals with an ABI. This review included randomized controlled trials (RCTs), non-RCTS, cohort, case-control, case series, pre-post and single subject interventions related to intervention strategies used to assist those with an ABI recover. Data extracted included demographic information, inclusion and exclusion criteria, the description of the intervention and the study results. Articles were scored for quality using either the Downs and Black or the Physiotherapy Evidence Database Scale (PEDro) evaluation tools. A level of evidence using a modified Sackett scale was assigned to each intervention.

Results: Despite the large body of literature addressing ABI rehabilitation interventions, only 28.7% were found to be RCTs and less than half of those selected were considered strong evidence. Therefore strong levels of evidence were limited or not available for most areas of ABI rehabilitation.

Conclusions: Due to the high proportion of low quality interventional studies found, there appears to be a need to improve upon the methodological quality of ABI rehabilitation research.

0449

Principles and Clinical Applications of fNIR and EEG Non-Invasive Imaging Techniques

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Objectives:

- Acquire fNIR and EEG principles of non-invasive imaging techniques in reference to data acquisition strategies for the laboratory and clinics.
- Understand the advantages and disadvantages of fNIR and EEG imaging techniques as uni-modal and multi-modal methods.

- Explore insights into the role of fNIR and EEG neuroimaging provides in a variety of natural and clinical settings with applications in brain computer interfaces (BCI), neurorehabilitation, anesthesiology, and pain assessment.

Method: The principles of optical imaging techniques in continuous wave near infrared spectroscopy will be presented. The methodology of the 16 sensors used in assessments of prefrontal cortex oxy-hemoglobin and de-oxy hemoglobin will be demonstrated during the performance of selected activities including human performance, anesthesiology, brain computer interface and pain assessment.

Principles of digital electroencephalography (EEG) focusing on the general properties of human EEG with the issues associated with quantitative methods will be reviewed.

There will be a review of the methodological procedure of neuropsychological assessment which is used to measure functional changes due to the impairment of specific cognitive and behavioral domains. Both standard neuropsychological tests, along with non-invasive neuroimaging techniques for selected clinical neurorehabilitation populations, will be presented.

Results: Review of results from human performance studies show that fNIR is a field deployable technology to assess localized brain activity. These results demonstrate a positive relationship between the participant's behavioral performance and fNIR responses as a function of task load. In addition, past work illustrates that fNIR can be used to study neural correlates of attention and working memory, as well as, integrate fNIR with other physiological and neurobehavioral measures.

The benefit of a combined use of fNIR and EEG has been demonstrated in a performance monitoring study in healthy adults, by taking advantage of both the spatial information about the hemodynamic activity and the fast temporal dynamic of the cognitive processes of interest.

Using fNIR, a bar-size-control task using a closed-loop BCI system was designed and tested with healthy adults across two days of testing. Comparisons of the mean task and rest period oxygenation changes were significantly different and the mean task completion time decreased across practice sessions.

Conclusions: A similar approach to the study of the human cognitive activity can help explain the mechanisms underlying the impairments caused by disorders such as traumatic brain injury or multiple sclerosis, hence providing some physiological evidence important for the choice of a proper intervention.

0450

Predicting Case Management Service Use Following Traumatic Brain Injury (TBI): A Critical Appraisal of the Caregiver Information and Support Link (CISL) Database

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Objectives: The practice of CM occurs within the context of varied health delivery systems and populations worldwide, and it has emerged as a significant health service for persons with TBI (Quinn, Pannone, Gruman & Roja, 2004). The primary aim of the study was to examine factors associated with the use of case management (CM) services by adolescents and adults with TBI based on data from CISL. A secondary objective was to provide a critical appraisal of the CISL.

Method: This research involved secondary analysis of data from the CISL database which developed as part of a Canadian provincially-funded project for survivors and caregivers living with TBI. Data collected since 1989 included questions on service use. This was the only known extensive database in Canada that collected data on service use following TBI from the consumer perspective (N = 1,960). A primary purpose of the database was to assist in understanding the needs of persons living with TBI and their caregivers by collecting data directly from the source. Bivariate analyses were conducted comparing user and non-user groups of CM, and sequential (hierarchical) regression was performed using the framework of the Behavioral Model of Health Service Use (Anderson & Davidson, 2001). In addition, the generalizability of the CISL data was compared to administrative data from our publicly funded health care system of seriously injured persons from lead trauma hospitals in the province of Ontario.

Results: Hierarchical regression analyses revealed that age (older, less likely to use CM), education (less education, more likely to use CM), severity of injury (less severe, more likely to use CM), activity limitations (more limited, more likely to use CM), community integration (more integrated, the less likely to use CM), living at home alone (less likely to use CM), living in a facility (more likely to use CM), and funding by "other" insurance (less likely for worker's insurance) significantly and reliably predicted use of CM services.

In addition, compared to population based data, the CISL data was not significantly different from the

Ontario Trauma registry in terms of subject mean age (mean = 37) and gender distribution.

Over half of the data were missing for key variables in the full CISL database.

Conclusions: Clear differences exist between CM users and non-users, suggesting further investigation into the use of and access to this component of the continuum of care following TBI. Although the CISL database was comparable to population based data in terms of demographic characteristics, the study revealed some weaknesses such as missing data for key variables. However, it provided unique data that is not available elsewhere in Canada on a large scale.

0451

Development of a Challenge Assessment Tool for use with High Functioning Children with an Acquired Brain Injury: Bridging the Measurement Gap

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Objectives: The lack of an appropriately targeted and validated outcome measure for high-functioning youth with an acquired brain injury (ABI) reduces clinicians' ability to document an improvement in their advanced gross motor skills. The Gross Motor Function Measure (GMFM) is an outcome measure used internationally to evaluate gross motor abilities in children with cerebral palsy or ABI. Although it has strong psychometric properties, children who display high-level gross motor functioning demonstrate a ceiling effect on this measure despite persistent physical impairments. They may attain scores of greater than 90% on the GMFM, but still have residual motor impairments that may interfere with their safe reintegration into the home, school and community.

The purpose of this study was to develop an ABI-Challenge Assessment (ABI-CA) to evaluate gross motor function among high-functioning youth with an ABI. This ABI-CA is intended to capture changes in performance of advanced gross motor skills that represent the areas of: balance and postural control (static and dynamic), coordination, agility and speed, and strength.

Objectives:

I. Identify items that capture challenging gross motor functional activities among high-functioning youth with ABI.

II. Select items for the ABI-CA based on perceptions of the safety, feasibility and importance of these items among physical therapists with experience treating youth with ABI.

III. Develop a response scale and users manual for the items comprising the CA.

IV. Evaluate the feasibility of administering the ABI-CA among high-functioning youth with ABI.

V. Make recommendations based on results of pilot testing regarding further revisions to the CA.

Method: Module development was a multi-step process. A large pool of items was first identified from existing scales and literature. An expert panel of ABI physical therapists helped to select and narrow down the item pool based on ratings of safety, feasibility and importance. These items were entered into an online web-based survey where Canadian and international pediatric physical therapists' item ratings were used to reduce the item pool. The CA was then developed and pilot tested with children and adolescents with an ABI.

Results: Seventy-eight items were generated and reduced to 47 items based on expert panel discussion. Web-survey item reduction by 86 pediatric physical therapists yielded a 23-item CA administered to six youth with an ABI aged 8–17 years. The ABI-CA total mean score was 50.7/81 points (SD = 17.4) showing evidence of room at the top of the scale for detection of improvement over time. *Conclusions:* This study resulted in a 23-item CA, which is feasible to administer and significantly challenges the high-functioning ABI population beyond the current GMFM. Future studies are required to refine the CA's items and response options, and determine its psychometric properties prior to clinical use.

0452

“LemonAid”: A Model for Community-Based Functional Therapies After ABI

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Objectives: Clients with acquired brain injury are more motivated to engage in therapeutic tasks that provide a direct link to successful completion of their long term functional goals. This therapeutic model

showcases methods for implementing these types of purposeful activities through volunteerism associated with a fund raising event; The Anthem LemonAid.

The Anthem Blue Cross and Blue Shield insurance company of Virginia in coordination with The Children's Miracle Network sponsors this event each year to benefit children with cancer.

This presentation serves to outline the components of a transdisciplinary functional approach to community based therapy for survivors of brain injury. The presenters will provide examples of all therapeutic disciplines' based goals and interventions in a non-controlled, naturalistic and interactive, community based environment. This specific treatment model employs a variety of essential skills necessary for successful community re-entry.

Method: Clients who participated in this program over the last three years ranged in age from thirty-two to fifty-three and ranged from mild to severe brain injury. One hundred percent of the clients participating were male.

Within group settings, clients are educated about the fundraiser; who sponsors the event, as well as, who benefits from the funds raised, what the sponsor provides for the event, and where and when the event will be held. Preparatory activities include: selecting a decorating theme, selecting items for bake sale, shopping for the decorating and baking items, making a sign for the stand, baking the items, preparing the lemonade, packing the vans, setting up and decorating the stand, and taking down the stand.

During the actual event activities cognitive, language, behavioral and physical skills are utilized and directed by our treatment staff. Actual event activities include: taking money and making change, handing out stickers, pouring lemonade and distributing food, and marketing. All clients are prepped regarding prices of items, general purpose of the activity and appropriate social skills beginning one month ahead of the event and consistently reviewed up until and on the day of event.

Following the event, clients are asked a series of questions to assess their overall reaction to the volunteer experience and to give a forum for discussion of their performance in goal areas.

Results: Based on our observations and client feedback over the three years of this project, functional progress has been particularly noted in the areas of social skills, instrumental activities of daily living and initiation.

Conclusions: Clients respond positively to the volunteer nature of this event as indicated in post event group debriefing with OT and RT. The activity, given it myriad components, allows for

multiple opportunities for client autonomy; thereby, increasing their locus of control and quality of life.

0453

Location of Functional Activation Changes During Recovery From Traumatic Brain Injury

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Objectives: Previous research using functional magnetic resonance imaging (fMRI) has revealed increased prefrontal cortex activation during cognitive tasks in traumatic brain injury (TBI). Longitudinal studies have examined the relationships between activation and behavioral performance during recovery from TBI using regions of interest (ROIs) defined by subject activation at early time-points or group contrast activation. However, studies have not examined the extent to which the size and location of activated regions varies within subjects during recovery. In order to test the extent to which ROIs defined in this manner represent within-subject variability over time, the current study examined left and right prefrontal cortex (PFC) ROIs at separate time-points, three and six months post-injury, to determine the reliability in the spatial overlap of ROIs.

Method: Six individuals with moderate to severe TBI completed a non-verbal working memory fMRI paradigm involving matching the identity and location of facial stimuli. fMRI data were collected at three and six months post-injury to examine recovery. Activation clusters in the right and left PFC were identified and quantified using the MarsBar SPM toolbox to determine cluster volume and degree of ROI overlap between the time-points.

Results: When comparing time 1 to time 2 data, there was a decline in percent signal change in prefrontal cortex regions of interest for all participants. The ROIs remained generally the same size at time 2 despite decrease in mean activation in ROIs defined by time 1 data. Though this change in activation could be due in part to recovery, it has important implications showing that using a time 1 data ROI does not capture all activation at a later timepoint. An overlap of activated voxels was found in only 5 of

12 examined PFC ROIs between timepoints. Among those regions that overlapped, only 12.7% of voxels were commonly activated at both time points.

Conclusions: Changes in PFC involvement in working memory during recovery from TBI may be partially characterized by large changes in the anatomical location of activation within an individual despite relative stability in overall activation cluster sizes. Results from the current study indicate that ROIs defined by one time point or aggregate data may not appropriately represent the anatomical localization of functional activation during recovery from TBI. Independent behavioral regressors such as reaction time may be useful to determine if anatomical changes in activation represent neurological change that is important for task performance. Methodological recommendations are made for examining recovery in TBI using fMRI methods. Better understanding how to define ROIs will help to improve knowledge of functional changes in recovery.

0454

Addictive Behaviours Post Acquired Brain Injury

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Objectives: To conduct a systematic review of the literature examining addictive behaviours following an acquired brain injury (ABI) and the interventions used to treat these behaviours.

Method: The following databases: MEDLINE/PUBMED, CINAHL, EMBASE, and PsycINFO were searched looking for any interventions currently available to assist individuals with an ABI overcome an addictive behaviour. Included in this review were randomized controlled trials (RCTs), non-RCTS, cohort, case-control, case series, pre-post and single subject interventions. When possible, articles selected were scored for quality using either the Downs and Black evaluation tool or the Physiotherapy Evidence Database Scale (PEDro)

evaluation tool. Following this a level of evidence using a modified Sackett scale was assigned to each intervention.

Results: Addictive behaviours have been identified as a significant problem with those who sustain an ABI both before and after injury. This behaviour may impede the individual's ability to return to work and many report lower life satisfaction and lower levels of productivity. Despite the number of articles found identifying substance use disorders as a problem with those who sustain a TBI, very few effective interventions were found following an extensive search of the various databases.

Conclusions: More needs to be done looking at interventions that have been found to be effective or in developing interventions that will be effective in eliminating these behaviours.

0455

Practice Patterns in Emergency Department Management and Follow-up of Pediatric Mild Traumatic Brain Injury

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Objectives: Children with head trauma commonly present to emergency departments (ED). Tools such as the Acute Concussion Evaluation (ACE), ACE Care Plan and CDC physician's tool kit for mild Traumatic Brain Injury (mTBI) are available to physicians for patient diagnosis and management at discharge. It is unknown whether Emergency Physicians (EPs) providing care to pediatric patients with mTBI are aware of or utilize these tools.

Objective: To identify practice patterns for diagnosis of pediatric mTBI and follow-up care recommendations for mTBI among EPs.

Method: We surveyed 22 EPs from 22 EDs in a multicenter network in 2008. Clinicians recorded

responses as yes or no, with free text explanations, also rating responses on a Likert scale of 1–4.

Results: 17/22 (77.2%) EPs surveyed, responded. Among respondents, there was little familiarity with ACE, ACE Care Plan, and CDC's physician tool kit for mTBI. Only one had used the ACE in a clinical setting (5.5%). After being introduced to the tool, there was general consensus that the ACE (70.5%) and ACE Care Plan (64.7%) could be useful in their practice. While a digital form of the ACE would be desirable for most, there was hesitancy to include the ACE into computerized charting systems because of administrative barriers and software rigidity. Of participating facilities less than 1/3 implemented this type of charting software (29.4%). The acuity of patients presenting with mTBI was unanimously determined to not be a barrier to the ACE's implementation.

Most facilities have standardized discharge instructions for mTBI (70.5%). Of these facilities, most believed these instructions were not satisfactory in their current form and needed significant modification (82.3%). The overwhelming majority did not have a clinical pathway in place to manage mTBI (88.2%), but agreed that having one would improve patient care (60%). Although most facilities had the capacity for follow up neuropsychological evaluation (88.2%), fewer had follow-up clinics specializing in mTBI (41%), even fewer routinely referred patients for neuropsychological evaluation (17.6%) placing the burden of follow-up care largely on the primary care physician (PCP). There was agreement that it is important to disseminate follow up instructions to PCPs and school nurses (70.5%) although lines of communication with school nurses are not well established and require significant improvement (70.5%).

Conclusions: There is lack of recognition and use among EPs of tools for screening and follow-up for children with mTBI such as the Acute Concussion Evaluation (ACE). ED implementation of a validated tool for diagnosis and management of mild TBI in children such as the ACE and ACE Care Plan may improve early identification of mTBI, decrease practice pattern variation and disseminate information to PCPs and school nurses.

0456

Osteopathic Craniosacral Treatment Effects in Spasticity and Motor Control

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Objectives: Craniosacral Therapy (CST) is an osteopathic treatment that has been used in neurological conditions such as Parkinson's disease and TBI, and shown to cause generalized relaxation. One study reported improved overall outcomes when CST was implemented during the acute rehabilitation period of TBI patients. However, although cranial osteopathy's effect in clinical practice seems successful, the theoretical phenomena and treatment efficacy has not been consistently substantiated with reliable or reproducible measurements in the literature. Therefore, this single-subject pilot study sought to determine the effect of CST on post-stroke motor control by measuring muscle tone and activation at rest and during a reach-to-target task.

Method: The subject was a 70-year-old, left-handed male, 10 years status-post right MCA infarct with left sided hemiparesis and severe spastic dystonia. Quantitative assessment of motor function using the Fugl-Meyer scale was 17. Passive ROM was 0–90° for shoulder flexion and abduction, 80–150° at the elbow, and 0° at the wrist and fingers. Spasticity, measured using the Modified Ashworth Scale (MAS) were 3 at the shoulder and elbow, and 4 at the wrist and fingers. The patient underwent 30 minutes of CST, which consisted of releasing dysfunctions found in the occipitoatlantal joint, cranial and sacral bones, and paravertebral musculature of the thoracic and lumbar spine. Muscle activity was recorded in the left trapezius (lower, middle and upper), deltoid (anterior and posterior), triceps, biceps, pectoralis major, FDS, FCU, EDC and ECRL muscles using surface EMG both at rest and during a reach-to-target task, before and after CST.

Results: After CST, muscle activity at rest increased in the middle and lower trapezii, and decreased in the deltoids, triceps, biceps, pectoralis and upper trapezius muscles. Muscle activity during reach was similar, with further increase in activation of the EDC and ECRL. Co-activation during reach (defined as the ratio of antagonist to agonist muscle activity) decreased between biceps and triceps, FDS and EDC, and FCU and ECRL suggesting decreased spastic co-contraction and improved motor control. However, neither MAS nor Passive ROM values changed.

Conclusions: The results suggest that CST can change muscle tone during rest and activity. While it is possible that a period of rest could induce similar changes, this is the first time that the effect of CST on muscle activation is reported. Craniosacral therapy may be a noninvasive and effective treatment option

for improving motor control in the presence of spasticity after a stroke and possibly other neurological insults to the brain. Further study is needed to elucidate the mechanisms and efficacy of CST in the treatment of abnormal muscle tone post-stroke.

0457

Sleep Efficiency and Resolution of Post Traumatic Amnesia on a Rehabilitation Unit after Closed Head Injury

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Objectives: Sleep disturbance is common in the subacute recovery phase following brain injury. A previous study from our group found 68% of patients with Closed Head Injury (CHI) had disrupted sleep on a rehabilitation unit. In the present study, we investigated whether improvement in sleep efficiency correlates with duration of post-traumatic amnesia (PTA) after CHI.

Method: 14 CHI patients were enrolled and followed prospectively. Mechanism of injury included motor vehicle accident, fall, and blunt assault. An actigraph was placed on each subject's wrist within 72 hours of admission to the rehabilitation unit and recorded data for the duration of their stay. A minimum of 7 days of continuous actigraphy data was obtained on all subjects. PTA was measured daily using the Orientation Log (O-LOG).

Results: 78% of subjects had mean week-1 sleep efficiency scores of $\leq 63\%$. Patients admitted having already cleared PTA had significantly better week-1 sleep efficiency scores than those with ongoing amnesia ($p = 0.032$). For those patients admitted with ongoing PTA, each 10-unit increase in sleep efficiency score correlated with one unit increase in OLOG score ($p = 0.056$).

Conclusions: Disrupted sleep is common in the post acute stage following CHI. Improved sleep efficiency correlates with resolution of PTA. Decreased sleep efficiency may negatively impact memory return after traumatic brain injury. Actigraphy is uniquely suited to study the sleep patterns of the emerging TBI patient.

0458

Discerning hierarchies in pathological behavior after brain injury; The viability of Kurt Goldstein's ideas on symptom formation.

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Objectives: Working with brain injured soldiers from the First World War, the German neuropsychiatrist Kurt Goldstein (1878–1965) developed original and fertile ideas about symptom formation and personality change after brain damage. Are these ideas integrated in today's practice, and when not, would they be valuable if they were?

Method: Historical and systematic analysis of Goldstein's key concepts and ideas on symptom formation in brain injury patients.

Results: Goldstein's work has been widely praised and certain concepts, like the "catastrophic reaction," have become familiar in the English speaking world, but his unique way of analyzing the behavior of his patients, with reference both to their brain injury and to the environment in which they have to function, has been largely ignored or forgotten.

Goldstein conjectured that the interaction between a damaged brain and the personality of the victim, and between the brain damaged individual and its environment, can lead to a very complex symptomatology, unlikely to be disentangled easily. Instead of accepting all symptoms at their face value, as equivalent expressions of a damaged brain, he started to analyze them and showed that the importance or centrality of a symptom is not always matched by its visibility in the brain injured patient. Core symptoms often disappear from sight, due to compensation strategies or through the overlay of secondary psychological reactions. In analyzing symptoms, we may discover their hierarchy and the history of their formation. Symptoms are answers to questions, according to Goldstein. When a particular symptom sticks out, this often only means that the current situation presents the patient with a particular question, challenge or problem. When the question disappears, the symptom will also disappear. This also means that creating an "adequate environment" for the patient can be a very effective intervention.

Conclusions: Goldstein's ideas about the complexities of symptom formation are largely unknown or ignored today. However, they are still useful and may contribute to a more differentiated and more effective approach to the problems of brain injury patients.

0461

Rehabilitation including treadmill therapy for patients with incomplete locked-in syndrome after stroke; a case series study of motor recovery

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Objectives: Locked-in syndrome (LIS) may be the most disabling condition with preserved consciousness, but motor recovery after rehabilitation has scarcely been examined. The aim of this study was to explore changes in motor function in patients with incomplete LIS referred to rehabilitation.

Method: A prospective, explorative, multiple case study design was applied. A multidisciplinary intervention program was conducted including treadmill therapy (TT) with body weight support. Patients with incomplete LIS, being in a stable medical condition and able to stand upright supported by a standing frame, were consecutively recruited to TT in a time period from 2001–05. Physical performance was recorded on video at the start and end of rehabilitation and TT periods, and treadmill data were registered. From the raw video material, performances of transfer and walking were selected as the focus of observation. Two external observers described the performances independently, using an observational form, and validated the joint and condensed descriptions.

Results: A total of nine patients fulfilled the intervention program and no adverse events were noted. Personal assistance and body weight support were reduced during the TT period, and all patients demonstrated improved physical performance. While five patients were able to practice some kind of walking activity at the end of rehabilitation, four patients demonstrated improvement in body functions, showing better postural control.

Conclusions: This study indicates that TT can be a safe and useful method to intensify the rehabilitation program for patients with incomplete LIS.

0462

Robotic orthosis Lokomat: its use in the rehabilitation of locomotion for neuromotor outcomes of patients with brain injury. Presentation of a pilot study.

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Objectives: Treadmill training for the rehabilitation of locomotion has already been established at many rehabilitation centers in the world. When combined with regular physiotherapy it leads to further improvements in the mobility of spinal cord injured (SCI) and stroke patients.

Method: 8 patients with head injury for less than 6 months, were randomized into 2 groups working for a period of 9 weeks. ABA or BAB, where A = 3 weeks of training with Lokomat, B = 3 weeks of work with conventional physical therapy. The data collected were measured by:

EU-Walking Scale
Rivermead Motor Assessment Scale
Motricity Index
Medical Research Council Scale of Strength
Ashworth Scale of tone

Results: After 4 weeks of therapy, the walking ability of the Lokomat group and the control group expressed as the functional ambulation classification was significantly improved. The functional ambulation category (median ± interquartile range) was at baseline 0 ± 0 in control and 0 ± 1 in the therapy group and increased after therapy to 1 ± 3 in both groups significantly (P = 0.01). There was no significant difference in gain of these parameters between the groups. The Lokomat group had a significantly longer single stance phase (sec; mean ± SEM) on the paretic leg when walking on the floor. At baseline, it was 0.19 ± 0.17 and after therapy 0.49 ± 0.07 (P = 0.014). The control group had increased their body weight approximately 1.33 ± 1.40 kg (mean ± SEM; P = 0.046), mostly as fat mass, whereas the Lokomat group had lost fat mass approximately -2.9 ± 1.0 kg (mean ± SEM; P = 0.016) and increased their muscle mass approximately 3.36 ± 1.4 kg (mean ± SEM; P = 0.031).

Conclusions: This pilot study indicates that Lokomat therapy is a promising intervention for gait rehabilitation. Although there was no difference between groups in gain of functional scores, the Lokomat group showed an advantage of robotic training over conventional physiotherapy in improvement of gait abnormality and body tissue composition.

0463

Internal Structure and Developmental Sensitivity of the Pediatric Version of the ImPACT Neurocognitive Battery for Children with Mild Traumatic Brain Injury

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Objectives: We examined evidence of validity for a developmentally appropriate pediatric version of ImPACT. The battery is a computer-administered neurocognitive battery with 7 subtests and 5 alternate forms that is designed to assess cognitive function in children aged 5 to 12 years with concussions. We first examined the internal structure through factor analysis to identify psychometrically sound composite scores from the individual subtests. Test-retest reliability examined temporal stability of the factor structure, and different factor rotation methods were used to show replicability. We then looked at age and gender trends to evaluate the developmental sensitivity of the Pediatric ImPACT composite scores.

Method: 566 typically developing children without injury (65% male) aged 5 to 12 years ($M=9.5$) completed the test battery. Principle axis factoring with Promax rotation was employed to identify the factor structure of 24 variables measuring performance accuracy, response speed, and variability. Reliability coefficients were calculated to show test-retest stability and Varimax rotation was used to see if factor structures remained stable with different rotation methods. Composite score findings were compared across the age range and between genders using MANOVA.

Results: A three factor structure- Response Speed, Learning and Memory, and Response Variability (using a regression-based ICV) accounted for 49.2% of the total variance. Three composite scores, created using the regression based factor scores (SPSS Version 12) were submitted to MANOVA. Factoring a second administration of the test produced the same internal structure, lending support to its replicability (mean test-retest interval = 0.2 days). A similar factor structure also emerged with alternative rotation methods. Significant main effects were found for age ($p < .05$) for each of the composite scores, with participants responding faster on the Response Speed composite ($\eta = .70$)

and more accurately on the Learning and Memory composite ($\eta = .20$) with increased age. A small ($\eta = .05$) and non-linear relationships was found between age and the Response Variability composite. A small gender effect was found for the Response Speed composite ($\eta = .02$) only, suggesting a minimal role of gender in test performance.

Conclusions: Factor analysis of a new pediatric version of the ImPACT test battery revealed a stable three-factor structure that is defined by Response Speed, Learning and Memory, and Response Variability composite scores. There were strong, linear, developmental improvements for Response Speed and Learning and Memory scores with age, but less consistent age-related change in Response Variability. There were no meaningful gender differences for any of the composite scores. The consistency of factor structure and developmental sensitivity provide two lines of evidence for validity of the Pediatric ImPACT battery.

0464

Parallel Or Serial Processing? A Time Course Study Of Phonological Encoding For Lexical Retrieval In Healthy Younger And Older Adults

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Objectives: The present study was designed to detail the time course of substages within phonological encoding for naming, namely, segment and syllable retrieval, in both healthy younger and older adults. The research questions addressed were: What is the time course for processing of segmental versus syllabic information? Do these substages proceed in parallel or serial fashion?

Method: Sixteen healthy younger adults ($M=28.3$ years, range 23–40) and 16 healthy older adults ($M=73.3$ years, range 68–80) performed two phonological tasks. In task #1, participants were instructed to make a segment decision (final /n/ vs. /r/) about the picture name, e.g. “Go” (i.e. press the button) if the name ended with a /n/ sound and “Nogo” (i.e. don't press the button) if the name ended with a /r/ sound. In task #2, participants were instructed to make a syllable judgment, i.e., whether there were one or two-syllables in the word, regarding the picture name. Electroencephalogram (EEG) data was collected as participants performed the tasks. The Event-Related Potential (ERP)

component, N200, a negative peak at around 200 ms at fronto-central sites reflecting response inhibition, was then selected for analysis.

Results: Both groups showed significant N200s for both tasks but the N200 appears to begin 100 ms later in the older compared to the younger group. Additionally, only the older group demonstrated a significant within-group difference in access of segment vs. syllable information, showing earlier access to segmental information [$F(3, 45) = 4.297$, $p = 0.020$, $\eta^2 = 0.223$]. This does not indicate that the processes are not “parallel” in the sense of being independent, of course. Rather, it seems unlikely that the output of the segmental process feeds in as the input of the prosodic process given the findings with the younger group. Our findings do suggest that aging affected syllabic access more adversely than segmental access.

Conclusions: Findings from this study support the parallel view of processing for the two phonological substages of segment and syllable information in the younger adults. It is probably also parallel in the older adults, although the data showed that syllabic access is affected more by aging than segmental access.

Results of the study also serve as an age-matched control for investigation of phonological naming deficits in the brain-damaged population. Furthermore results can allow for more finely directed studies aimed at therapeutic remediation at the appropriate level of phonological difficulty and for the investigation of post-treatment changes in brain processing of the brain-damaged population.

0465

Devilish spirals: the influence of family dynamics on psychopathology after brain injury. Review and first steps towards guidelines.

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Objectives: The interaction between the symptoms of brain injury patients and the dynamics in their families constitutes a delicate balance. Various factors may destabilize it, with enormous consequences for the quality of life in all persons involved. It is a well known fact that behavioral disturbances after brain injury contribute heavily to the burden of

disease in the family. This may lead to psychiatric disorders in family members, especially depression. Divorce is not uncommon. Moreover, family dynamics may lead to ‘devilish spirals’ in which the interaction between family members fuel the worsening of the behavioral and emotional disorders in the brain injured member. Therefore, pitfalls and strengths of a family should be ascertained in the early phase. Too often medication is used to temper behavioral disorders in the patient, although the real problems are situated on the family level. If family dynamics are not systematically investigated in the early phase and regularly evaluated thereafter, the abovementioned balance is at risk. Relevant interventions on the family level may be overlooked with a possible negative outcome or inadequate interventions.

Method: Pubmed, PsychInfo and reference lists were searched for studies on the combination of brain injury and family. Specific attention was given to the literature about guidelines, protocols or systematic evaluation of (early) family dynamics in brain injury. A comparison was made with all Dutch guidelines for the treatment of main psychiatric disorders with reference to interactions between family and symptoms in the brain injured patient.

Results: Few papers discuss the interaction between family dynamics and behavioural disorders in brain injury patients. There are no guidelines about evaluating or diagnosing risks, pitfalls and strengths of the families dealing with brain injured members. As a result ad hoc treatments are often chosen, with negative effects in the long run. This review is a first effort towards a guideline for systematic evaluation of family dynamics when a member suffers from brain injury.

Conclusions: There is a great need for systematic guidelines for the evaluation of family dynamics and their effect on the behavioural and emotional disorders in brain injured patients.

0466

Long-term functional outcome following moderate to severe traumatic brain injury

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Objectives: Many traumatic brain injury patients sustain long-term physical and cognitive impairments, which have a deep impact on the level of

functioning and quality of life. The aim of this study was to examine the course of functional outcome up to three years following moderate to severe traumatic brain injury and to evaluate the effect of injury severity on the course of functional outcome.

Method: Between 1999 and 2005 the Rotterdam Traumatic Brain Injury (Rotterdam TBI) study, a prospective 3-years-follow-up study in patients who sustained a moderate or severe traumatic brain injury (Glasgow Coma Score between 9–12 or 3–8, respectively) was performed. Functional outcome was measured 3, 6, 12, 18, 24, and 36 months after injury. Outcome measurements of interest on the physical domain were the Barthel Index, Glasgow Outcome Scale, and Functional Independence Measure. On the cognitive domain the Functional Assessment Measure, Neurobehavioural Rating Scale, Disability Rating Scale and the Levels of Cognitive Functioning Scale were used. Quality of life was assessed using the RAND-Medical Outcome Survey Short Form-36. Changes over time were evaluated for each outcome for the total group and in the subgroup of patients with severe traumatic brain injury. Ceiling effects were studied by calculating the percentage of patients reaching the maximum scores on the physical and cognitive health questionnaires.

Results: In total, 113 patients were included in the study, of which 29 patients had moderate and 84 patients had severe traumatic brain injury (82 men, 31 women, age range 16–67 years). Follow-up measurements were completed for 98 patients. In general, all functional outcomes showed the same pattern over time. Mean outcome scores significantly ($p < 0.05$) improved during the first year post injury and stabilized during the second and third year. From 12 to 36 months post-injury, none of the mean outcome scores showed significant improvement over time. The same patterns were found in the subgroup of patients with severe traumatic brain injury. After three years, the maximum score on the physical and cognitive health questionnaires was reached by a substantial part of the total patient group, varying from 9% on the Functional Assessment Measure up to 87% on the Barthel Index.

Conclusions: Mean functional outcomes on physical, cognitive and quality of life domains improve significantly during the first year post-injury in patients with moderate to severe traumatic brain injury. From one to three years post-injury mean functional outcome measures stabilize due to ceiling effects.

0468

fNIRS as a Useful Tool for Cognitive Evaluation Following Traumatic Brain Injury

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Objectives: Behavioral observation and neuropsychological tests have guided the planning of cognitive rehabilitation and the assessment of its effectiveness. However, the information about the actual changes that rehabilitation interventions induce at the brain level is still limited. The availability of this information would, instead, prove useful for a more objective and individualized approach to the evaluation of a treatment efficacy. To this end, the integration of functional neuroimaging in the evaluation of cognitive impairments could offer a more objective monitoring of rehabilitation outcomes.

The aim of this study is to demonstrate the applicability of a portable neuroimaging technology, namely functional near-infrared spectroscopy (fNIRS), to the assessment of working memory after traumatic brain injury (TBI). fNIRS is an optical brain imaging technology that detects changes in the hemodynamic response within the cortex following sensory, motor, or cognitive activation. fNIRS is safe, noninvasive, portable, cost effective and may allow imaging of brain activity in ecologically valid tasks.

Method: Participants included four TBI and ten healthy controls. Neuropsychological evaluation of attention and working memory was based on the WAIS-III Digit Span and WAIS-III Letter-Number Sequencing.

Brain activation measurements were collected through fNIRS during a visual n-back task. It is a sequential letter task in which stimuli are single consonants presented in a pseudo-random sequence on a computer monitor. The stimulus duration was 500ms, with a 2500ms interstimulus interval. The task was parameterized by incrementing the working-memory load from 0 to 4 items. In the 0-back condition, subjects responded to a single prespecified target letter (e.g. "X") by pressing a button. In the 1-back condition, the target was defined as any letter identical to the one immediately preceding. In the other conditions (2-back and 3-back), the targets were defined as any letter identical to the one presented 2 or 3 trials back.

Physiologically irrelevant data and noise were eliminated from fNIRS measurements and the maximum change in oxyhemoglobin and deoxyhemoglobin concentration was obtained for the left and right dorsolateral prefrontal areas.

Results: Based on the performance in the neuropsychological tests, the TBI revealed impaired learning performance as compared to the group of healthy controls.

Evaluation of fNIRS data revealed a pattern in the hemodynamic activity that was significantly different between the healthy controls and the TBI patients in the DLPFC, known to be involved in the working memory processes.

Conclusions: The results obtained in this preliminary study show that fNIRS is a promising neuroimaging tool that can prove to be clinically useful to investigate and identify the neurological underpinnings of cognitive functioning after TBI. In particular, fNIRS offers to neurorehabilitation some unique advantages over other conventional neuroimaging techniques: fNIRS is in fact portable, low-cost, noninvasive and allows a reasonably flexible task design.

0469

Who Goes Where and Why? An Environmental Scan of Rehab Referral, Admission and Discharge of Persons with Brain Injury in Two Canadian Provinces

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Objectives: There is evidence of large international variation in brain injury (BI) rehabilitation programs' content and services offered. The optimal model of care is not yet known. Clinical (e.g. injury severity, recovery potential) and non clinical factors (organizational or social) have been found to influence access and referral patterns. Outcomes of programs may vary depending on the nature and type of BI patients admitted, but little information exists regarding the admission and discharge criteria used by BI rehabilitation facilities in Canada, or whether they are standardized. Exploring these issues could help develop guidelines potentially leading to national standards of care in BI rehabilitation in Canada. The objective of this research was thus to conduct an

environmental scan of major centers in the two most populated Canadian provinces (Quebec and Ontario) to learn more about the organizational structures and processes of BI programs related to admission, discharge and referral criteria.

Method: Publicly available information (2006–2009) on the institutional policies and accreditation procedure/evaluation of 4 urban inpatient rehabilitation facilities were used as the basis of the environmental scan to describe the BI programs and their admission/discharge criteria. In-depth interviews were then conducted with the program managers to complete the scan.

Results: The organisational structures and processes of the BI programs varied in terms of number of beds, waiting times for admission, patient volume and admission criteria. Some facilities have explicit substance abuse and psychiatric restrictions. «Rehabilitation potential» was also not clearly defined for all centers. Some facilities expressed the need for better defined discharge and referral criteria; some programs emphasize safety at home while others use goal attainment to determine discharge disposition. Discharge to long-term care varied from 0 to 20% across programs. All facilities reported that accessibility to outpatient rehab services in remote areas was problematic.

Conclusions: Different admission and discharge criteria appear to be used by the participating inpatient facilities illustrating potentially substantial practice variation. These results thus underscore the importance of obtaining similar information from other facilities across the provinces and in particular from those in remote or rural areas and a need for best practice guidelines. This type of information should be used when developing large multicenter research projects aimed to improve clinical practice for this patient population.

0470

Applicability of fNIRS to the TBI Population: Demonstration on an Attention Task

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Objectives: A commonly observed consequence of traumatic brain injury (TBI) is cognitive impairment, whose assessment represents a considerable challenge. Additionally, the choice of a successful treatment among the many existing neurorehabilitation strategies still relies on behavioral observation, and little information is available about the physiological changes produced at the brain level by the specific intervention.

The integration of neuroimaging and electrophysiological measures may be more objective and effective in the evaluation of cognitive impairments. This study evaluates the applicability of functional near-infrared spectroscopy (fNIRS) for assessment of TBI-induced impairments of attention. fNIRS is an optical neuroimaging technology that detects changes in the hemodynamic response within the cortex. fNIRS is safe, cost effective and portable, allowing easy deployment in any clinical or real world setting.

Method: Participants included five male TBI patients between 18 and 37 years old.

A continuous wave fNIRS system monitored the hemodynamic activity of the prefrontal cortex using a 16-channel sensor. Brain activation measures were collected during a target categorization task, where the subjects were asked to respond at the occurrence of an infrequent target. The stimuli were strings of letters (“XXXXX” for the target and “OOOOO” for the nontarget); a minimum of 12 context stimuli was required between two successive targets, in order to allow for the hemodynamic response to evolve.

Event-related responses were obtained the fNIRS measures.

Results: The pattern of the hemodynamic response elicited by the two classes was in agreement with previous studies that investigated the applicability of fNIRS to the study of attention-related tasks. The changes in the concentration of oxyhemoglobin and deoxyhemoglobin differ between target-locked and nontarget-locked responses: target stimuli elicited in fact a more marked activation in the areas of the prefrontal cortex monitored by fNIRS.

Conclusions: This pilot study suggests the potential for fNIRS to be applied to the monitoring of attention in the TBI population. As a continuation of this ongoing study, we will include a pool of healthy controls: this would enable a direct comparison between the hemodynamic responses recorded in the two groups in order to study the relation between an fNIRS-based objective measure of brain activation and cognitive impairments using a portable, low-cost and flexible neuroimaging modality.

0471

Return to Consciousness Following the Treatment of Posttraumatic Hydrocephalus: A Case Report

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Objectives: Posttraumatic hydrocephalus (PTH) is an elusive complication of traumatic brain injury (TBI) and a significant barrier in recovery of consciousness. This case report details a 25-year-old veteran with a severe TBI in a stable minimally conscious state (MCS) three months after injury. Upon admission to the Emerging Consciousness Program at a Veterans Affairs Polytrauma Rehabilitation Center, ventriculomegaly was noted on head CT. After screening and definitive treatment for PTH, he emerged from MCS to a conscious state based upon objective scales. To our knowledge, there are no reports in the literature highlighting quantifiable emergence from MCS after treatment of PTH.

This case report will highlight the importance of recognizing PTH as a barrier to emerging consciousness and recovery from TBI. It will also focus on the importance of using validated, quantifiable scales to track recovery and response to interventions. It will demonstrate the use of these objective scales to detect and document what can be subtle clinical changes that aide in the diagnosis of PTH and the formulation of treatment plans.

Method: Case report.

Results: Three months post severe closed head injury, the patient was admitted to a specialized program to support recovery of consciousness. Prior to admission, his recovery had plateaued with reliable arousal but little evidence of environmental awareness. Upon admission, ventriculomegaly was noted on head CT and a diagnosis of PTH was presumed. Coma Recovery Scale-Revised (CRS-R) subscales were stable prior to the intervention for PTH. Intervention was a high volume CSF tap (HVT) and subsequent ventriculoperitoneal shunt placement (VPS). Scores on both the Coma Recovery Scale-Revised and Coma/Near Coma scale showed marked improvements from baseline after HVT and VPS. Specifically the Motor Function Scale on the CRS-R went from 4 (indicating MCS) to 6 post intervention indicating emergence from MCS. Other CRS-R subscores captured similar improvements. The Coma/Near Coma Scale score improved from 2.27 (moderate coma) to 0.8 (no coma) from baseline to post intervention. Clinically, the patient

progressed from MCS to a conscious state with stable command following, response to simple yes/no questions with a head nod or hand gesture, and intelligible and contextually appropriate speech.

Conclusions: PTH is an important barrier to return to consciousness (RTC) following severe TBI. To our knowledge, this is the first reported case of RTC following diagnosis and successful treatment of PTH. This case suggests that an unknown percentage of MCS may be modifiable by timely and appropriate medical treatment of PTH.

0472

Computerized Assessment of Oculomotor Dysfunction in Persons with MTBI

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Objectives: The incidence of traumatic brain injury is 1.5 million per year with 80% categorized as mild traumatic brain injury (mTBI). Rehabilitation strategies are challenging due to the complex presentation of symptoms including oculomotor dysfunction in persons with mTBI. This project proposes the development of a standardized computer assessment of oculomotor function using a combination of metrics describing saccades, smooth pursuit and dynamic visual acuity.

Method: A total of 85 participants including persons with ($n=14$) and without mTBI ($n=71$) were recruited from the Texas State and the surrounding community. Participants completed a medical history questionnaire including symptoms and quality of life such as hours of sleep, emotional status, alcohol consumption, dizziness, imbalance and visual symptoms. Assessment of oculomotor function included measurements of smooth pursuit, saccades, and dynamic visual acuity. Assessments of fixation, saccades and smooth pursuit were recorded using the Tobii x120[®] eye-tracker (Stockholm, Sweden) which uses 2-dimensional measurements at a sampling rate of 120Hz, accuracy of $\pm 0.5^\circ$, spatial resolution $\pm 0.2^\circ$, and drift $\pm 0.3^\circ$. Dynamic visual acuity was documented with the InVision[®] (NeuroCom International, Inc) which is a 3-dimensional, computerized recording system.

Results: Variables of interest were fixation error (FE), smooth pursuit error (SPE), saccadic error (SCE), and dynamic visual acuity error for horizontal and vertical head movements (DVA-h, DVA-v) including questionnaire scores. Data analysis was conducted using SPSS (vs. 17) for descriptive statistics including

Standardized T-Tests to explore group differences. A Spearman-Brown Coefficient of Reliability was calculated using a hypothesized mean of zero to explore reliability of error scores. Alpha level will be 0.05. Preliminary results indicate that saccade latencies vary around mean values of 219 (± 31)ms with longer delays associated with mild neural impairments. In addition, aspects of oculomotor dysmetria have been apparent including aspects of overshoot or undershoot varying with a mean magnitude of overshoot of 1.3° ($\pm 0.8^\circ$) and undershoot of 1.5° (± 0.9). Also of interest are findings that dynamic visual acuity for horizontal (DVA-h) and vertical (DVA-v) head movements continued as significant deficits in persons after mTBI compared to age-matched healthy participants even up to two years post injury. Impaired mean DVA-h error values were 2.09 (± 1.22) compared to 1.50 (± 1.18) lines in the healthy group while mean DVA-v values were 1.80 (± 1.03) compared to 1.73 (± 0.90) lines respectively. **Conclusions:** Preliminary results in our lab suggest that oculomotor function can be measured with high accuracy as a valuable, standardized clinical assessment of oculomotor behavior during recovery from mTBI. In addition, our work agrees with other well-known labs (Leigh & Zee 2006) indicating that deficits in oculomotor responses can be used as sensitive indicators of impairments even with mild neurological disorders. Existing data results will support future training protocols to augment rehabilitation strategies for persons with mTBI during recovery post injury.

0473

Creative-arts therapy as a social and community integration tool for youth with acquired brain injuries: "I want to thrive, not just survive!"

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Objectives: Acquired brain injury (ABI) during adolescence presents even greater challenges to youth already facing complex issues in this transitory period. Studies have demonstrated that youth with

ABI suffer from social and community withdrawal as a result of their injuries. However, there is a lack of research focusing on interventions designed to promote social and community integration for these youth. One strategy could be the use of creative-arts based therapies, as art forms that are close to reality, or an 'imitation of life', such as theatre, have been shown to enhance group collaboration, personal reflection and self-awareness. Thus, the objective of current study was to collect pilot data regarding the effectiveness of a theatre skills training program in helping to improve social and community integration skills for youth with ABI, as these therapies have been shown to be useful for individuals with similar cognitive and behavioural issues.

Method: Five adolescents between the ages of 13–17 with an ABI and identified social communication problems took part in a camp experience over two stages of pilot testing. The theatre skills training program was facilitated by theatre artists and occupational therapists and included activities such as mask work, character development, painting, sculpting, and story-telling, among others. Three separate focus groups were held with participants, caregivers and therapists/theatre facilitators after their participation in the program during both stages of testing for a combined total of six focus groups. Specific questions were designed to allow participants to provide feedback regarding the program's feasibility, usability and acceptability for youth recovering from ABI. Suggestions for improvements and thoughts regarding its therapeutic potential were also collected. Focus groups were tape recorded and then transcribed verbatim and supplemented with field notes. The data was coded descriptively, categorized and analyzed for key themes.

Results: From stage one focus groups, four main themes emerged: (1) Increasing self-esteem and self-efficacy through the creative process; (2) Abstract versus concrete thought and the use of imagination as a skill; (3) The creative environment and its effect on the participants; (4) Increased social skills and emotional awareness. During stage two, thematic analysis revealed: (1) Specific activities and characteristics of the program enjoyed by the participants; (2) Specific activities and characteristics not enjoyed by participants; (3) Outcomes of the camp; (4) Changes in perceptions of self; (5) Suggestions for improvements; (6) Routines and repetition used as strategies.

Conclusions: Results suggest that a combination of directed group activities and self-reflection within a creative learning context may improve social cognitive and community integration skills for youth with ABI. The skills and knowledge gained by these youth

will also be more adaptable to real life situations, as the program allows the youth to form peer groups within the therapy to practice new skills.

0474

The Relationship between Physical and Cognitive Fatigue in Pediatric Mild Traumatic Brain Injury

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Objectives: Research with children following concussion has suggested a range of post-injury somatic, cognitive, emotional, and sleep symptoms. Studies indicate that fatigue is one of the most common symptoms in pediatric mTBI, and may relate to factors associated with the post-injury neurometabolic cascade. This study investigates how over time recovery from physical symptoms, in particular fatigue, relates to a change in cognitive symptoms in a group of concussed children ages 5 to 12.

Method: Participants: Participants were 39 children (69.2% male) ages 5 to 12 years ($M=10.21$, $SD=2.0$) diagnosed with mTBI, followed in an outpatient clinic. Patients were seen serially with 89.7% followed over two visits, and 53.9% of patients seen for a third visit. Median time interval from the day of concussion to the day of visit was 7.4 days for Visit 1; 14.4 days for Visit 2; and 30.4 days for Visit 3.

Measures: The patients and their parents completed the Post-Concussion Symptom Inventory (PCSI) and the Pediatric Quality of Life Multidimensional Fatigue Scale Acute Version (PEDS-QL) during each serial visit. These instruments are designed to measure post-concussive symptoms in pediatric mTBI. To assess fatigue, we created two different scales (physical and cognitive fatigue) derived by joint factor analysis of PCSI and PEDS-QL instruments, with self-report and parent versions.

Results: Child self-report revealed strong correlations between physical and cognitive symptoms for baseline ($r=.835$; $p=.000$), first ($r=.806$ $p=.000$), and second visit ($r=.886$ $p=.000$), while this relationship was weaker for the third visit ($r=.475$; $p=.119$). Parental report indicated statistically significant correlations between physical and cognitive fatigue for all visits (Baseline $r=.877$, $p=.000$; Visit 1: $r=.806$, $p=.000$; Visit 2: $r=.817$, $p=.000$; Visit 3: $r=.872$, $p=.000$). The strength of the

correlations was not affected when controlling for gender differences and baseline fatigue levels. The trend of fatigue was examined with mean fatigue ratings of the first and second visits higher than baseline levels, with a reduction at the third visit. The repeated measures analyses did not reach statistical significance with the small sample size and variability of the sample likely reducing statistical power. Parent and self report of fatigue was highly correlated across visits and type of fatigue (e.g. baseline correlation of child and parent physical fatigue were $r = .834$; cognitive fatigue correlations were $r = .654$).

Conclusions: Physical and cognitive fatigue in this sample of children with mTBI were highly correlated with improvement noted over time, suggesting a common underlying neurophysiological mechanism. Parents and children shared similar views of these two types of fatigue. The differential role of each fatigue type across recovery remains to be understood. Further studies will investigate the relationship between cognitive/physical fatigue on neuropsychological outcome/recovery.

0475

Neurotherapy for TBI: A CAM Intervention

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Objectives: There is a critical need to develop more effective treatments to reduce the morbidity associated with persistently bothersome symptoms following traumatic brain injury (TBI). Recent developments within the bio-energy domain of complementary and alternative medicine (CAM) utilizing EEG information have suggested some promise for application to TBI. A novel approach known as the Flexyx Neurotherapy System (FNS) that involves minute pulses of electromagnetic (EM) energy to stimulate changes in brainwave patterns has been adapted for this purpose. The present study reports on a series of patients seen in a clinical practice who underwent this intervention as an initial step in documenting the potential promise of this approach.

Method: Subjective symptom self-report data were collected on 35 patients with a history of TBI (range of number of head injuries: 1–15; mdn 3; 18 with LOC) seen at the Neurotherapy Center of Washington, Bethesda, MD, for FNS treatment.

Prior to any treatment, patients prioritized their most bothersome symptoms. At the beginning of each treatment session they rated each symptom on a 0–10 VAS with appropriate anchors. Symptoms were categorized as those involving prominent attention (concentration/focusing) problems, other cognitive (e.g., fogginess, memory) problems, difficulty following conversations, fatigue, headache, anger (including irritability, rage, explosiveness), anxiety, mood swings (including depression), motivation problems (e.g., difficulty finishing tasks, inertia, procrastination), and sleep disturbance. Number of treatment sessions ranged from 3–38 (mdn = 20).

Results: Curve estimation regression analyses indicated linear trends in evidence for significant decreases in all bothersome symptom ratings over the course of treatment sessions, including attention ($\beta = -.13$; $R^2 = 0.14$, $F[1,227] = 37.31$, $P < .001$), other cognitive problems ($\beta = -.17$; $R^2 = 0.24$, $F[1,333] = 104.46$, $P = .001$), difficulty following conversations ($\beta = -.07$, $R^2 = .07$, $F[1,107]$, $P = .005$), fatigue ($\beta = -.13$; $R^2 = 0.16$, $F[1,296] = 57.49$, $P < .001$), headache ($\beta = -.21$; $R^2 = .24$, $F[1,100] = 31.66$, $P < .001$), anger ($\beta = -.24$; $R^2 = .47$, $F[1,177] = 160.20$, $P < .001$), anxiety ($\beta = -.20$; $R^2 = .22$, $F[1,387] = 107.12$, $P < .001$), mood swings ($\beta = -.05$; $R^2 = .02$, $F[1,237] = 4.69$, $P = .03$), motivation problems ($\beta = -.10$; $R^2 = .06$, $F[1,228] = 14.94$, $P < .001$), and sleep disturbance ($\beta = -.12$; $R^2 = .08$, $F[1,264] = 8.41$, $P = .005$). Reported side effects were minimal.

Conclusions: Neurotherapy involving minute pulses of EM stimulation appears to be potentially efficacious for reduction of persistent, bothersome symptoms associated with TBI. While this report on a series of patients in a clinical practice has ecological validity for the everyday treatment setting, a randomized controlled trial incorporating a sham condition is warranted to provide a more rigorous test of this intervention.

0476

Life Expectancy after TBI and Recommendations for Living a Healthy Life

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Objectives: This presentation will present data regarding a study of life expectancy after traumatic brain injury, including risk factors and recommendations for living a healthy lifestyle. At the end of this presentation, attendees will be knowledgeable about

life expectancy after TBI and the factors contributing to early death, as well as strategies for improving lifestyle habits after TBI.

Method: Craig Hospital and the Colorado Department of Health and Environment recently completed a study, funded by the Colorado Traumatic Brain Injury Trust Fund Research Program, to determine life expectancy, and risk factors and causes of death following TBI. This study used Colorado death information, and data from the Colorado TBI Surveillance System which includes residents with TBI discharged alive from acute hospitals between 1998 and 2003.

Results: Individuals with TBI in Colorado were found to carry 2.5 times the risk of death compared to those in the general population of similar age, gender and race, with life expectancy reduced by an average of 6 years. Specific risk factors, such as greater severity of TBI and poor general health, pose an especially high threat to survival and indicate a need for increased vigilance of health status, especially among younger individuals.

Conclusions: Individuals are at an increased risk of death following TBI, and die of some causes at a greater rate than in the general population. Risk factors are identifiable and can be amenable to prevention, resulting in reduced deaths after TBI. Recommendations will be given regarding what individuals with TBI can do socially, physically and environmentally to live longer, healthier lives. Resources for health and wellness will be shared and a brochure regarding the data and recommendations will be distributed.

0477

Brain Injury Coping Skills Group: An Intervention Aimed at Preventing Emotional Distress and Improving Self-Efficacy in Individuals with Brain Injury and Their Caregivers

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Objectives: To determine if training in coping strategies improves psychological functioning and self-efficacy (SE) in survivors of brain injury (BI) and caregivers.

Method: Twenty survivors and 20 respective caregivers were recruited from an acute rehabilitation

facility. The study design included randomization of participants to either the treatment or wait-list controlled (WC) group. Treatment consisted of the Brain Injury Coping Skills Group (BICS), a 12-session, manualized, group cognitive-behavioral treatment (CBT) providing psychoeducation, support, and coping skills training. Assessments were made at baseline, post-intervention, and 3-month follow-up. Primary outcome measures included the Brief Symptom Inventory - 18 (BSI-18) and the Brain Injury Coping Skills Questionnaire (BICSQ).

Results: Repeated measures analysis of variance of pre-post treatment data revealed a significant time-by-treatment interaction for self-efficacy ($F = 17.46$, $p < .001$) with greater improvement in the BICS group. BSI-18 variables improved over time but not differentially between treatment conditions. However, BSI-18 global distress increased in the WC group ($t = -2.52$, $p, .03$) from post-intervention to 3-month follow-up but not in the BICS group. SE assessed post-treatment predicted global distress at 3-month follow-up across groups ($r = -.43$, $p = .01$). Ninety-nine percent stated that they would recommend the group to others. There was a 0% attrition rate in the BICS group.

Conclusions: Few CBT studies have included both survivors of BI and caregivers in group treatment, and no studies have examined the role of SE. Prior intervention studies show inconsistent effects on emotional functioning, raising questions regarding the role of moderating variables. Results showed that participation in BICS leads to significantly better SE compared to a WC group, and that SE post-treatment predicts level of distress 3 months later. This study offers a new conceptualization that SE may mediate longer-term emotional adjustment after brain injury. Results indicate that SE is an important and modifiable factor in helping individuals better adjust to BI.

0478

Biomechanical Analysis of Blast Induced Brain Injury – Finite Element Modeling of Blast Effect on Mechanical Response of the Human Head

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Objectives: Traumatic brain injury (TBI) is a signature injury of the recent wars, affecting a majority of the military casualties. The measurements of wave propagation patterns within an in vivo

brain continue to be a significant challenge. Up to now, the interaction of the blast wave with the head and the mechanical pathway leading to pathophysiological consequences has not been demonstrated in the human head. Previously an anatomically inspired human head finite element (FE) model was successfully utilized to quantify the internal mechanical parameters and correlated to the pathophysiological manifestations of TBI in blunt impact. We hypothesized that primary blast TBI is directly induced by pressure differentials across the skull/fluid/soft tissue interfaces and is further reinforced by the reflected stress waves, leading to stress concentrations in certain regions of the brain. The objectives are to characterize the blast interaction with the head and resulting responses of the brain and to compare the effect of head orientation with respect to the wave direction in free-field, surface blast and with various surrounds.

Method: A hybrid multi-material Lagrangian-Eulerian approach was used to simulate the explosion, wave propagation and the coupling of the blast overpressure wave to the FE head model. The FE human head consisted of various anatomical structures with material properties based on previously published data. The expansion of the TNT was described using Jones-Wilkins-Lee equation of state. Peak incident overpressure of 1.4MPa based on Bowen's curve for non-lethal injury was produced by 1kg TNT at a standoff distance of 0.8m. Four conditions were modeled to simulate the subject standing, lying on the ground and against a wall when receiving the blast from air and surface burst. 5 and 10kg of TNT with same incident overpressure were simulated to compare the effect of varying impulses (170, 199Pa-s) on resulting brain response.

Results: The blast overpressure propagated through the scalp, skull and across the brain at various magnitudes with brain pressures ranging from 4.2–6.4MPa in all four cases. The brain pressure was amplified by 38% due to reflected pressure in case of the subject lying on the ground. By changing ground properties from soft soil to concrete, the peak pressure was increased further by 6%. Increased pressure impulse by a factor of 1.1–1.3 exerted increases in brain pressure, head excursion, velocity and acceleration by as high as a factor of 1.8–3.9.

Conclusions: A hybrid Lagrangian-Eulerian approach provided a useful tool to understand mechanical processes involved in blast injury. The surrounds were of importance in effecting the injury likelihood to blast. Impulse of incident pressure played an important role on brain pressure response as well as the head kinematics. The computer model can assist in determining the dose-effect relationships describing the tissue damage effect operant in blast injury.

0479

Mild Traumatic Brain Injury Moderates Executive Attention in U.S. Army Soldiers with Post-Traumatic Stress Disorder

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Objectives: Evidence indicates that a significant percent of soldiers that suffer mTBI have a greater risk of co-morbid diagnosis of PTSD (Hoge, McGurk, Thomas, Cox, Engel, & Castro, 2008; Tanielian & Jaycox, 2008). This co-morbidity in our military population highlights the importance of identifying measures that are sensitive to the disparate pathophysiology associated with mTBI and PTSD.

Impaired attention is the most sensitive and reliable neurobehavioral index of mTBI (Kraus, Susmaras, Caughlin, Walker, Sweeney, & Little, 2007). While some studies provide evidence that attention is impaired in individuals with PTSD (Vasterling, Duke, Brailey, Constans, Allain, & Sutker, 2002), others have not (Danckwerts & Leathem, 2003).

The aim of the current study was to explore functioning of attentional and affective processes in individuals with PTSD as well as assess the additive effects of co-morbid mTBI on these functions. The Attention Network Task (ANT; Fan, Wu, Fossella, & Posner, 2001), Iowa Gambling Task (IGT; Bechara, Tranel & Damasio, 2000), and Balloon Analogue Risk Task (BART; Maner, Richey, Cromer, Mallott, Lejuez, Joiner & Schmidt, 2006) were chosen based on prior research suggesting that the neural substrates involved in performance on these tasks overlap with the regions of interest implicated in PTSD (Rauch, Shin, & Phelps, 2006), namely the ventromedial prefrontal cortex (VMPFC) and anterior cingulate cortex (ACC). A Backwards Digit Span was used to assess working memory functioning. In addition to neuropsychological testing, the Beck Depression Inventory (BDI), Beck Anxiety Inventory (BAI), and PTSD Checklist-Military Version (PCL-M) were administered.

Method: Active duty U.S. Army Soldiers (N = 35) were recruited via flyer/poster at various medical facilities and referrals from medical providers at these locations at Fort Bliss, TX. Eligible volunteers were placed in to one of three groups; Controls vs. PTSD vs. PTSD with mTBI.

Results: Group differences in these attention indices were analyzed using separate one-way ANOVAs. The results revealed there was no significant group differences in Alerting, $p=.104$, and Orienting, $p=.127$, attention networks. In contrast, the response time index for Executive Attention was significant, $p=.051$, suggesting the PTSD group had more difficulty in resolving conflict. When data from the PTSD and co-morbid mTBI cases were analyzed as a separate group ($n=6$), this effect size increased when compared to controls ($p=.037$), but not between controls vs. PTSD group ($n=11$) or the PTSD group vs. PTSD/mTBI group (see Figure 1). Scores in working memory were significantly poorer for target groups compared to controls ($p<.05$), irrespective of string length.

Hierarchical regression model revealed that anxiety scores significantly contributed to the variance in Executive Attention network scores (.37), whereas depression was the only variable that accounted for some of the variance in working memory performance (.25).

Separate ANOVA and simple t-tests revealed there were no statistical group differences in the number of advantageous choices across blocks or overall on the IGT or on the BART.

Conclusions: The results from this study reveal that Soldiers with PTSD do not have significant attentional impairments unless suffering from a co-morbid mTBI when compared to healthy controls. In co-morbid cases, our findings show that individuals have difficulty with resolving conflict as indicated by the Executive Attention network index of the ANT, but not on emotion based tasks. Working memory was impaired in PTSD and co-morbid groups, which appears to be mediated by depressive symptoms.

The Executive Attention network has been associated with functioning of the ACC (Fan et al., 2005). In light of this, our finding of compromised executive control of attention in individuals with PTSD supports the imaging evidence that implicates dysregulation of the ACC in this psychiatric condition. Furthermore, the positive relationship between symptom severity (i.e., anxiety) and Executive Attention might suggest that neurobiological changes may be exacerbated by co-morbid symptomatology.

In conclusion, affective symptoms in individuals with a mTBI appear to contribute to compromised executive control of attention, which suggests dysregulation of specific neurobiological underpinnings implicated in resolving conflict. Furthermore, efficacy of this network is influenced by the severity of anxiety symptomatology.

0480

Knowledge Translation in Acquired Brain Injury Rehabilitation; The Cognitive-communication Intervention Review Framework

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Objectives: As evidence builds in the field of acquired brain injury rehabilitation, the potential exists for this to translate to improved outcomes and quality of life. Unless this knowledge is disseminated and implemented, these benefits will not be realized. Translating the evidence for cognitive-communication interventions proves to be complex, due to vast inconsistencies in reporting on the wide array of cognitive-communication conditions, interventions and communication outcomes. Thus, the objectives are to 1. Systematically analyze the full scope of cognitive-communication interventions following ABI, based on the current definition and theoretical framework of cognitive-communication disorders, and to 2. Develop a model for the consolidation of existing evidence for cognitive-communication interventions for the purpose of translation to clinical practice, and to guide future research directions.

Method: Twenty systematic reviews on topics of communication and cognition interventions were analyzed by two expert reviewers, to reveal a limited number of key search terms and lack of consistency in terminology. Key terms were then identified based on the conceptual framework and definition of cognitive-communication disorders; Difficulty with any aspect of communication that is affected by disruptions of cognition, where communication includes listening, speaking, gesturing, reading, and writing in all domains of language (phonologic, morphologic, syntactic, semantic, pragmatic), and cognition includes processes and systems (e.g., attention, memory, organization, executive functions).

Areas of function affected by impairments in cognitive-communication include behavioral self-regulation, social interaction, activities of daily living, learning, academic and vocational performance. Following this, the Cognitive-communication Intervention Review Framework was developed to provide consistency for consolidation and translation of evidence, as a model for future evidence based reviews, and to guide future research directions based on identified gaps in the evidence.

Results: The Cognitive-communication Intervention Review Framework delineates eleven categories

across three target areas for cognitive-communication interventions and forty-four key search terms. These include; A. Communication Interventions: 1. Social communication, 2. Verbal expression, 3. Auditory or listening comprehension, 4. Reading comprehension and 5. Written expression. B. Cognitive Interventions to Improve Communication: 6. Attention, 7. Memory, 8. Organization, reasoning and problem solving, executive functions/ metacognition & self-regulation. C. Communication Interventions at the Level of Participation: 9. Community and family communications, 10. Academic and school supports and 11. Vocational communication

Conclusions: The Cognitive-communication Intervention Review Framework provides a model for knowledge translation and transfer, consolidating the evidence for cognitive-communication interventions in a manner that lends itself to the comparison and application of evidence across time. Improved consistency in the analysis and consolidation of evidence using a systematic approach such as the Cognitive-Communication Review Framework, will inform clinical practice, allow for longitudinal comparisons, guide future research directions, and ultimately improve speech-language pathology services and communication outcomes for individuals with acquired brain injury.

0481

Chronic Post-traumatic Headache Resolution after Ventriculoperitoneal Shunt Placement: A Case Report

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Objectives: Introduction

Decompressive craniectomy is an effective treatment for uncontrolled intracranial hypertension due to severe traumatic brain injury (Toussaint & Origitano 2008). However, late complications after this procedure can include post-traumatic hydrocephalus (PTH), particularly when there is also a history of traumatic subarachnoid hemorrhage (SAH), and cerebellar herniation through a craniectomy defect. This case report will summarize the recovery of a 36 y/o Army Staff Sergeant who suffered a severe penetrating traumatic brain injury (TBI) while on active duty in Operation Iraqi Freedom. He was hit by shrapnel from an improvised explosive device while working as a turret gunner in a Humvee.

Injuries included obliteration of the right occipital lobe, subdural hemorrhage (SDH), SAH, intraventricular hemorrhage (IVH), retained foreign body, and cortical blindness. He underwent emergent right occipital and posterior fossa craniectomy with intracranial hemorrhage and lateral IVH evacuation. He was stabilized and underwent extensive rehabilitation at the inpatient Polytrauma Rehabilitation Center. He functionally recovered well in spite of significant residual visual impairment. He had a cranioplasty 5 months after injury and serial brain imaging showed right occipital encephalomalacia and stable right cerebellar herniation through his residual craniectomy skull defect. He was followed in the outpatient setting by PM&R and Neurosurgery for nearly two years for severe persistent daily headaches (HAs) and gradual cognitive decline.

Objectives

This case report discusses the importance of recognizing late complications of decompressive craniectomies that can lead to significant declines in function and quality of life.

Method: Case Report

Results: Ambulatory EEG demonstrated epileptiform activity; Topamax was started without improvement in either headaches or cognition. CT scan did not show significant ventriculomegaly but did show persistent cerebellar herniation at the posterior skull base under the craniectomy repair. Patient was admitted for a diagnostic high volume spinal tap and experienced temporary resolution of HAs for a four-day period. A ventriculo-peritoneal (VP) shunt was placed, following which the patient had complete resolution of his headaches and experienced significant improvement in cognition.

Conclusions: The incidence of post-traumatic hydrocephalus (PTH) varies widely. A higher incidence of PTH is associated with increased length of coma, increased age, decompressive craniectomy (DC), and SAH (Mazzini et al., 2003). This patient had DC, traumatic SAH, and head CTs that showed persistent cerebellar herniation through the residual craniectomy defect. It is possible that the cranioplasty may have altered the pattern of CSF flow at this level leading to late development of PTH. When persisting refractory posttraumatic headaches occur in a patient with this history, one should suspect PTH, particularly since this condition can respond to treatment with a VP shunt.

0482

Social in Conversations of Adults with Traumatic Brain Injury

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Objectives: Traumatic brain injury (TBI) often results in lasting cognitive and communication problems, as well as secondary social deficits. There is growing evidence that challenges in these areas are manifested in the conversations of individuals with TBI (Bond & Godfrey, 1997; Coelho, 2007; Snow, 2000). It is imperative to better understand these breakdowns in communication and their sources, to create evidence-based treatment protocols. One requisite skill for successful conversation and thus a potential place for breakdown is in the ability to modify language use with changes in the conversational context. This study examined one aspect of language use in context – the use of mental state terms – in conversations between adults with TBI and familiar partners of their choosing. Mental state terms have been used to examine social cognition in conversations of adolescents with TBI (Stronach & Turkstra, 2008), to explore the effects of social cognitive impairments on interpersonal interactions. Conversational context was manipulated in this study by introducing conversation starters that were designed to induce differing levels of self-disclosure or intimacy, with the expectation that mental state term use would increase when participants talked about more intimate topics.

Method: Five men in the chronic stage of TBI and five age- and sex-matched controls participated in this study, along with a male conversational partner chosen by each participant as a frequent communication partner. Each dyad engaged in 3 video-recorded, semi-structured conversations. Dyads were given lists of conversational starter questions adapted from the Relationship Closeness Induction Task (Sedikides, 1999) to help guide conversation and to induce differing levels of topic intimacy. All conversations were transcribed orthographically and analyzed for standard language measure using the Systematic Analysis of Language Transcripts software (SALT; Miller & Chapman, 1994–2004). Conversations were then analyzed for mental state terms, and an index of the number of mental state terms per utterance was calculated. Mental state terms were also classified into three categories: cognitive state terms, emotion state terms, and desire state terms. Changes in the proportion of each type of mental state term across conversational levels were also analyzed.

Results: Adults with TBI used more mental state terms in more intimate conversations, however they did not increase their mental state term use to the same extent as matched peers. Adults with TBI also

used a significantly different pattern of mental state term types across intimacy levels as compared to participants in the control group.

Conclusions: These results suggest that individuals with TBI were able to perceive changes in conversational context; however, they adjusted their mental state term use both quantitatively and qualitatively differently than age-matched peers.

0484

Health-related quality of life (QOL) of individuals with Traumatic Brain Injury in Barranquilla, Colombia.

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Objectives: To assess health-related quality of life (QOL) of individuals with Traumatic Brain Injury (TBI) in Barranquilla, Colombia.

Method: 31 Colombians with TBI and 61 controls completed the SF-36, a self-report measure composed of eight component areas: physical health problems, pain, role limitations due to physical problems or due to emotional problems, emotional well-being, social functioning, energy/fatigue, and general health perceptions.

Results: The samples were similar with respect to age, gender, and education. Compared to healthy controls, individuals with TBI had lower means on all SF-36 sub-scales. Significant differences were found on role limitations due to physical problems (82.79 vs. 49.19; $p < 0.001$), role limitations due to emotional problems (79.24 vs. 46.24; $p < 0.001$), social functioning (81.35 vs. 70.16; $p < 0.05$), pain (80.53 vs. 66.94; $p < 0.01$), and general health (78.03 vs. 69.84; $p < 0.05$).

Conclusions: Individuals with TBI living in Barranquilla Colombia report having poorer quality of life across various domains, including role limitations and social functioning. These findings suggest the need for rehabilitation health professionals to develop and implement culturally-appropriate interventions to improve quality of life in Colombian individuals with TBI.

0485

A New Model of Traumatic Axonal Injury: Studying the Effects of Strain and Displacement Rates

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Objectives: Traumatic brain injury (TBI) continues to be a major health problem, with over 500,000 cases per year with a societal cost of approximately \$85 billion in the US. In many cases of TBI widespread disruption of the axons occurs through a process known as diffuse axonal injury (DAI) or traumatic axonal injury (TAI). In the current study, an in vivo TAI model was developed using spinal nerve roots of adult rats. This model was used to determine functional and structural responses of axons to various strains and displacement rates.

Method: Seventy-two L5 dorsal nerve roots from male Sprague-Dawley rats were each subjected to a predetermined strain (<10%, 10–20%, and >20%) and rate (0.01mm/sec, 1mm/sec, or 15mm/sec). Neurophysiologic recordings were performed before and after stretch to determine changes in conduction velocity (CV), amplitude, and the area of the compound action potential (CAP). Morphological injury as evident by primary and secondary axotomy as well as impaired axoplasmic transport (IAT) was determined using the Palmgren silver impregnation technique and bAPP immunostaining, respectively.

Results: Results showed that CV, amplitude, and area of the CAP decreased as strain and displacement rate increased. Further, high strains led to a complete conduction block that appeared to be rate dependent. Strains of 16%, 10%, and 9%, at 0.01mm/sec, 1mm/sec, and 15mm/sec, respectively, led to 50% probability of complete conduction block in the nerve roots. Results from histological assessment indicate an increase in periaxonal spacing (secondary axotomy) and torn fibers (primary axotomy), as well as impaired IAT, with increasing strain and rate.

Conclusions: Overall, the results from the current study indicate that (1) functional axonal injuries as evidenced by changes in the CV, amplitude, and area of the CAP are strain- and rate-dependent; (2) high strains at low rates caused complete conduction block in the roots, while a similar block was observed at lower strains at the high rate; (3) the extent of IAT and primary and secondary axotomy occurred concomitant with functional injury and were strain- and rate-dependent. The proposed in vivo nerve root

stretch model serves as a good model for axonal injury and the results obtained from the current study could be used towards understanding of traumatic axonal injury mechanisms.

0486

Bromocriptine for treatment of central dysautonomia

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Objectives: A case report of a 16 yo boy with central dysautonomia (also known as sympathetic storming, or hypothalamic-midbrain dysregulation syndrome) secondary to anoxic brain injury is presented. This is characterized as severe, paroxysmal increase in heart rate, temperature, blood pressure, decorticate and decerebrate posturing. Risk factors include hypoxia, Diffuse Axonal Injury, brainstem injury and younger age. Our patient exhibited tachycardia, agitation, inattention, communication disorder, spasticity, posturing both decorticate and decerebrate. The increase in tone impeded any potential benefits from conventional therapy.

Method: Bromocriptine 2.5mg bid was administered for one week. Modified Ashworth Scale (MAS) was used to measure any changes in tone. FIM scores were used to measure changes in Basic Activities of Daily Living. Evaluation by certified Physical and Occupational therapists were made to assess functional gains and reported.

Results: Before treatment patient had a MAS tone of 4/4 in both upper and left lower extremities with sustained clonus. The right lower extremity tone was 2/4 with sustained clonus. There was no any isolated lower extremity movement. He had no functional movement in his arms due to his spasticity resulting in his fully abducted and externally rotated shoulders, fully flexed elbow position, with poor trunk control. Transfers and mobility were not possible due to his extensor tone.

After treatment for one week with bromocriptine, the patient's tone decreased to 1/4 in all muscle groups. The patient was able to bring his arms to his side. His grasp and release improved. He no longer required the hand splint which allowed further participation in ADL training. The decrease in tone improved the patient's ability to transfer with moderate assistance performing a stand pivot transfer. He was able to roll with supervision, go from supine to sit with moderate

assistance, sit to stand with minimal assistance, and ambulate 10 feet using a standing platform walker and moderate assistance. His tachycardia, agitation and communication also improved.

However, patient began to suffer visual hallucinations, anorexia and vomiting. Hallucinations, although short lived, lasting, 1–2 minutes, although easily redirectable, prompted discontinuation of the medication.

Gains were maintained 3 weeks after the discontinuation of the medication, after a brief fall in FIM scores and rebound spasticity from which he quickly recovered.

Conclusions: Low dose short course bromocriptine should be considered as treatment for central dysautonomia resulting in dramatic changes in both tone and functional measures and quality of life. The functional gains persist after the discontinuation of the medication.

0487

Neurobehavioral problems in a group of individuals with Traumatic Brain Injury in Barranquilla, Colombia

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Objectives: To assess neurobehavioral problems of individuals with Traumatic Brain Injury (TBI) in Barranquilla, Colombia.

Method: 31 Colombians with TBI and 61 controls completed the Neurobehavioral Functional Inventory (NFI) composed of six sub-scales: depression, somatic problems, difficulties with memory and attention, communication problems, aggression, and motor problems.

Results: The samples were similar with respect to age, gender, and education. Compared to healthy controls, individuals with TBI had significantly higher means on all NFI sub-scales: depression (24.15 vs. 29.84; $p < 0.001$), somatic problems (17.77 vs. 21.19; $p < 0.01$), difficulties with memory and attention (34.72 vs. 40.97; $p < 0.01$), communication problems (18.43 vs. 22.55; $p < 0.01$), aggression (14.92 vs. 18.16; $p < 0.01$), and motor problems (13.21 vs. 15.74; $p < 0.05$).

Conclusions: Individuals with TBI living in Barranquilla Colombia report more frequent neurobehavioral problems across all domains. Culturally-appropriate cognitive and neurobehavioral interventions should be implemented to reduce or eliminate these problems in Colombian individuals with TBI.

0488

Medical Care Costs Associated With Traumatic Brain Injury (TBI) Over The Full Spectrum Of Disease: A Population-Based Study

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Objectives: Identification of appropriate targets for cost-effective TBI prevention requires accurate population-based estimates of TBI-attributable costs over the full spectrum of disease. Rochester Epidemiology Project (REP) records-linkage resources afford a rare opportunity to provide such estimates.

Method: Using REP resources, we identified all Olmsted County, MN, residents with any diagnoses indicative of potential TBI 1985–2000 ($N = 45,791$). A random sample ($N = 7,175$) was selected for labor-intensive review of complete medical records to confirm head injury and characterize events as definite (moderate/severe), probable (mild), possible (symptomatic), or no TBI. For each confirmed case ($N = 1,429$), we selected one non-TBI control of same sex, similar age, who was seen at a REP provider within the year (± 1) of case's TBI (index date). Case/control pairs were followed in REP provider billing data for direct medical care costs, with follow-up for both members of each pair censored at earliest of death or emigration of either member. To adjust for pre-index costs, the study was limited to case/control pairs for which both members had index dates after 1987, the earliest year complete costs were electronically available. Costs for each case and control were obtained for 12-months before and 0–6, 6–12, and 12–72 months after index. Differences between case and control costs within each time period separately were stratified by TBI category (definite/probable/possible) and compared using Wilcoxon signed-rank tests. Costs were modeled as a function of case status (definite/probable/possible and no

TBI), adjusted for age, sex, and pre-index costs using generalized linear models.

Results: There were 1,161 confirmed cases (55% male; age range = 0–102 years, median = 21 years). The number of case/control pairs for definite/probable/possible respectively were 94 (8%), 442 (38%), and 625 (54%) at index and 55 (5%), 409 (39%), and 584 (56%) at 6 months. Median cost differences (case minus control) and p values for definite/probable/possible respectively for 12 months pre-index were \$57 (.11), \$12 (.01), \$124 (<.0001); for 0–6 months post-index were \$8,377 (<.0001), \$1,377 (<.0001), \$342 (<.0001); for 6–12 months post-index were \$88 (.06), \$0.00 (0.88), \$0.00 (.01); for 12–72 months post-index were \$1,120 (.18), \$272 (.006), \$851 (<.0001). The age- sex- and pre-index adjusted proportion of all TBI-attributable costs that were contributed by definite/probable/possible respectively for 0–6 months were 51%, 41%, 8%; for 6–12 months were 6%, 40%, 54%; for 12–72 months were 4%, 30%, 66%.

Conclusions: By 6 months post-index, the cost differences between cases and controls within each category approached cost differences in the year before index. TBI-attributable costs were much less for probable/possible compared to definite events. However, probable/possible events accounted for >90% of all TBI events, and by 6 months post-index, >90% of all TBI-attributable costs. Thus, probable/possible events should be a major focus of efforts toward cost-effective intervention.

0489

The PQRS-Montreal: A Valid Measure of Patients' Perception of the Quality of Rehabilitation Services for Persons with a Traumatic Brain Injury

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Objectives: The Perception of Quality of Rehabilitation Services – Montreal (PQRS-Montreal) questionnaire recently underwent psychometric testing. The 61 items concerned actual behaviours of service providers within a multi-disciplinary TBI rehabilitation team and specific processes of care judged important to provide as part

of the full range of TBI rehabilitation services throughout the continuum of care. We will report the results of research to estimate the construct validity, internal consistency, concurrent validity (with respect to a global client satisfaction scale) and criterion-related validity of the questionnaire (with respect to TBI severity, age, gender and phase of care).

Method: Participants were adults treated for TBI at in and outpatient rehabilitation facilities in Quebec, Canada. Subjects participated in a 40-minute interview at discharge and answered 2 questionnaires: PQRS-Montreal and Client Satisfaction Questionnaire (CSQ). Responses for the former were recorded using a 5-pont scale (completely disagree to completely agree).

Results: 530 subjects participated (mean age = 41.5 + 16.9 years, mean GCS score = 10.5 + 4.1, range 3–15). The mean item score ranged from 1.7 to 4.7, the lowest scored items concerning get-togethers for family members, sexuality, and learning about the consequence of TBI. The highest scores concerned items relating to the quality of the clinical team. Exploratory and Confirmatory Factor Analysis identified 3 subscales with 1 or 2 factor solutions explaining 28% to 41% of the variance. These subscales translated into meaningful latent constructs named «Ecological approach», «Quality of team» and «Service organisation». This analysis also indicated that 6 items did not correspond to any of the subscales (i.e. had weak communalities and saturations) and together they did not form a unidimensional subscale. They were subsequently deleted resulting in a 55-item questionnaire. The internal consistency of the subscales varied from 0.51 to 0.90 (Cronbach's α). All subscale scores were significantly correlated with the CSQ (Pearson correlation coefficients, $p < 0.001$): «Ecologic approach» = 0.26, «Client-centered approach» = 0.46, «Overall team quality» = 0.51, «Service organisation – continuity» = 0.48 and «Service organisation – availability» = 0.20. Multiple linear regression analysis indicated that depending on the subscale, rehabilitation phase, gender, age, and GCS score accounted for 2.5 to 10.8% of the total variance of the subscale scores.

Conclusions: Study results support the validity of the questionnaire and the theoretical assumptions that the perception of the quality of rehabilitation services is a multidimensional concept that appears to differ from patient satisfaction in the context of TBI rehabilitation. A valid tool to measure patients' perception of the quality of rehabilitation services should help mobilise the necessary resources to better meet the needs of adults with TBI.

0490

Effect of Specific Lesions on Response Inhibition in Children with Traumatic Brain Injury

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Objectives: Research has implicated deficient response inhibition in various neuropathological disorders. The Stop Signal Task (SST) is the most widely used measure of response inhibition. A lesion-deficit approach plays a role in identifying the brain regions that are necessary for a particular process. Previous lesion-deficit studies in adults have largely implicated discrete anatomical regions of the prefrontal cortex in deficient response inhibition as measured by the SST. Lesion research in children has been limited to the comparison between frontal and non-frontal regions, which has failed to yield a significant lesion-deficit relationship. The primary aim of this study was to determine whether lesions previously found to impair response inhibition in adults have the same impact in children.

Method: Participants included 30 children aged 7–16 years with moderate-to-severe traumatic brain injury (TBI), 23 orthopedic injury (OI) controls, and 30 population controls (PCs). Patients in the TBI and OI groups underwent magnetic resonance imaging and performed the SST at 3-months post-injury. In the TBI group, lesions were primarily located in the following regions: superior frontal gyrus (SFG), middle frontal gyrus, inferior frontal gyrus, orbital frontal gyrus, and non-frontal regions. Four lesion tissue types were examined: gray matter, white matter, both gray and white matter, and gray-white matter junction.

Results: Results revealed that TBI children as a group had significantly impaired response inhibition compared with PCs, but did not differ from OI controls. However, a subset of TBI children with white matter lesions of the SFG had significantly impaired inhibition compared with both control groups.

Conclusions: This suggests that deficient response inhibition in children following TBI may stem from frontal white matter damage, particularly in the SFG region. Future research should use diffusion tensor imaging to examine the integrity of white matter tracts. It would also be useful to longitudinally assess the impact of SFG white matter lesions on response inhibition in TBI children.

0492

Diffuse metabolic abnormalities in acute mild Traumatic Brain Injury: a quantitative proton MR Spectroscopy study

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Objectives: It is not clear whether the symptomatology of mild traumatic brain injury (mTBI) is neurological and/or psychosomatic, since conventional imaging is usually unremarkable. Therefore, what distinguishes mild from more severe TBI is the lack of biomarkers to assess injury status and prognosis. While some regions are more prone to injury than others, no single structure has been consistently shown to be involved. Quantitative magnetic resonance (MR) techniques-detected abnormalities in “normal-appearing” brain are often not reproducible. This suggests mTBI injury is heterogeneous, diffuse and minimal. Therefore, in this proton MR spectroscopy (1H-MRS) study we used a strategy of maximum brain coverage and sensitivity. For comprehensive coverage we used two approaches: (i) localized, three-dimensional 1H-MRS of a large (360 cc) volume-of-interest (VOI) of mostly white matter assessing neuronal health, membrane turnover and glial status via their metabolic surrogates N-acetylaspartate (NAA), choline (Cho), creatine (Cr) and myo-inositol (mI); (ii) non-localized, whole-brain NAA (WBNA) 1H-MRS to cover cortical gray matter and assess global neuronal health. For high sensitivity, all 480 individual spectra from the localized 1H-MRS were frequency-aligned and then summed to yield a single spectrum per subject with excellent spectral resolution and signal-to-noise ratio.

Method: Subjects: 14 acute (mean time from TBI 19 days), patients (mean age 35) were scanned at 3 Tesla. Ten reported at least one post-concussion symptom. Nine matched controls (mean age 37) were also enrolled. 3D 1H-MRS: The VOI centered on the corpus callosum was excited with TE/TR = 35/1800 ms PRESS and partitioned into 480 nominal voxels, 0.75 cc each. Their spectra were summed to yield one VOI spectrum per subject and metabolites were quantified and normalized for brain volume inside the VOI. Two-way analysis of covariance (ANCOVA) based on ranks was used to compare patients to controls with respect to each measure, accounting for the matching of the comparison groups in terms of age and gender. WBNA 1H-MRS: Non-localizing 1H-MRS

sequence with TE/TI/TR = 0/940/10,000 ms was used and concentrations were normalized for brain volume.

Results: VOI: Patients' average tissue volume fraction (0.94), NAA (7.27 mM) and Cr (5.89 mM) levels were not different ($p > 0.2$) from controls'. In contrast, Cho and mI concentrations, 1.47, 3.70 mM, were 8% and 12% higher in patients ($p = 0.047, 0.031$). Whole brain: Patients' average brain volume (1162 cc) and WBNA (11.1 mM) were not different from controls'.

Conclusions: There was no brain atrophy, neuronal or axonal damage either globally or within the VOI (normal brain volume, tissue fraction, WBNA and NAA). Increased Cho and mI suggest membrane turnover and glial abnormalities in the mostly white matter VOI. Based on the model of diffuse axonal injury, these may represent disruptions of cell membrane integrity (Cho) and astroglial scarring (mI) which accompany axonal disconnection.

0493

Sleep/wake Disturbance Following Traumatic Brain Injury; Impact on functional recovery of cognition and communication; A Case Report

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Objectives: Impairments in sleep patterns and development of secondary sleep disorders are among the most commonly reported neuropsychiatric sequelae following traumatic brain injury. These can exacerbate other common injury related difficulties, including pain, mood, behaviour, cognition and communication. The objective of this study was to observe functional reports of attention, memory, language processing and mood in relation to quality of sleep prior to and after assessment and treatment of sleep in an adult male with severe TBI, one year post injury.

Method: The participant completed the Daily Cognitive-communication and Sleep Profile (D-CCASP) on a daily basis with the assistance of a rehabilitation coach, to obtain subjective measures of sleep quality and cognitive-communication function over a four month period, during which he underwent an evaluation of sleep (polysomnography), and pharmacological management. A follow-up sleep

study and maintenance of wakefulness testing were completed at three years, eight months post injury. A time-series analyses (ARIMA modeling) was performed to examine the effect of medication regimen on cognitive communication function and sleep quality over time.

Results: The first polysomnogram, one year post injury revealed fragmented sleep with reduced efficiency and prolonged awakenings. Treatment in the form of pharmacological management began with a progressive series of five medication changes. Results of the D-CCASP using a time-series analyses demonstrated significantly increased attention, language processing, memory, and sleep quality associated with changes in medication. ($p < 0.01$).

A follow-up sleep study at three years eight months post injury revealed an abnormal polysomnogram with prolonged REM latency likely due to medications citalopram, mirtazapine. Prominent periodic leg movements were noted which appeared to interfere with sleep onset – and could also be seen as a possible side effect of medications. A Maintenance wakefulness test followed this study and the study participant fell asleep in the first nap with a latency of 24.5 minutes for an average sleep latency of 36.1 minutes across all four assessments. Although this was within published normal limits, there did appear to be evidence of increased sleep tendency despite medications. Gains in cognitive-communication function were maintained over time.

Conclusions: In this case, improvement of sleep and arousal through pharmacological management resulted in positive changes in cognitive-communication function. We postulate that these were not related to spontaneous recovery as the participant was greater than 1 year post injury. Given the high prevalence of sleep/wake disturbances, coupled with the high prevalence of cognitive-communication impairments, it is important that sleep be systematically evaluated and monitored post injury.

Clinical and research evidence suggests that timely and effective diagnosis and management of sleep/wake disturbance post TBI may facilitate potential recovery of cognitive and communication function. Further research is warranted.

0494

Correlation between Mechanical Response and Diffuse Axonal Injury in a Rodent Model of Blunt Head Trauma

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Objectives: The Marmarou weight drop model of traumatic brain injury (TBI) has been utilized in numerous studies. However, there is scarcity of published work on the mechanical responses of this model and their correlation to cellular injury. Therefore, a modified version of this model was developed to study the kinematics of the rat head and their correlation to the severity of diffuse axonal injury (DAI) following TBI.

Method: Thirty-two anesthetized male Sprague-Dawley rats (375–425grams) were used. A custom-made 450g weight housing a miniature accelerometer (Kistler 8044) was dropped from 2.25m. Linear and angular responses of the head were measured with an accelerometer (Endevco 7269) and angular rate sensor (DTS AR12k) glued to the skull approximately 5 mm anterior to the 10 mm helmet. Impact was captured by a high-speed video camera (MotionXtra HG-100K). Mechanical responses were determined from accelerometer and video data. Surface righting and length of unconsciousness were assessed post TBI. 24 hr post-TBI, rats without skull fracture were perfused. 13–15 sections (40 um thick) spaced 0.48 mm through corpus callosum (CC) were processed for beta-APP immunocytochemistry. Density of DAI was determined by taking digital photomicrographs at 200x and 400x, creating panoramic images of each section using Photoshop CS3, and counting each retraction ball and axonal swelling in the digitized panoramic images using NIH Image J. Correlation between DAI (quantified retraction balls and swellings) and mechanical and behavioral responses was determined by linear regression.

Results: The average impact velocity and impact duration were 6.12m/s (± 0.07) and 91ms (± 8), respectively. DAI was observed in CC and various brainstem regions similar to those described in the original model. However, there were variations between rats in the mechanical responses during impact and the total DAI count. In fifteen rats with valid mechanical response data, the average peak translational acceleration was 864g (range 425–2313g), the average peak rotational velocity was 131 rad/s (range 26–181 rad/s), and the total DAI count in CC ranged from 24 to 715. Linear regression showed positive correlation between total DAI counts and the following mechanical responses: impact velocity ($R^2 = 0.587$), kinetic energy of impact ($R^2 = 0.589$), and average head acceleration ($R^2 = 0.500$). There was also good correlation between total DAI counts and time to surface right ($R^2 = 0.453$).

Conclusions: The results of this study showed a positive correlation between DAI in CC and impact velocity, kinetic energy, average head acceleration and time to surface right. Average head acceleration showed promise in the current rodent model and is the basis of the existing Head Injury Criterion (HIC) used by most regulatory agencies in assessing the safety of motor vehicles. This model also shows promise in elucidating the relationship between extent of cellular brain injury and mechanical response, which is not possible through biomechanical cadaveric studies.

0495

Behavioral Analysis and Interdisciplinary Treatment Planning after Brain Injury: A methodological approach to addressing the challenges of neurobehavioral issues in post-acute rehabilitation.

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Objectives: A complex array of neurobehavioral sequelae are exhibited within the brain injury population that affect an individual's ability to participate in and benefit from rehabilitation programming, integrate into other settings or the community, and ultimately maximize their independence. The application of behavior analytic principles and procedures within the rehabilitation process supports efficient and effective neurobehavioral programming for the survivor as well as the treatment team.

A pyramidal model will be proposed that broadly categorizes brain injury residuals. Specific behavior analytic principles and procedures will be identified and applied accordingly. The model structures the identification and development of effective assessment and intervention techniques toward successfully managing and treating emergent as well as ongoing issues. Further, it provides structure with regard to the interdisciplinary treatment team's efforts, toward establishing and maintaining stability in areas critical to the rehabilitation process.

Method: The pyramidal model consists of three distinct components; medical stability, cognitive and behavioral stability, and stable activity plan. Each component requires thorough examination in order to identify treatment goals, which is completed by members of the treatment team with expertise in one or more of the components. Thereafter, treatment plan elements warrant attention with respect to

the order in which they are addressed, as achieving stability in one area may be a prerequisite to future programming efforts in another; other areas may be addressed concurrently. Specific behavior analytic principles and procedures are applicable to each component and support the development and implementation of the neurobehavioral treatment plan.

Results: Specific data collection tools are utilized in conjunction with each component of programming. They include preliminary assessment data gathered by various members of the team, interval data gathered by staff and/or the client, and weekly/monthly data collection related to individual or collective elements of the treatment program.

Ongoing data and results can be shared directly with members of the treatment team, the client, families, funders, as well as consultants providing specific elements of care, e.g. neuropsychiatry. Data are then utilized to determine stability within each component and to assess readiness and/or identify a need to develop and incorporate additional programming.

Conclusions: This model provides a structure that guides the interdisciplinary treatment team in constructing and implementing an individual's overall treatment program, and can account for and accommodate programming for various combinations of sequelae.

This methodology provides an important framework for families, funders, clients and members of the treatment team by facilitating discussion, collective evaluation and an overall orientation to the neurobehavioral program process.

0496

When cure entails care: Traumatic brain injury and the continuum of care

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Objectives: In a guest editorial of the Journal of Rehabilitation Research and Development, Gregory Larkin brings attention to the complex care that is required by patients with Traumatic Brain Injuries (TBI). As he notes, the patients who do not receive dynamic and coordinated health care services are likely to experience a lower quality of life (QOL) (2007, 44/7, xxiii). My claim is that these patients not only present a challenge to medical practice, but

they also compel bioethicists to reexamine the ideal of cure.

Method: In this paper I defend three claims. First, I show that the paradigm of cure as restoration centered on acute care is no longer adequate. Medical advances are such that cure is no longer an end-product which is brought about by acute medical procedures only; cure is now a process which: a) can take a long time; b) may not be a direct result of acute services only; and c) may not amount to full restoration. Second, these changes have implications for the patient herself as well as her loved ones or close others. These two claims are not controversial as they have been experienced by many individuals and their families. However, my final assertion is more so. I put forward that there are ethical implications to the fact that cure is no longer an end-product born out of acute care services, and these ethical considerations force a revision of the concept of cure which has profound implications for the delivery of health care services.

Results: The paper proceeds as follows. In the first part, I examine the services given in the acute phase of TBI; this phase normally comprises both acute medical and rehabilitation services. I focus on what happens to an individual after he leaves the acute phase of medical and rehabilitation services. The complete discontinuity between the acute and on-going phases of rehabilitation is possible only because there is an assumed reliance on the services of family caregivers. In the second part of the paper, I argue that such a model fails both the injured person and his family. Finally, in the third section, I make the case that such a failure has ethical implications which points to an inadequacy of the conceptual model of cure as an end-product and I suggest the manner in which the concept of cure should be revised.

Conclusions: Taking Margaret Walker's ethics of responsibility (1998), I show that the cure paradigm, although it intends good outcomes, creates a vulnerable class of individuals. Understanding cure as on-going process that is not limited to acute care interventions is a better way of providing services when cure is only partially restorative.

0497

Functional Trials: A Behavior Analytic Approach to Assessment and Awareness-Building for Survivors of Traumatic Brain Injury

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Objectives: This presentation provides a preliminary but systematic introduction to and evaluation of the “Functional Trial Assessment Strategy,” which has been developed and refined by clinicians at ReMed in their work with survivors of Traumatic Brain Injury. The strategy utilizes behavior analytic techniques in the areas of assessment and skill building. Concurrently, this methodology can play an important role in the treatment of a phenomenon known as anosognosia which presents this population and treating clinicians with a specific set of challenges.

Method: The “Functional Trial Assessment Strategy” is a framework in which a multidisciplinary team of clinicians can construct analog conditions to either test or work toward developing an individual’s skills in a safe and structured manner. This presentation seeks to describe and explore the utility of this strategy in guiding the rehabilitation efforts with this unique population. Via specifically designed trials, data is collected regarding an individual’s ability to complete specific tasks, and their ability to accurately predict and later describe their performance.

Results: Data produced via the “Functional Trial Assessment Strategy” provides the treatment team with invaluable information regarding an individual’s current level of functioning as well as insights into an individual’s level of awareness of deficits. When structured and sequenced as the approach outlines, Functional Trials can provide the clinical team necessary information to make informed and data based treatment and care decisions on both large and small scales. When applicable, findings from specific trials and case studies may be referenced to demonstrate how this data can guide programming.

Conclusions: Data generated via the “Functional Trial Assessment Strategy” can be used to determine which method of programming is most appropriate in order to promote safety and stability across critical areas of function. Findings can help guide the treatment team to emphasize either specific skill building efforts or environmental modification. Additionally, information obtained via this strategy can be used to assess ones level of awareness of deficits and their ability to build awareness over time. When appropriate, case studies will be presented in order to demonstrate the utility of this approach and discuss its efficacy toward achieving the stated goals of assessment; skill building and addressing barriers associated awareness deficits.

0498

The application of differential reinforcement and other behavior analytic procedures and principles in continuum-based neurobehavioral programming; Maximizing independence and promoting least restrictive settings.

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Objectives: TBI survivors with neurobehavioral sequelae, particularly those with co-occurring issues, frequently experience difficulty in achieving and/or maintaining a level of safety and stability that enables them to progress to less restrictive settings and/or to maximize their independence. Some individuals struggle to achieve any level of safety and/or stability, while others experience periods of stability that result in momentary but impermanent changes due to the occurrence of one or more problematic behaviors, such as substance abuse, demanding/threatening, non-compliance/resistance. The development of treatment plans for these individuals’ represents a significant challenge to providers, as they must account for multiple behaviors that often necessitate specialized treatment. Utilizing behavior analysis, with special attention given to differential reinforcement and principles of reinforcement, a framework has been established that incorporates these complex factors into an integrated plan, with a goal of maximizing independence and/or moving to a less restrictive setting.

Behavior analytic procedures promote acquisition, generalization and maintenance of behavior. Continuum-based, neurobehavioral programming for adult TBI survivors necessitates not only that individual behaviors be established, e.g. sobriety, but more broadly that individuals establish multiple behaviors, e.g. maintain sobriety, a stable activity plan and a budget.

Method: A “Phase Plan” is a carefully designed set of concurrent differential reinforcement procedures that individually and collectively promote stability. It accounts for critical factors related to rate as well as potency of reinforcement and establishes conditioned reinforcers, such as movement within and across phases.

Plans are constructed into distinct phases, each consisting of several weeks. Input is obtained from the interdisciplinary treatment team to establish target behaviors within each phase and specific criteria are then established that represent successful

completion of a week; completing the requisite number of weeks results in completing a phase, and completion of a phase enables movement onto the subsequent phase. As an individual completes each week and/or phase various contingent reinforcers are made available as guided by the plan.

Specific data collection tools are utilized, including a daily schedule that allows for interval data collection regarding specific behaviors, and a weekly criteria checklist that is utilized to monitor all target behaviors within each phase.

Results: Samples of the data collection tools and summary data will be presented showing gradual progression toward increased independence, accompanied by increased program demand.

Conclusions: The overall behavior analytic architecture of the plan, facilitates interdisciplinary involvement and client progress by providing all involved with objective behaviors and criteria that correspond to progress and linking this progress with intermediate reinforcers. Importantly, the criteria for the final phase represent maintenance criteria so as to minimize the amount of change the survivor experiences as they prepare work to maintain their increased independence and/or transition to a less restrictive setting.

0500

Neuropsychological outcomes in individuals with Traumatic Brain Injury from Cali, Colombia.

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Objectives: To examine the neuropsychological functioning of individuals with varying severities of TBI from Cali, Colombia.

Method: 79 Colombian individuals with TBI (15 mild, 41 moderate, and 23 severe) from Teravida Neurological Rehabilitation Center and Valle University Hospital in Cali, Colombia, and 79 controls from the city of Cali. All participants were administered Spanish-language neuropsychological battery (NEUROPSI). The NEUROPSI measures attention/concentration, orientation, executive function, memory, reading, writing, language, and motor function.

Results: The four groups were similar with respect to age and gender, but had significantly different educational levels ($p < 0.001$). The MANCOVA, controlling for education, showed significant differences between groups on the neuropsychological variables overall ($p < 0.001$) and all domains except motor function (p 's < 0.05). Post-hoc MANCOVAs analyzing differences between pairs of groups showed significant differences for controls vs. severe TBI ($p < 0.001$) on all domains (all p 's < 0.05), controls vs. moderate TBI ($p < 0.001$) on language, reading, and short- and long-term memory (p 's < 0.01), controls vs. mild TBI ($p < 0.01$) on short- and long-term memory (p 's < 0.05).

Conclusions: Although neuropsychological function within the group of individuals with TBI is similar, individuals with severe TBI perform worse across all domains of NEUROPSI neuropsychological functioning. Individuals with mild TBI have more memory problems compared to controls and individuals with moderate TBI have more memory, language, and reading problems compared to controls. Targeted rehabilitation programs should be designed and implemented to improve cognitive function in Spanish-speaking individuals with TBI.

0501

Real World Strategy Training for Adults with Executive Dysfunction Following Traumatic Brain Injury

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Objectives: The use of problem solving training in rehabilitation for people with executive dysfunction following acquired brain injury has been shown to be effective. However, few studies have reported achieving generalization of this improvement to daily life activities. Our pilot work using the Cognitive Orientation to Occupational Performance (strategy training in the real world) adapted for adults with traumatic brain injury (TBI) has demonstrated that this training, provided in clients' own environments and focused on client-chosen goals, enables significant changes to be made in real-world activities. Thus, the objective of the current study was to further evaluate the potential of the strategy training to effect goal achievement and

generalization with adults with executive dysfunction.

Method: An experimental design was used with participants assigned to a treatment group (TG) (n=6) or wait-list control group (CG) (n=6). Participants were community dwelling adults at least one-year post-moderate to severe TBI. The groups were well matched with three males and three females in each group, a mean age of 31.7 for the TG and of 30.0 for the CG. The TG had 16.0 years of education and the CG 16.7 years, and the TG was on average 10.8 years post injury while the CG was 10.4 years post-injury. A brief neuropsychological assessment was conducted to characterize participants. The primary outcome measure was self and significant other report of performance change on goals identified through a standardized interview (the Canadian Occupational Performance Measure). A 2-point change on a 10-point scale has previously been demonstrated to be clinically significant. Each participant was encouraged to identify 5 goals, three of which were trained. The intervention entailed guiding participants to use a meta-cognitive or problem-solving strategy to achieve their goals. The intervention occurred over 20, 1-hour sessions in the participants' own environments and was delivered by a trained occupational therapist.

Results: Thirty-one goals were identified by the TG. A performance change of 2-points was reported on 16 of these on self-report and 8 on significant other report. Thirty goals were identified in the control group. A performance change of 2-points was reported on 2 of these on self-report and 3 on significant other report. The difference in the proportion of goals reported as changing by two points was significant at $p \leq 0.001$ for self and showed a trend towards significance ($p \leq 0.1$) for significant-other report. Participants in the TG reported taking on additional new activities because they felt more confident and optimistic about success.

Conclusions: The adaptation of CO-OP for adults with TBI appears to be an effective way to achieve real-world performance change even many years post brain injury. These data and reports from participants suggest that the use of the strategy generalizes beyond the trained goals.

0502

Traumatic Brain Injury Outcome in Racial Minority Populations

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Objectives: In the United States, the approximate incidence of head trauma is 2 million per year, with 80,000 of these individuals suffering from some level of chronic disability as a consequence of the injury. Research to date indicates that racial disparities exist in clinical progress and outcome from traumatic brain injury (TBI). Due to the fact that there is an increasing amount of head injuries among minority populations, there is a need to improve the understanding of outcome and recovery from TBI in understudied populations. The current study focused on the demographics, incidence and functional outcomes for a racial minority population in a rural-small city medical setting.

Method: This study involved a retrospective chart review and identification of 85 adults (72 males, 13 females) from racial minority groups, and a comparable white sample, that sustained moderate to severe TBI and were treated at the Hershey Medical Center in Pennsylvania between the years of 1987 to 2009.

Results: The average age in the minority sample was 35.5 years (SD=14.55) and 43.4 years (SD=22.17) in the white sample. The most frequent mechanisms of injury were motor vehicle accidents (51.8%), assaults (27%), and firearms (7%) for minorities. In the white sample, motor vehicle accidents were also the leading cause, though falls were the second most frequent, followed by assault. The average Glasgow Coma Scale score following TBI at hospital admission was 5.1 (SD=3.0) and the average Functional Independence Measure total score was 13.1 (SD=5.6) in the minority sample. The average length of stay in the hospital, as well as the most frequent discharge destination (rehabilitation facility) did not differ between groups. The majority of individuals in both samples were found with alcohol or other drugs at the time of injury. Alcohol was present in 55% of the minority sample at injury and drugs were found in 61% of the individuals, while alcohol was present in 40% of the white sample, and drugs were found 16%. The mortality rate was 40% for minorities in this study, compared to 34% in the white sample.

Conclusions: Within this semi-rural medical community, the minority and white populations sustained severe head injuries, primarily due to motor vehicle accidents. Between the two samples, only significant differences were found in age of injury, and alcohol and drug use. The results from this study add to the increasing understanding of outcomes from TBI in minority groups and warrants further research of how demographic and clinical factors influence and

predict outcome and recovery within various racial groups. Improvements in the descriptions of these groups can increase awareness for services that can improve functional recovery for minority populations sustaining TBI.

0503

Sodium Disorders in Patients with Traumatic Brain Injury

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Objectives: Disorders of sodium are both the most common and most poorly understood electrolyte disorders in neurological patients. We have the objective to determine the incidence of sodium disorders and its association with different traumatic brain injuries (TBI).

Method: The prospective study counted with 80 patients diagnosed with moderate and severe TBI. All patients underwent brain computed tomography (CT). Sodium disorders incidence, presence of injuries in the first CT after-TBI and conscience level had been analyzed. Cases that presented other potential causes of disorders of sodium and systemic trauma were excluded from the study.

Results: The incidence of sodium disturbances was 45%: 20 patients presented hypernatremia, and 16 hyponatremia. Of these, 53% had already been detected in first sample. We verified at least one measure $< 125\text{mEq/l}$ in 50% of the patients with hyponatremia. In patients with subdural, intracerebral hematoma and with diffuse axonal injury, higher increase of sodium disorders. The incidence of sodium disorders among the patients with diffuse lesion were bigger than group of patients with brain contusion ($p = 0,022$).

Conclusions: The incidence of sodium disorders is higher in patients with TBI. No association had been verified between focal lesions and proportion of sodium disorders.

0504

The Relationship Between Speech Production Skills and Age at Injury in Young Children After Severe Traumatic Brain Injury

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Objectives: In the present study we first determine whether speech acquisition curves for individual children with severe TBI are significantly different than a normal speech acquisition curve generated from typically speaking children. We then examine the relationship between age at injury and the rate and extent of change in speech-sound production skills over 12 monthly sessions.

Method: Participants were 56 native English-speaking children with severe TBI (Glasgow Coma Scale < 8 and a positive CT scan); 19 were females and 37 were males. At the time of injury, the children ranged in age from 1 month to 116 months. Participants were enrolled in a prospective longitudinal study of the speech characteristics of young children following severe TBI. Children participated in 12 monthly testing sessions, beginning when the child was able to produce at least 10 intelligible words. At each testing session a 15-minute continuous speech sample was obtained.

The first 100 first-occurrence words produced by each child were transcribed phonetically. Point-by-point agreement for phonetic transcription was above 90%.

The Percentage of Consonants Correct-Revised (PCC-R) was the primary speech measure for profiling changes in rate and level of consonant mastery. PCC-R is an interval-level severity metric and reflects the number of consonant errors (omissions, substitutions) divided by the number of consonants attempted.

Results: Predicted values for PCC-R at each monthly age were generated from a normative growth curve derived by compiling data from typically developing children between 18 and 130 months of age (Campbell et al., 2007). PCC-R scores of children with TBI were converted to standard scores and compared to the normative growth curve at each monthly sampling session.

Findings showed that 12 months after injury, PCC-R scores remained significantly low (> -1.5 SD) in 25% of these children (14/56). PCC-R scores did not differ significantly by gender $t(55) = 0.83$, $p = 0.41$, $d = 0.2$. Individual PCC-R growth curves for all 56 children differed significantly from the normative growth curve ($p < 0.05$).

PCC-R score and age of injury were significantly correlated at every sampling session (Spearman $Rho = 0.71$ to 0.89 ; $p < 0.01$). At the final session, 40% of children injured before age 5 years, and 13% of children injured after age 5, had significantly low PCC-R scores ($t^* [31] = 2.93$, $p = 0.006$, $d = 0.79$).

At the final session, the mean PCC-R standard score for children injured before age 5 was -1.7 SD ($SD=2.3$); the mean PCC-R standard score for children injured after age 5 was -0.3 ($SD=1.0$).

Conclusions: Serious speech deficits persist up to one-year post injury in a substantial number of children. Children injured before age 5 are significantly more likely to have serious speech deficits than those injured after age 5.

0505

Blast Polytrauma and Coagulopathy

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Objectives: Exposure to powerful military explosions often results in polytraumatic injuries including non-penetrating blast injuries to the brain and body as well as severe hemorrhage from both penetrating and internal injuries. The complex injuries make fluid resuscitation difficult with the injured brain requiring increased blood flow in contrast to systemic tolerance of hypotension-hypoperfusion and a susceptibility to pulmonary edema when excess fluid is given. In addition to these resuscitation challenges, reports from military surgeons suggest coagulopathies occur in some blast-exposed casualties. The rates of occurrence and cause remain uncertain though hemorrhage, hypothermia and hemodilution have been suggested. We hypothesized that an additional cause of the reported coagulopathy may be the result of blast-induced brain injury. Disruption of the blood-brain barrier (BBB) would lead to exposure of tissue factor in the brain resulting in an initial hypercoagulable state followed by a hypocoagulopathy from clotting factor depletion. To address this issue the effect of blast injury alone and in conjunction with hemorrhage and resuscitation on coagulation status was investigated.

Method: Male Sprague-Dawley rats under isoflurane anesthesia received femoral artery/vein cannulas, with or without IV heparin (300 IU post-surgery). Groups were exposed to sham blasts and whole body blast over-pressures at 87, 96 and 118kPa. Additional groups underwent blast exposure combined with severe hemorrhage (MAP 30 mmHg for 30 min) or hemorrhage and fluid resuscitation (hypotensive followed by full resuscitation using a hetastarch solution: Hextend). Blood samples (control, post-trauma, terminal) were taken for blood gases and for measures of coagulation status using thromboelastography (TEG).

Results: Neither blast nor hemorrhage alone or combined cause a coagulopathy as measured by TEG. However, TEG is inherently variable and may not be adequate for subtle trauma-induced coagulopathies. Results suggest blast exposure does result in intra-cerebral, intra-vascular thrombus formation, which may be the cause of traumatic brain injury and mortality. Resuscitation for blast or blast-hemorrhage-induced hypotension leads to early mortality probably as a result of pulmonary edema and lung dysfunction.

Conclusions: The blast over pressure injury model, especially when combined with hemorrhage, provides a serious, potentially lethal small animal model of polytrauma, with injuries including brain contusions, organ lacerations, broken bones and tissue edema.

Blast over pressure exposure (87–125 kPa) causes injuries in many different organs but generally does not result in large frank hemorrhages, even in animals treated with IV heparin. This suggests there is no significant coagulopathy. Preliminary results suggest that intravascular thrombi occur in the brain after blast injury despite the absence of a notable hypercoagulable state as measured by TEG. Blast causes a hypotension, which when treated with fluid resuscitation, leads to pulmonary edema and dysfunction shown by reduced blood pO₂ and pH and elevated pCO₂ and lactate.

0506

Remote Postoperative Epidural Hematoma after Subdural Hygroma Drainage

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Objectives: Subdural hygroma (SDG), a common complication of blunt head trauma, is reported to occur in 5–20% of all patients with closed head trauma. The treatment need is a controversial but in symptomatic patients surgical drainage 0.1,2. No case of epidural hematoma after hygroma drainage has been reported. We report on a patient with this complication after subdural hygroma surgery.

Method: A 37-year-old man, victim in an automobile accident was admitted to a local neurosurgical hospital with blunt head injury. On admission, patient was drowsy and initial evaluation has showed a Glasgow Coma Scale score of 6, both pupils were isocoric and reactive to light. The patient underwent evaluation with computed tomography (CT) scan and basic laboratory studies with no

significant abnormalities. Patient was admitted in an intensive care. Two weeks later, patient showed improvement in neurological status and was discharged with Glasgow Outcome Scale of 04. Three weeks after trauma patient got worse, disorientated, and with right hemiparesis (grade IV). CT scan was performed and showed an increasing subdural fluid collection with mild mass effect and some effacement of the left ventricle (Figure 2). The fluid collection was most consistent with subdural hygroma without associated subdural hematoma.

Results: We performed a frontal trepanation with fast drainage of an extreme hypertensive subdural collection with citrine aspect, no excessive bleeding or any other complication was described in the operating room. In postoperative Patient returned to ICU and remained in coma. A new CT scan demonstrated a large right parieto-occipital acute epidural hematoma. Patient was taken back to the operating room, a craniotomy and evacuation of the hematoma was performed with good result. In hospital discharge patient presented GOS 4.

Conclusions: A high clinical suspicion or awareness of this entity is necessary to diagnose this dangerous disorder on time. Complete reliance on neurologic monitoring, trust in an false-negative early CT scan, and a relative complacency after an apparently successful initial surgery for hygroma drainage may delay the diagnosis of this postoperative EDH and lead to a catastrophic outcome. We believe that cases like the one reported indicate the need of a criterious postoperative clinical monitoring even in easy, simple neurosurgical procedures.

0507

Self reported Fatigue and Cognitive Performance in a Sample of Spanish Speaking individuals with Traumatic Brain Injury.

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Objectives: To determine levels of fatigue in Colombian individuals with TBI and its potential impact on cognitive performance.

Method: 30 Colombian individuals with TBI from Teravida Neurological Rehabilitation Center and

Valle University Hospital in Cali, Colombia and 30 age- and education-matched controls from the city of Cali. All participants were administered a Spanish-language version of the Modified Fatigue Impact Scale (MFIS) and underwent a Spanish-language neuropsychological battery (NEUROPSI). The MFIS measures the frequency of fatigue in the past 4 weeks and is composed of 3 sub-scales: physical fatigue, mental fatigue, and psychosocial fatigue. The NEUROPSI measures attention/concentration, orientation, executive function, short- and long-term memory, and language.

Results: The samples were similar with respect to age, gender, and education. Compared to healthy controls, individuals with TBI had lower means on all fatigue measures and all neuropsychological domains. Significant differences were found on mental fatigue (10.9 vs. 4.6; $p < 0.01$), psychosocial fatigue (2.1 vs. 0.5; $p < 0.001$), and total MFIS (20.4 vs. 9.0; $p < 0.01$). Significant differences in cognitive functioning were found on five domains: attention/concentration (24.4 vs. 19.7; $p < 0.001$), language (41.7 vs. 36.8; $p < 0.05$), executive function (9.4 vs. 8.5; $p < 0.05$), short- (17.3 vs. 16.0; $p < 0.001$) and long-term memory (25.7 vs. 20.2; $p < 0.001$). In the TBI group, mental fatigue was significantly negatively correlated with orientation ($\rho = -0.45$; $p < 0.05$) and attention/concentration ($\rho = -0.40$; $p < 0.05$), psychosocial fatigue with orientation ($\rho = -0.40$; $p < 0.05$) and attention/concentration ($\rho = -0.39$; $p < 0.05$), and physical fatigue with orientation ($\rho = -0.43$, $p < 0.05$).

Conclusions: Spanish-speaking individuals with TBI performed worse than controls on almost all domains of the NEUROPSI. Individuals with TBI reported experiencing more mental and psychosocial fatigue than their counterparts with the same age and educational levels. The more of these specific types of fatigue reported by individuals with TBI over the past month, the worse their performance on neuropsychological tests measuring orientation and attention/concentration. These findings suggest that rehabilitation professionals should take into account the general level of fatigue of their clients when embarking on cognitive rehabilitation programs in order to maximize their effectiveness.

0508

Training Paraprofessionals to Administer Real World Strategy Training

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Objectives: Recent research indicates that Real World Strategy Training (RWST), an adaptation of the Cognitive Orientation to Occupational Performance approach, is effective in assisting brain injured individuals to make significant improvements in self-identified every day life goals such as cooking meals, passing a test, and planning a party. To date, this program has been administered by trained occupational therapists. The question arose as to whether paraprofessionals could be trained to effectively administer the program to improve accessibility and to reduce costs. The objectives of this project were two fold: 1) to determine if RWST was effective when administered by paraprofessionals to ABI participants, and; 2) to determine the training and supervision needed.

Method: Two paraprofessionals were trained using group lectures, video review, modeling and ongoing mentoring by a trained occupational therapist. The paraprofessionals then administered RWST to three brain injured participants. Efficacy was measured using pre-post Canadian Occupational Performance Measure (COPM) scores. Treatment reliability was determined by video review of each sessions led by the paraprofessionals.

Results: Functional outcomes measured by the COPM indicate that goal attainment by the brain injured participants was similar whether the program was administered by the paraprofessional or an occupational therapist. Sessions led by the paraprofessionals were determined to be reliable based on preset criteria in the video review method.

Conclusions: Initial data suggest that paraprofessionals can be reliably trained to effectively administer RWST. This creates a unique role for the occupational therapist in training and mentoring paraprofessionals.

0509

The Effect of Onset-Admission Interval and Site of Cerebral Vascular Accident on Rehabilitation Outcomes

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Objectives: Onset-admission interval (OAI) refers to the time period between the onset of a CVA and admission to acute rehabilitation. The importance of early intervention has generally been supported by studies showing that the effectiveness of functional rehabilitation, typically evaluated by the Functional Independence Measure (FIMTM) tool, decreases with increasing OAI. Few studies have looked at the differential effects of left, right or bilateral CVAs on the relationship between OAI and functional outcomes or at the effects of OAI on the different modes of functional rehabilitation (Mobility, Activities of Daily Living (ADL), Cognition and Bowel & Bladder) that contribute to the total FIMTM score.

Method: Data was collected retrospectively from 613 patients with a CVA who were admitted to the acute rehabilitation unit at NYU Hospital for Joint Diseases from January, 2002-July, 2008. Patients whose onset admission interval exceeded 60 days were excluded from the study.

Of the 545 patients who met the inclusion criterion, 248 were admitted with a left hemisphere, 194 with right hemisphere, 61 with bilateral, and 42 with non-specific CVAs. Average age was 70.0 (Median, 71.1), average OAI was 19.5 days (Median, 15), and average length of stay was 21.3 days (Median, 21.0). The average admission FIMTM score was 44.9 (Median, 40) and the average gain in FIMTM score was 20.5 (Median, 20.0).

Results: Data were analyzed using stepwise linear regression with OAI, age, and medical complexity, determined by the Case Mix Group (CMG), as the predictor scores and FIMTM improvement as the main Dependent measure. A separate regression analysis was done for right, left, bilateral, and all CVAs combined, respectively. For each of the four CVA categories, a separate analysis was conducted for total FIMTM improvement, and for the individual Mobility, ADL, Cognition, and Bowel & Bladder FIMTM improvement scores, respectively.

The results showed that OAI was a significant predictor of total FIMTM improvement for all four CVA categories ($p < .001$) with longer OAI associated with poorer improvement. For the right hemisphere, bilateral, and all-CVA-combined categories, OAI was a significant predictor of Mobility, ADL, and Bowel & Bladder FIMTM improvement scores ($p < .001$) but for left hemisphere CVA, was only significant for mobility ($p < .05$). OAI was not a significant predictor of Cognition FIMTM improvement for any CVA category. Overall, the strongest relationship between OAI and poorer FIMTM improvement scores was demonstrated in the bilateral CVA group where OAI accounted for the greatest amount of variance (6.2% to 17.3%) and

showed the steepest negative regression coefficients. A further analysis of the regression curves also showed that the negative impact of OAI occurs sooner for bilateral CVAs (less than 20 days) than for unilateral CVA (more than 30 days).

Conclusions: The results of this study show that, with the exception of Cognition, a longer Onset Admission Interval is associated with poorer therapy outcomes, an effect which is particularly evident for bilateral CVAs.

0510

Rehabilitation Outcomes in Patients With Traumatic Brain Injury in Argentina

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Objectives: Introduction:

Hospital Nacional Posadas, located in Buenos Aires state serve an influence area of approximately 1.500.000 people. Each year, nearly 700 are assessed at the Emergency Department for TBI. Twenty per cent of the patients are admitted in the ICU or Intermediate Care Unit. Almost the survivors are discharged at home. The consequences associated with brain injury are extensive. A majority of patients who are discharged at home do not receive any follow-up treatment.

Objective:

To identify and characterize injury variables and outcomes un persons with traumatic brain injury (TBI) admitted to a referral Hospital of Trauma in Buenos Aires state, Argentina.

Method: Material and Methods:

Prospective study of 48 patients with TBI covering a 3 year period in a referral hospital for trauma. Admission Glasgow Coma Scale (GCS) and computed tomography (CT) scan were used for patient's categorization. Glasgow Outcome Scale (GOS) and modified Rankin Scale (mRS) at discharge disposition and at 6–12 months postinjury.

Results:

Most common mechanism of injury was motor vehicle accident, and predominant computed tomographic scan finding was contusions, diffuse injury III, and subdural. The mean GCS motor (GCSm) was 4. Mean length of stay in acute facilities and the ward was 13.6 days, and 5.8 days respectively.

Mortality was 29,1%. More than 90% of patients were discharged home and didn't receive any follow-up treatment. There was improvement in GOS and mRS at 6 and 12 months.

Conclusions:

Most patients in this cohort had severe brain injury. Almost survivors require some rehabilitation treatment. Rehabilitation facilities are needed.

0512

Title: Effects of amantadine on post-concussion symptoms and neurocognitive performance in concussed adolescents

Cara Camiolo Reddy, Michael Collins & Mark Lovell

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Objectives: Amantadine, a dopaminergic agent with pre- and post-synaptic CNS effect, has been used for the treatment of arousal, executive functioning, and agitation following brain injury in adult and pediatric populations. To date, there has been no report of its use in the treatment of deficits following concussive injury. The aim of this study is to evaluate the effect of amantadine on post-concussion symptoms and neurocognitive performance in adolescents.

Method: This is a retrospective study utilizing a convenience sample of 29 consecutive male and female subjects undergoing evaluation and treatment through the University of Pittsburgh Medical Center Sports Medicine Concussion Program from 2006 through 2008. The subject pool consisted of individuals treated with amantadine after failing to recover following a prolonged period of rest. Following injury, all subjects underwent a clinical interview and completed the ImPACT computerized neurocognitive test battery. The neuropsychological testing modules of ImPACT are comprised of a series of 6 tests to yield four composite scores: Verbal Memory, Visual Memory, Processing Speed, and Reaction time. The ImPACT battery also includes a symptom inventory with a seven point Likert scale on twenty-two concussive symptoms. The athletes' self-reported symptoms and neurocognitive test scores were tracked until the time of recovery. All statistical analyses were conducted utilizing Statistica version 6.0. A repeated Measures of Analysis of Variance (ANOVA) design was utilized to evaluate change in ImPACT composite scores at different points in time.

Results: The sample consisted of 12 males and 17 females with an average age of 15.7 years (range = 13 to 18 years). The male and female groups did not differ significantly with regard to age, level of education, or prior concussion history. The average time post-injury for initiation of amantadine was 102 days (range = 14 to 544 days). Following the introduction of amantadine, test performance improved from pre-treatment levels on all ImPACT composite measures. In addition, subjects demonstrated a significant decrease in post-concussive symptoms following the introduction of amantadine.

Conclusions: Discussion: The majority of concussed individuals spontaneously recover following a period of cognitive and physical rest. There are no widely accepted interventions for those individuals with persistent neurocognitive deficits and post-concussive symptoms. In this study, amantadine was initiated for subjects who were not exhibiting spontaneous recovery following prolonged periods of physical and cognitive rest. Amantadine treatment resulted in a significant decrease in symptoms as well as improvement in all aspects of ImPACT.

0513

Acute and Chronic Toxic Effect of Cadmium on Some Haematological, Biochemical and Enzymological Parameters in the Freshwater Fish *Channa Punctatus*

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Objectives: Among physiological changes produced by heavy metals, energy metabolism has a key role as the animal forced to expend more energy to mitigate the toxic stress. Cadmium is reported to induce changes in organisms. However, longterm effect of cadmium on physiology of fish CHANNA in local conditions are little known.

Method: living specimens were procured from local ponds and were acclimatised in lab conditions. healthy fishes were divided in 10 groups of 30 each. 1st group was exposed to 11.2 ppm of Cd (LC50) for 96 hr and other for 15, 30, 60 and 120 days with sublethal conc. (1.12 ppm). Control was maintained in toxicant free water. fishes were sacrificed to get blood and tissues. Reference methods were adopted for estimation of various parameter, selected for the study.

Results: Fish were hypoglycemic and hypolactemic. liver, muscle and brain protein level was depleted. enzymes level was differently decreased or elevated. **Conclusions:** Glycolysis and gluconeogenesis was impaired in liver and brain. glycolysis prevailed in muscle. aerobic oxidation is adversely affected in metal exposed fish, while proteolysis was increased.

0514

Does Distractibility Inhibit Figural Fluency in Patients with Traumatic Brain Injuries?

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Objectives: The purpose of this study was to explore the effects of distracters in the Ruff Figural Fluency Test (RFFT) on patients with traumatic brain injuries (TBI). It was hypothesized that there would be differences in both number of Unique Designs and Perseverative Errors among low distractibility and high distractibility trials.

Method: A multi-group comparative research design was chosen. Using the RFFT, an outpatient total sample of 54 of patients with traumatic brain injury (27 individuals diagnosed with mild TBI and 27 individuals diagnosed with moderate to severe TBI's) was included for analysis. The RFFT was incorporated mid-way into a battery of neuropsychological tests and the number of unique drawings for each trial and the respective number of perseverations were recorded. Groups were partitioned by both severity of TBI and distractibility of trials (i.e., low distractibility and high distractibility) A series of single T-tests was utilized to evaluate total sample between group differences, for both Unique Designs and Perseverative Errors. A one-way ANOVA was utilized to evaluate distractibility by TBI severity in terms of Unique Designs and Perseverative Errors. **Results:** The total sample analysis revealed a significant difference between performances on high distractibility trials as compared to low distractibility trials for both for Unique Designs and Perseverative Errors. An analysis yielded no significant differences among the severity groups regarding Unique Designs or Perseverative Errors.

Conclusions: Important qualitative information can be lost if we look at only the combined results of

trials on the RFFT, and clinicians should also evaluate performances on low distractibility trials as compared to performances on the higher distractibility trials. Patients with TBI's are susceptible to higher levels of distractibility and the RFFT is sufficiently sensitive to capture this effect.

0515

Narrative Interviews with Family Members of a Traumatic Brain Injury Survivor: A Qualitative Inquiry.

Nicole Andreatta & Jan Ewing

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Objectives: Qualitative interviews informed by narrative practices were conducted to produce a more robust understanding of family reactions to brain injury over time and available resources needed both within and outside of the family unit (Camplair et al., 1990) as well as to establish praxis (Ewing, 2007).

Method: Narrative inquiry was used in this study as its own evolving form of qualitative inquiry, drawing from the narrative research methodology developed by Polkinghorne (1995) and modified by Chase (2005). Polkinghorne (1995) distinguished two primary approaches to interpreting text: paradigmatic analysis and narrative analysis. The paradigmatic analysis procedures produce categories out of common elements in narratives and stories. Chase's modification of Polkinghorne's (1995) analysis of narratives posited that the purpose of paradigmatic narrative study was to consider how the participants were supported and limited by social resources and how the participants developed interpretations. In contrast, narrative analysis involves the synthesis of actions, events, and happenings that produce stories as the outcome of the research process (Polkinghorne, 1995). A combination of these methods was utilized first to draw themes from the narratives of the participants and later to consider the ways in which the participants were organizing the events of their lives and taking action, as well as the social implications of their experiences (Bruner, 1986; Chase, 2005; Polkinghorne, 1995).

Results: The results of this study highlighted how participants tended to see head injury as a personal and private issue, as opposed to a personal and social issue. Society treats persons with disabilities as not normal, and it doesn't welcome difference. This very powerful but narrow way of thinking of the TBI

survivor (and by relation themselves) as abnormal resulted in the participants feeling angry, isolated, and marginalized. The power imbalance that these families were experiencing were coached and supported by power balances in the larger culture. The imposition of normalcy as a framework has grave implications for therapy. Chase (2005) suggests that when the researcher's interpretations of participants' stories reveal oppressive narratives, they create space for social change.

Conclusions: This study highlighted the marked impact of cultural messages about normalcy and operations of social control and how problems often arose because family members were convinced by their culture to believe in narrow and self-defeating views of themselves and the world. The findings in this study suggest that knowledge of these social influences and struggles may be helpful to rehabilitation professionals in addressing the specific needs of the families of TBI survivors. Narrative therapy is proposed as a way to examine these implicit and sometimes unexamined beliefs of family members living with disabilities as a result of TBI.

0518

Astragaloside IV decreases amyloid- β production by altering the processing of Alzheimer's amyloid precursor protein

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Objectives: This study investigated the effects of Astragaloside IV (AGS-IV) on secretion of β -amyloid protein ($A\beta$) — a core factor involved in the pathogenesis of Alzheimer's disease (AD) and amyloid precursor protein (APP) processing in human neuroblastoma cell line SH-SY5Y stably expressing Swedish-type mutated APP695 (SH-SY5Y-APP695sw).

Method: SH-SY5Y-APP695sw were incubated in Dulbecco's Modification of Eagle's Medium (DMEM)/Ham's F12 medium supplemented with AGS-IV with different concentration, the levels of $A\beta$ secreted in the medium were determined by sandwich ELISA, and the expression of FL-APP, sAPP, sAPP α , sAPP β sw and BACE1 were measured by western blotting. RT-PCR was performed to determine the level of transcription of APP and BACE1.

Results: AGS-IV at 20 μ M reduced the secretion of $A\beta$ 1-40 and $A\beta$ 1-42 in SH-SY5Y-APP695sw to $41.04 \pm 8.65\%$ and $40.40 \pm 9.37\%$ of control,

respectively, but these did not result from the reduction of APP transcription. Immunoblotting analysis showed that AGS-IV treatment did not change the levels of FL-APP ($114.81 \pm 2.48\%$, $P = 0.224$), sAPP ($91.71 \pm 15.11\%$, $P = 0.339$) and sAPP α ($122.59 \pm 21.0\%$, $P = 0.355$) produced by SH-SY5Y-APP695sw, and reduced the levels of sAPP β sw by $41.10 \pm 6.02\%$ significantly versus the control. AGS-IV treatment reduced the expression of BACE1 by $37.32 \pm 13.0\%$ at translational level and did not affect its transcription.

Conclusions: AGS-IV decrease the levels of A β from SH-SY5Y-APP695sw in dose-dependent manner by altering APP processing, but did not show significant difference between A β 1–40 and A β 1–42 decrease. AGS-IV modulated APP processing by downregulating the level of BACE1 without affecting its transcription. Our study indicates that AGS-IV, besides as an antioxidant, is capable of interfering A β production, and could have the potential to be a novel therapeutic agent to treat AD.

0520

Psychopharmacological treatment of apathy and aggression: two faces of one ‘brain coin’?

Jan Wiersma & Klaas Arts

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Objectives: Apathy and aggression are two of the most difficult problems to treat in brain injury patients. At the same time they are amongst the most frequent problems in the sequelae of brain injury. Psychopharmacological treatment is an important tool to relieve the burden of disease for the patient and relevant others (family, work). It is of great concern that the two guidelines published in the past years (one in the United States and one in the Netherlands) clearly show the same: there is almost no evidence based treatment. Worldwide the use of medication in treatment of (the above mentioned) behavioral problems is sky high, but almost all prescriptions are ‘off label’. The need for a clear paradigm and transparent advice use of medication is urgent.

Method: The literature (PubMed, Psychinfo) on the psychopharmacological treatment of apathy and aggression is summarized and evaluated on the quality in level of evidence. A comparison is made between the psychopharmacological treatment of apathy and aggression. Conclusions of existing

guidelines will be incorporated. The body of evidence will be used to find an explanation for this overlap looking to brain function.

Results: The comparison between the field of psychopharmacological treatment of apathy and aggression shows interestingly a clear and huge overlap. Medication used in apathy is also used in the treatment of aggression and vice versa. Some medication is used more exclusively in one of the two. This fact can be traced back to a specific braincircuit, which depending on how the balance is disturbed can lead to apathy or aggression.

Conclusions: There is a clear overlap between medication used in the treatment of apathy or aggression. This fact is not mentioned frequently and underestimated in understanding this from the perspective of one ‘braincoin’ with very different phenomenological expressions. This more functional view on the brain has also implications for future research.

0521

Aspiration Pneumonia Associated with the Use of Dantrolene Sodium in Low Level Responsive Patients with Traumatic Brain Injury

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Objectives: Dantrolene Sodium (DS) is commonly used as a first line medication to treat spasticity in patients with traumatic brain injury (TBI), particularly those at the lowest level of responsiveness. DS works outside of the central nervous system (CNS) to treat spasticity by interference with excitation contraction coupling of individual muscle fibers through inhibition of release of calcium from the sarcoplasmic reticulum. The rationale for its use in these patients is that there is no CNS depressant effect that may impair responsiveness or inhibit neuronal recovery as seen with other systemic spasmolytics.

Low level responsive brain injured individuals are at risk of many complications in the rehabilitation center because of their vegetative state. Aspiration pneumonia can be a significant complication of these patients because of an inability to protect their airway.

This is a case report of three patients on a specialized brain injury rehabilitation unit.

Method: Two male and one female patients are described after admission to a low level responsive brain injury program.

Patients suffered a severe closed head injury as a result of a high speed motor vehicle accident and were admitted to the rehabilitation center from an acute trauma center at a Rancho Los Amigo Scale II. All patients had severe spasticity as a result of their injury which was not responsive to conservative measures such as stretching, range of motion, or serial casting.

Results: Patient 1: The patient was started on DS for generalized hypertonicity and was noted on flexible fiberoptic examination to have frank aspiration of oral secretions. After DS was discontinued repeat laryngoscopy showed resolution of aspiration.

Patient 2: After initiation of DS for generalized hypertonicity this patient was noted to have significant loss of ability to swallow his secretions and was noted to have copious drooling. Symptoms resolved with discontinuation of DS.

Patient 3: During titration phase of DS for generalized tone this patient suffered a severe aspiration pneumonia requiring transfer to ICU for ventilation and respiratory support. The patient had no significant neurologic improvement though there were no further clinical aspiration events after DS was discontinued.

Conclusions: DS is often utilized by clinicians as a first line agent to treat generalized hypertonicity in moderate to severe brain injury because its peripheral site of action is thought to avoid sedation and possibly inhibition of central neuronal recovery DS, however, may lead to weakness of pharyngeal muscles which may increase the risk for aspiration particularly in the case of the low level responsive patient.

0523

Fatigue After Traumatic Brain Injury: Association With Neuroendocrine, Sleep, Depression, Pain, and Other Subjective Complaints

Jeffrey Englander¹, Tamara Bushnik¹, Jean Oggins⁴ & Laurence Katznelson²

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Objectives: Although fatigue is a common experience in the general population it is particularly bothersome to those with traumatic brain injury (TBI) with prevalence estimates of 16–80% of individuals after TBI. Associated symptoms include depression, sleep disturbance, cognitive and motor disturbances and pain. In addition, neuroendocrine abnormalities as manifested by pituitary dysfunction can occur after TBI and these symptoms can overlap with those associated with TBI. We embarked on this study to better define those associations in a community sample of individuals with TBI. The hypotheses were: 1) There would be an association between hormone abnormalities and fatigue; 2) sleep quality would be associated with fatigue; 3) depression would be associated with fatigue; 4) pain, memory and cognitive functioning would be associated with fatigue.

Method: 119 community-dwelling individuals with TBI of at least one year duration were recruited. Participants fasted from midnight the night before with only water and morning medications permitted. The protocol, including completion of blood tests and study questionnaires, required approximately four hours, beginning between 8am and 10am. Subjects underwent a baseline blood draw to assess levels of glucose, cortisol, free T4, thyroid stimulating hormone (TSH), insulin growth factor – 1 (IGF-1), a complete blood count series, and basal growth hormone (GH). Dynamic assessment of GH was obtained through serial blood draws following an intramuscular injection of glucagon. Participants also completed the Multidimensional Assessment of Fatigue (MAF); Fatigue Severity Scale (FSS); visual analog pain rating; Pittsburgh Sleep Quality Index; Beck Depression Inventory–II; Disability Rating Scale; Craig Handicap Assessment and Reporting Technique; and Neurobehavioral Functioning Inventory.

Results: Fifty-three percent reported significant fatigue on the MAF compared to one-third on the FSS. 68% had problems with sleep (PSQI) and 33% reported moderate to severe depression (BDI-II). 65% were found to have moderate to severe growth hormone deficiency; 64% had adrenal insufficiency as defined by a low fasting cortisol; 12% had central hypothyroidism; and 15% of men had testosterone deficiency. Low serum IGF-1 correlated with time since injury and duration of unconsciousness. Pituitary dysfunction did not correlate with fatigue or other symptoms. Significant predictors of fatigue as measured by the MAF were female gender, depression, pain, and perception of memory deficits. Significant predictors of fatigue as measured by the FSS were depression, perception of motor deficits, and using anti-depressants.

Conclusions: The most robust correlates of fatigue were gender, depression, pain, and self-assessment of memory and motor dysfunction. Investigation of post-TBI fatigue should include screening for depression, pain and sleep disturbance. There was no correlation between pituitary dysfunction and fatigue. However, because the prevalence of hypothyroidism and adrenal dysfunction in this population was high, screening for these hormone deficiencies is also recommended given the relative ease and cost efficacy of replacement.

0524

Education and Outreach In The 21st Century: Using Friends, Tweets, and Peeps To Build an Online Community

Victoria Youcha

WETA, Arlington, VA, United States

Objectives: A 6/2/09 New York Times article, "Online, a Reason to Keep On Going," discusses using online social networks with older adults to provide some of the same benefits as a group of friends. This presentation is about using online networks to help those affected by brain injury stay connected. It will demonstrate how social networking sites – Facebook, LinkedIn, Twitter, and YouTube – can be used by the brain injury community. Participants will learn about setting up a Facebook group for their consumers and other online resources related to traumatic brain injury. Participants will learn: 1. How to help consumers use the Web to find authoritative information and social support; 2. Which social networking sites and existing groups provide trustworthy support and information to people with TBI and their families; and 3. How to use social networking to share information with TBI survivors and their families.

Method: This interactive session will take participants to several sites to demonstrate how social media can be used to help people with brain injury and those who care for them.

A brief handout will provide valuable links to additional information and basic guidelines for getting started.

Results: After this session participants will know:

- (1) The latest on-line resources available to the brain injury community;
- (2) How to use existing on line communities to build social supports for consumers;
- (3) How to set up a secure group on Facebook; and

- (4) Strategies for safely and creatively using social networking resources to help overcome the isolation that so often hinders the recovery of those with a brain injury.

Conclusions: The internet, when used wisely, can be an important source of information about brain injury and in addition can be used to teach and learn specific skills. Professionals who understand how the strategic use of social media can benefit those affected by brain injury have the opportunity to create and support a sense of community, reduce social isolation, and provide a venue to practice social interactions.

0524

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0526

Measuring Outcomes of Community Integration Programs: A case study

Carolyn Lemsky¹ & Deirdre Dawson²

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Objectives: When the ongoing consequences of brain injury are significant and the gap between pre and post injury abilities great, the challenges of community integration are difficult to bridge. Measuring the success of programming to promote community integration presents equal challenges. There is little agreement about how community integration should be measured. Community participation is a personal matter, defined by individual values, preferences and needs. There are objective markers of integration, including independence in daily activity and vocational success which benefit society at large and may be used to justify a program's existence—but these don't tell the whole story. Individuals with brain injury may experience low life satisfaction for a variety of reasons that include limited awareness and the necessity to cope with a great loss in the context of significant cognitive impairment. This presentation will provide an assessment of the effects of a community integration program that included case management, and options for recreational programming, psycho-educational programming and outreach services and in a group of 32 people who

had been without community integration services for as much as 15 to 20 years.

Method: A group of 32 individuals were admitted to a program designed to support the aging caregivers of people living with acquired brain injuries. To be eligible for services, caregivers and/or survivors needed to be over the age of 55 years and living within a specific area of metro-Toronto. Services offered included case management, four hours of direct service per week and access to a variety of community-based programming. Caregivers and survivors completed assessment at admission and after six and 12 months of service. Measures included the Center for Epidemiological Studies – Depression Scale (Radloff, 1977) Mayo-Portland Adaptability Inventory-4 (Lezak & Malec, 2005); Satisfaction with Life Questionnaire (Diener, Emmons, Larsen & Griffin, 1985); Canadian Occupational Performance Measure (Law et al., 2005) and Zarit Burden Interview (Zarit, Reever, & Bach-Peterson, 1980) and a satisfaction with service interview conducted by an interviewer un-related to the service recipient's care.

Results: Both caregivers and survivors had significant difficulty in completing the full assessment battery. Interviews were required to collect sufficient information. Survivors reported a high level of satisfaction with programming. The most valued services included vocational and socialization options, case management and respite. Preliminary analyses suggest a trend toward demonstrating psychological and social benefits for survivors and caregivers.

Conclusions: This program evaluation provides evidence for the need for community based community-integration services. In our sample, individuals who had previously been without these supports reported the greatest gains in mood and productive activity. Our findings also suggest that there is a need for qualitative methodologies to capture the full benefits of programming.

0527

A Randomized Clinical Trial of a Cognitive Orthotic with Executive Planning Capability in Individuals with Cognitive Dysfunction

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Objectives: Individuals with brain injury experience deficits across a number of functional domains. Cognitive deficits can be the most disabling since almost every aspect of the individual's life may be affected. Disease processes that affect the brain can also produce cognitive deficits similar to those observed following brain injury. While it is clear that cognitive orthotics can provide some benefit to individuals with memory and functional deficits, the ability to provide support for higher level executive function, such as flexibility in task scheduling, is lacking. One commercially available device, the Planning and Execution Assistant and Trainer (PEAT), was developed to serve as an executive function orthotic device. Therefore, this randomized controlled clinical trial examined whether individuals with cognitive impairments utilizing PEAT demonstrated better outcomes 3 and 6 months post-implementation than comparable individuals using current "community standard" cognitive/memory strategies.

Method: One hundred and twenty-five community-dwelling individuals at least one year post injury/diagnosis with cognitive impairments were recruited prospectively from the community. The baseline assessment consisted of a demographic intake form. For those with TBI, etiology of injury, duration of post-traumatic amnesia, and time to follow commands was collected. The Repeatable Battery for the Assessment of Neuropsychological Status was administered to document cognitive impairment. The following measures were assessed serially at baseline, 3 and 6 months after study initiation: the Kohlman Evaluation of Living Skills (KELS), Disability Rating Scale (DRS), the Participation Index of the Mayo-Portland Adaptability Inventory – Version 4 (M2PI), Supervision Rating Scale (SRS), Craig Handicap Assessment Reporting Technique – Short Form (CHART-SF), and the Diener Satisfaction with Life Scale.

After completion of the baseline assessment, each participant was randomly assigned to the PEAT (intervention) or community-standard (control) group. Each group received 11 hours of training in the implementation and use of the assigned cognitive aid. Participants used their cognitive aid outside of the training setting and were assessed at 3 and 6 months post-protocol initiation.

Results: Both groups were comparable on all baseline measures. Drop-out rates were similar between the two groups and there were no significant differences between those who dropped out or completed the study. The PEAT group showed greater

improvement than the control group in M2PI scores ($F = 5.70$; $p < 0.001$). However, all participants showed improved scores on the DRS, KELS, SRS, CHART Occupation and decreased scores on the BDI-II. Most improvements came 3 months into the study, with decreases in depression and need for supervision coming at 6 months also.

Conclusions: There were select improvements in overall functioning for the PEAT group. Both groups demonstrated improvements across multiple dimensions suggesting that therapeutic interventions for the purpose of implementing cognitive aids can be beneficial even many years post diagnosis.

0528

Long Term Outcomes after Traumatic Brain Injury for Women

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Objectives: Although the traumatic brain injury (TBI) population typically has a greater proportion of men, there is a dearth of information on outcomes specific to women. These include factors related to reproductive health and services specific for women. The aim of this presentation is to address this inequity of research focus by examining long term reproductive, health, and functional outcomes relevant to women.

Method: The study utilized a retrospective cohort design and recruited women 18–40 years at time of TBI from eight acute and rehabilitation facilities across different geographic regions in Ontario, Canada. A face-to-face structured interview was conducted with women 5 to 10 years post moderate to severe injury ($n = 104$). A control population matched on age, education and geographic location was recruited using random digit dialing ($n = 104$). Outcomes included reproductive function (menstrual cycles, fertility, pregnancy), self rated general and mental health as measured by the Medical Outcomes Short Form-36, and cervical cancer screening. Conditional logistic regression analyses were performed.

Results: Amenorrhea and irregular cycles were common after TBI with (OR: 20.5; CI 6.31, 125.78) and (OR: 6.41 ;CI 2.72, 18.87) respectively. There were no significant differences with respect to ability to conceive or successfully carry a pregnancy between cases and controls; however, women with TBI reported significantly more post partum difficulties (OR: 3.25, CI 1.07, 10.40). Women with TBI had significantly lower mental health and more limitations in activities of daily living ($p < 0.001$). The difference between cases and controls regarding cervical cancer screening within the last three years was borderline significant ($p < 0.06$).

Conclusions: These findings support long-term monitoring of women's health outcomes after TBI, including reproductive health. Additionally, increased support after childbirth should be considered. More research is needed in this area, particularly with respect to any relationship with the neuroendocrine system, and potential barriers to access of specific preventive health services specific to women.

0529

Integrating Top-Down and Bottom-Up Interventions in Comprehensive Neurorehabilitation for TBI: A Synergistic Approach

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Objectives: Deficits in attention, processing speed, and executive functioning are among the most commonly reported and debilitating impairments following TBI. Comprehensive Day Treatment (CDT) is an evidence-based treatment for TBI-related impairments that incorporates neurorehabilitation, psychotherapy, and psychoeducation. Building on contemporary hierarchical models of cognitive functioning suggesting that attention/arousal processes underlie and support higher-order functions, and on decades of clinical research on the effectiveness of CDT, we have developed a CDT intended to directly address impairments in both foundational (i.e., attention) and higher-order (i.e., executive functions) processes. This paper presents a description of this novel model of CDT that utilizes both bottom-up (i.e., intensive individualized attention training) and top-down (i.e., strategies to be

generalized across situations) approaches to synergistically rehabilitate impaired functions after TBI.

Method: Two randomized-clinical trials (RCT) are currently underway to test the efficacy of a CDT that emphasizes the remediation of higher-order executive functions and basic attentional processes. Executive dysfunction is addressed in a top-down fashion through a series of problem-solving and emotional regulation modules that teach, practice, and integrate strategies that can be generalized across situations. Since attention, arousal, and information processing are necessary prerequisites of successful higher-order thinking, attention skills are addressed in a bottom-up fashion through intensive individualized attention and processing training tasks.

Results: Excerpts from the treatment manual and case examples are provided to illustrate the synergistic impact of simultaneously employing both top-down and bottom-up approaches in the remediation of cognitive and functional skills after TBI. Although data collection is ongoing, it appears that bottom-up remediation of attentional processes allows for more efficient learning and implementation of top-down strategies, in addition to enhancing awareness of deficits and self-monitoring of strategy use. In addition to explicitly incorporating top-down and bottom-up approaches in the remediation of executive functions and attentional processes respectively, techniques for incorporating both top-down and bottom-up methods in the remediation of other cognitive and functional domains are discussed.

Conclusions: Combining top-down and bottom-up approaches within a CDT appears to have a synergistic impact on overall functioning. Bottom-up attention training can improve sustained attention, inhibition of distraction, and arousal regulation. Improvements in these areas can enhance the ability to learn and apply top-down strategies in order to improve executive functioning. In turn, application of top-down strategies allows for environmental modification and self-structuring that can optimize attention and processing. Together, these approaches facilitate optimal functioning and generalization of gains outside the rehabilitation context.

0530

Acquired Aphasia And Apraxia: What Correlations Are And How They Work? A Longitudinal Case Study.

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Objectives: The purpose of this paper is to evaluate the clinical evolution of a 16-years-old boy (IS) with acquired aphasia and apraxia after anoxic encephalopathy with coma following heart ventricular fibrillation.

The clinical and instrumental evaluation of IS, his neuropsychological assessment and a scientific literature review about the attentive system and the executive functions let us assume a correlation between difficulties with verbs in comprehension/production and difficulties with recognition/reproduction of human observed actions.

Lots of studies examined both nouns/verbs dissociation in aphasia (Luzzatti et al., 2002), and attentive processes/specific modular disturbances relationships.

Particularly, in accordance with Moscovitch & Umiltà model (1990), the specific modular processes are related, as a continuum, to attentive central systems forming complex interactions. According to that, in our case study, the II and the III modules could have been damaged, the central executive system appointed to provide attentive resources in double task, in changing demands, in working memory and in the holding of more peripheral and modular attentive processes for checking the thought and the action.

The II module could get involved in the aphasic disorder, while the III one could get involved in the apraxic difficulties and in alexia-agraphia.

Method: Starting from these preliminary remarks, after the recording of neuropsychological baseline showing a correlation between the difficulties with recognition/reproduction of actions and the difficulties with verbs in comprehension/production, a rehabilitative training program was performed. In addition to the traditional therapy, a specific training based on the theoretical bases expressed before and on the recent evidences of mirror neuron system, was carried out. The intervention plan provided:

- exercises of focused and shared attention (through progressively complex tasks of attentive shifting)
- activities of recognition, reproduction, verbal comprehension, verbal production based on dynamic visual perception (short films) of human actions
- exercises of imitation and delayed reproduction of daily living actions
- exercises of imitation and reproduction of high-impact emotional actions

Results: The extensive rehabilitation program was carried out for 5 months. After a 8 weeks interval in

the training activity, the study checked up the IS present neuropsychological skills. The statistical analysis of collected data confirmed a correlation between the recovery of praxic skills and linguistic ones, especially those regarding verbs.

Conclusions: The development of the skills considered in our study, after neuropsychological training, confirms the hypothesis that aphasia and apraxia were expression of a disorder involving the attentive system and the executive functions.

The persistence of alexia/agraphia could be consistent with an incomplete recovery of attentive processes depending on III module.

We mostly claim that every kind of learning process needs attentive resources to develop, therefore the rehabilitation has to focus not only on the specific deficit, but also to the dedicated attentive modules and to the executive functions.

0531

Constraint-Induced Movement Therapy and Neuropsychological Rehabilitation in a 7-Months-Old Child with Left Hemiplegia and Unilateral Spatial Neglect After Traumatic Brain Injury

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Objectives: The consequences of a severe traumatic open brain injury, with an open fracture in the right parietal and occipital areas of the skull, total destruction of the right parietal lobe and partial injury of the right temporal lobe in a 7-months-old child, are described as the rehabilitative intervention of left hemiparesis with Unilateral Neglect (U.N.). Evaluating the effectiveness of constraint-induced movement therapy (CIMT) on the body's injured side and of neuropsychological rehabilitation to improve quality of movement and substantially to increase the availability of reaching and grasping in basic activities and in intentional activities; describing relative rehabilitative choices in agreement with the concepts of M. Jeannerod, G. Rizzolatti, M.A. Arbib, L.C. Robertson, G. Edelman and A.R. Damasio, in this particular case - regarding the age (7m) and the injury area (right parietal lobe and part of the right temporal lobe).

Method: We used a single-subject experimental design: a 7-month-old boy with hemiparesis and neglect following traumatic brain injury was evaluated with standard assessments during the first year

of intervention. The intervention included Constraint-Induced Movement Therapy (CIMT) and selective rehabilitative training of modular subfunctions of visual exploration and localization movements, and visual perception toward his left hemispace, moreover the involvement active/passive of left upper limb (reaching) and left hand (grasping) was used with specific activities and dedicated objects (toys) organising functional abilities by means of its perceptive qualities (acoustic, tactile, visive), cognitive aspects and motivational attractions.

Results: The child presented a complete recovery of reaching and grasping of upper left limb, with a thin awareness disorder, variable according to the characteristics of the task, to the context of trial, and to the related approach of the operator, which the level and the length of the child's awareness seemed to depend on. The child developed other new motor behaviours (holding, releasing, lifting, rotating, transferring, pulling, manipulating objects, gesturing, self-feeding, walking).

Conclusions: We consider the theoretical implications concerning the interactive assessment and rehabilitation of awareness/consciousness disorders and their hidden dangerous presence under movement disorders after TBI in early childhood. The CIMT role has been decisive to facilitate interpersonal interaction (between the child and care giver) focusing the attention on the interaction of his left body and the environment (relationship among body, objects and background). Constraint-induced movement therapy appears to be both feasible and efficient in children with acquired brain injury, mostly in the presence of motor unilateral spatial neglect.

0532

Acquired Brain Injury: psychiatric and neuropsychological findings

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Objectives: Since 2005 a rather unique project is carried out in the Netherlands: psychiatrists, neuropsychologists and neurologists are working together in an assessment procedure for children and adolescents with severe behavioral disorders and mABI. The aim is to get more insight in the coherence of psychiatric disorders and neuropsychological dysfunctions in children with mABI and the implications for treatment planning.

Method: 50 patients were referred to our out-patient clinic; data were collected of the psychiatric as well as neuropsychological and neurological examinations and these data were related to premorbid status, school history, social emotional background and cognitive levels of functioning. Special data-analysis is carried out regarding problems in information processing skills and executive functioning.

Results: Children with ABI are at risk for developing psychiatric disorders as a (direct) result of their brain injury and neuropsychological dysfunctioning. ADHD, conduct disorders and also autistic-like behaviors were often reported as well as decreasing levels of cognitive functioning.

Conclusions: It's essential for children with ABI to carry out multidisciplinary examinations in which not only neurological status, but also psychiatric, neuropsychological and cognitive functioning is taken into account to come to appropriate treatment and rehabilitation programs.

0533

Information and Advice after Minor Head Injury in the UK and Eire

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Objectives: In the UK up to 20% of all patients attending emergency departments (ED) present with head injury (HI), corresponding to 700,000 - 1,000,000 patients/year. Around 90% have minor HI (MHI) and the majority are discharged home directly from the ED. National guidelines provide guidance on the information and advice to be provided to patients discharged from EDs with MHI, however local studies have found that advice and information varies considerably from ED to ED. The aim of the current study was to survey all 319 EDs in the UK and Eire to evaluate the written information provided to patients and carers.

Method: The lead nurse at every ED was asked to complete a questionnaire and return a copy of the MHI information sheet(s) used at their ED. The questionnaire collected data on whether the sheets were available in other languages and formats and if separate sheets were available for children. An 'ideal' MHI information sheet was created from national guidelines incorporating 3 main areas: clinically important signs to trigger a return to the ED; post-concussion symptoms (PCS); and advice to aid

recovery. Each ED's MHI information sheet was scored against the 'ideal' sheet by two independent researchers.

Results: Over 80% of EDs (258/319) have responded so far and data is still being received. There is wide variation in the quality and quantity of advice provided to patients. Of the responses analysed, only half provide information on PCS. Few sheets stated that sleeping pills, tranquilisers and sedatives may mask symptoms requiring emergency medical attention. Most advised the patient to avoid alcohol, but only 20% advised against using recreational drugs. Patients were advised to cease playing contact sports for anything from 24hrs to over 3 weeks. Advice to parents of a child with MHI varied considerably, some recommended waking the child every 2 hours, others did not. Full analysis will be completed by January 2010.

Conclusions: Despite national guidelines designed to harmonise information and advice many EDs use their own MHI information sheet leading to considerable variation across the UK and Eire. In larger EDs, CT scans are now routinely carried out on patients with GCS < 15 and loss of consciousness. However smaller EDs do not have 24 hour access to CT. Patients discharged from these centres should receive clear information on symptoms triggering return to the ED but this is not always the case. The risk of intracranial haematoma after MHI is low, but the consequences of missing one after discharge can be fatal. Only half the EDs gave any information on common post-concussional symptoms. The UK is multi-cultural yet few EDs provided MHI information in languages other than English.

0536

The use of sodium amytal in psychogenic and pain related impairment associated with acquired brain injury

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Objectives: Sodium amobarbital or amytal is a medium action barbiturate that was first synthesized in 1927. It was subsequently approved by the FDA in 1938 and is currently a schedule II drug in the United States. The drug was first used by Dr. William Bleckwenn at the University of Wisconsin to circumvent inhibitions in psychiatric patients. It has subsequently been used to both diagnose and treat a myriad number of conditions including catatonia,

psychogenic amnesia and fugue states, unexplained muteness, disorders of consciousness, conversion disorders including pseudo-neurological states such as non-organic sensory loss, blindness, hemiparesis and movement disorders, depression and anxiety related disorders, as well as, certain pain related disorders including allodynia secondary to central sensitization. Our experience which is confirmed by the literature in the last 20 years is that this technique is both poorly understood by clinicians and rarely utilized in clinical practice.

Method: We will discuss the clinical indications, utility and technique of the amytal drug assisted interview and present 10 cases where we utilized such interviews with patients who had a history of presumptive traumatic brain injury who benefited in the context of overall assessment and/or treatment from use of amytal assisted interviews either on a one time basis or serially.

Results: We have found that sodium amobarbital (i.e. amytal) can be a useful adjunct to the assessment and treatment of a variety of clinical conditions seen in conjunction with claimed or confirmed acquired brain injury, particularly when there are issues of significant psychogenic overlay (which may manifest in a number of different clinical presentations including conversional signs and symptoms, as well as, intractable anxiety) and/or chronic pain, including tension headache, psychogenic pain, and centrally sensitized pain. We will also discuss our experience with patients who do not historically do well with this intervention.

Conclusions: Amytal drug assisted interviews, although currently rarely discussed in the context of acquired brain injury neurorehabilitation, neuropsychiatry, neurology and/or psychology, can provide a useful adjunct to clinical assessment and management of a number of different challenging psychological/psychiatric, as well as, physical impairments seen in persons with claimed and/or confirmed brain injury.

0538

Exploring Alternative Methods to Increase Endurance in Patients with TBI in Long Term Care Settings: Use of a Recumbent Tandem Tricycle.

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Objectives: Individuals who have sustained a traumatic brain injury (TBI) often present with multiple deficits affecting the physical, cognitive, and psychosocial aspects of their lives. Due to the unique challenges these combinations of deficits can present to participation in traditional methods of cardiovascular exercise, there are often secondary issues that arise, such as risk of weight gain and the associated health risks with being overweight. An emphasis is placed on reaching and maintaining an ideal body weight range to ensure these health risks are minimized. Consistent participation in cardiovascular exercise is required to effectuate an increase in endurance and cardiovascular health and to prevent weight gain.

Method: At our facility we were able to use a recumbent 2-man tricycle with several clients with a history of TBI. These clients were post injury from 2–8 years, ranging in age from 26–53, and they were all male. All clients have had severe brain injuries with a varying degrees of residual hemiparesis (MMT from 2–4) and spasticity (Modified Ashworth from 0–3). Two were non-ambulatory without moderate physical assistance and an assistive device.

One member of the therapy staff would ride in the front of the tandem tricycle with the client for a timed session with distance measured after the ride.

Results: The benefits we saw were the ability to train someone at higher Met levels than what they tolerated with more traditional exercise. The reasons for this were likely multi-factorial. As a comparison, we utilized response to using our indoor Sci Fit bike and consistently found higher met levels with the tricycle. All four clients assessed lost weight during the period of observation; per ideal body weight measurements. This is likely due to multiple factors including the new addition to their exercise regimen. In addition to training at higher met levels, we also found we could increase treatment time with some of our more distractible clients whose attention seemed to be better maintained during the tricycle exercise activity. Client specific results will be presented in the poster presentation.

Conclusions: We were successfully able to implement a recumbent tandem tricycle into our training regime with many clients. We were also able to encourage exercise at higher met levels to improve cardiovascular endurance and, in theory, affect IBW.

Our observation provoked an interest in searching for additional studies that have researched the following areas: bike based motor re-learning and carryover to mobility, influence of endurance activities on re-learning and retention of new motor skills, and the benefits of this type of alternative exercise program on the consistency of participation within the TBI population.

0539

Anger Self-Management Training for Traumatic Brain Injury: A Preliminary Investigation

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Objectives: Anger and irritability are common, persistent problems after traumatic brain injury (TBI) and negatively affect social outcomes. Problematic anger post TBI has multiple, interacting causes but few effective treatments. We developed and pilot tested an 8-session, manualized Anger Self-Management Training protocol for persons with TBI. In this paper we present the theoretical basis of the intervention, which focuses on self-awareness and problem-solving training; describe how hypothesized active ingredients were operationalized in treatment materials and methods; and present pre- and post-treatment findings, as well as qualitative data on feasibility and acceptability, from the first 6 participants completing the full protocol.

Method: Inclusion/ exclusion criteria included moderate to severe TBI at least 6 months prior to enrollment; self-reported anger worse than before injury; elevated scores on selected subscales of the State-Trait Anger Expression Inventory-Revised (STAXI-2) and/ or the Brief Anger- Aggression Questionnaire (BAAQ); no psychosis, (hypo)mania, major depression, or suicidality. The 6 participants (5 male; 3 white, 3 black) were ages 31–59, enrolled at 6.4 to 107.7 months post TBI. Baseline measures included neuropsychological tests, a Readiness to Change scale and the Brief Symptom Inventory-18 to assess emotional status. The anger and emotional measures were re-administered 1 to 3 weeks after the final treatment session. After extensive therapist training, treatment was conducted one-on-one, with significant others (SOs) invited to portions of 3 sessions. All participants completed all 8 sessions.

Results: Participants showed mean pre-treatment elevations on the BAAQ and on STAXI-2 scales measuring trait anger and anger expression, with low scores on anger control. Comparison of pre- and post-treatment scores using Wilcoxon tests showed a trend for improvement on the BAAQ ($p = .08$) with 4 of 6 participants showing substantial improvement (≥ 1 SD). On the STAXI-2, Trait Anger also decreased ($p = .11$), with 5/6 individuals showing improvement. Change on Anger Expression-Out was significant ($p = .04$), with marked changes (≥ 1 SD) for 3 participants. Preliminary data suggested

that less time post injury, involvement of an SO in treatment, and better executive function were associated with positive change from pre to post treatment. Self-rated readiness to change, demographic factors, and memory performance were not associated with change in this small sample. In structured de-briefing, all participants reported positive responses to the program regardless of their degree of quantitative change.

Conclusions: These preliminary findings provide support for a manualized self-management approach to treatment of anger post TBI. Further research is needed with a larger sample to extend these findings and to identify the minimum necessary dose, participant characteristics predictive of treatment response, specific active ingredients, and long-term clinical impact.

0540

Improved Control Of An Orthosis Attached To A Paralyzed Hand Through Brain-Computer Interface (BCI) Training After Traumatic Brain Injury: A Case Study.

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Objectives: A traumatic brain injury patient with chronic left hand paralysis trained to use motor imagery to control a hand orthosis connected to a magnetoencephalographic (MEG)-based brain-computer interface (BCI). The BCI mechanically opens-closes the hand based on the state of the mu-rhythm. In healthy persons, this rhythm is in a synchronous state while the person is at rest. Movement and imagining movement causes mu to desynchronize. We intended to entrain the ipsilesional motor cortex through imagined movements of the paralyzed hand to control the BCI and hand orthosis. Entrainment was assessed at 4 times over a 2.5 month training period.

Method: The patient was asked to performed the trained tasks (imagine opening-closing the paralyzed hand; rest), and attempted to open-close the

paralyzed hand, 8 times each in a block design with the action (rest) performed continuously for 20 seconds. Data were recorded from all MEG sensors and frequencies. Synthetic aperture magnetometry (SAM) was used for 3-dimensional localization of source power. 3D source strength was calculated using a spatial filter created from the covariance of the active state (imagery, or attempted movement) and rest. The data was then aligned to the patient's structural MRI. The minimum and maximum source strength power ratios in 2 regions-of-interest (left Brodmann Area (BA) 4 and ipsilesional right BA4) were calculated for the mu frequency band (6–14Hz). With SAM, a negative power ratio would indicate an active state desynchronous in comparison to the rest state.

Results: Imagery: minimum power in healthy (left) BA4 became less desynchronous (measurement 1 = -0.469, 2 = -0.307, 3 = -0.174, 4 = -0.184) while the affected (right) BA4 changed little (-0.134, -0.098, -0.065, -0.045); maximum power in both hemispheres was barely synchronous and did not exceed 0.121. Attempted Movement: minimum power in left BA4 became more desynchronous (-0.041, -0.386, -0.393, -0.204) as was the case in the ipsilesional BA4 (0.203, -0.029, -0.21, -0.015); more notably, maximum power rapidly decreased from a high level of synchrony in both hemispheres (healthy BA4: 0.935, 0.118, 0.012, 0.011; affected BA4: 1.016, 0.073, 0.088, 0.136).

Conclusions: These results indicate that (a) a patient with complete motor paralysis secondary to TBI can learn to control grasping motions of a hand orthosis attached to the paralyzed hand through control of mu rhythms in the ipsilesional hemisphere and (b) motor imagery training induces cortical reorganization in the ipsilesional hemisphere after TBI.

0541

Improving Outcomes of Severe Disorders of Consciousness

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Objectives: To evaluate the efficacy of an Advanced Care Protocol (ACP) in treating patients with SDOC. Following ACP treatment, rates of clinical progression and emergence in a sample of SDOC patients were hypothesized to be greater than published rates of recovery for “standard of care” medical treatment.

Method: Forty-one patients with SDOC were assigned to groups: Vegetative State (VS) traumatic etiology (VS-TBI), VS non-traumatic etiology (VS-NTBI), Minimally Conscious State (MCS-TBI), MCS non-traumatic etiology (MCS-NTBI). Design was a within-subjects retrospective case series measuring pre-post ACP intervention data. The ACP was administered sequentially over 12 weeks, incorporating traditional therapies (occupational, physical, speech), pharmaceuticals, median nerve stimulation, and neutraceuticals. Main Outcome Measures were: Pre- and post-treatment Disability Rating Scale (DRS), Functional Independence Measure (FIM), Glasgow Coma Scale (GCS), and Coma Recovery Scale-Revised (CRS-R); clinical diagnosis (VS, MCS, emerged) using criteria from the American Academy of Neurology and Mohonk Report.

Results: Patients significantly improved across all outcome measures, from baseline to discharge. Clinical improvement of 100% of MCS patients and 78–86% of VS patients was observed following ACP treatment. Significant differences between ACP vs. the published “standard of care” rates, in favor of the ACP, based on DRS scores and on clinical status at discharge.

Conclusions: These strikingly positive results of a novel multimodal intervention are a valuable contribution to this frontier of investigation.

0542

Challenges in Consent and Assent in Severe Disorders of Consciousness Patients

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Objectives: With novel and innovative treatments and research protocols addressing severe disorders of consciousness, the ethical and practical challenges of informed consent and assent have come center stage

for rehab institutions, health care teams, families and patients. The following paper/presentation 1) discusses the ethical framework of respect for the patient by researchers and by surrogate decision-makers; 2) presents issues of written consent by guardians who have been authorized to decide on behalf of the patient, 3) provides examples of determination of need for assent; 4) shares a practical model for implementation.

Method: A description and discussion of team members, assessment measures, and the decision-making process will be presented regarding informed consent and assent of SDOC patients. The need for objective and clinically practical methods in this process will be discussed and the issues of burden, suffering, and benefit will be reviewed. Additionally, through example, specific criteria will be shared that can help facilitate determination of when and how assent may occur.

Results: By following a procedure of informed consent and assent with SDOC patients that is ethically minded, open, and consistent, the interests and needs of individuals and families are best protected, while simultaneously allowing for implementation of innovative medical treatments to occur. A multi-disciplinary team approach that includes physician, nursing staff, SDOC program co-ordinator, PT/OT/ST, and neuropsychology is optimal. The SDOC consent procedure should occur in the context of the Belmont Report guidelines of Respect, Beneficence and Justice. Additionally, measures to effectively determine when assent should occur are necessary in the informed consent/assent plan.

Conclusions: As we look to ethical, medical decision-making models in other areas of health disease and disorders as our guide in the frontier of SDOC research and treatment, we must continue to develop specific informed consent and assent guidelines for SDOC research in order to facilitate medical advances. Although it is by pursuing experimental treatment that we have made such medical advances, we must also commit ourselves to protect this patient population and their families. To achieve this delicate balance, and to better serve this patient population in the future, we must ensure standardized and specific processes for informed consent by surrogates, and assent by patients, thus allowing scientific research to occur in this underserved population.

0543

Discovery and translational utilities of acute, subacute and chronic brain injury biomarkers

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Objectives: Traumatic Brain Injury (TBI) is a major problem in civilian and military medicine. TBI can be classified by using Glasgow Coma Scale, length of loss of Consciousness (LOC) and Period of Posttraumatic Amnesia (PTA) and CT abnormality into severe, moderate and mild. Among civilians, there are over 1.7 million TBI cases in the U.S. annually. Among combat veterans, up to 20% of meet the criteria for MTBI (conventional and blast-related) on post-deployment screening. Importantly, a subset of individuals affected by MTBI are eventually diagnosed with postconcussion syndrome (PCS), characterized by persistent symptoms, cognitive complaints and other impairments that significantly impact their normal daily function, resulting in long-term disability. Yet, there are no simple non-invasive FDA-approved diagnostics for acute brain injury. Our goal is to develop and clinically validate blood-based biomarker assays for the diagnosis, prognosis, and short- and long-term management of mild, moderate and severe TBI patients.

Method: Using animal model of moderate and severe TBI (rat controlled cortical impact; CCI) and extensive proteomic and systems biology analysis, we have identified a set of candidate protein biomarkers for the acute phase of TBI (within first 24h). We have developed sensitive antibody tools and quantitative sandwich ELISA to a subset (8) of these biomarkers.

We have also embarked on identifying additional biomarkers that might be suited to diagnose and monitor the subacute and chronic phases of TBI. We used both a rat CCI model as well as a military-relevant blast overpressure-induced brain injury model in rat and studied potential biomarkers in the subacute (7 days) and chronic phases (1 mo.) of TBI.

Results: For acute TBI, several protein biomarkers are now fully validated in biofluid (CSF and blood) in both rat and following TBI (human (severe, moderate and mild). These acute TBI biomarkers include ubiquitin C-terminal hydrolase-L1 (UCH-L1), α II-spectrin breakdown products generated by calpain (SBDP150/SBDP145) and glial fibrillary acidic protein (GFAP).

In addition, about 10–12 distinct candidate subacute/chronic protein biomarkers have been tentatively identified. We are now in the process of building antibody tools and ELISA for their detection and validation in follow-up rat and human clinical studies (including patients in persistent vegetative state (PVS)).

Conclusions: It is a fruitful approach to discover protein biomarkers for the acute and subacute/chronic phases of TBI, and then develop sensitive ELISA for the translational validation of their utilities in human clinical studies.

0544

Differential Performance on the TOMM, MSVT and NVMSVT in Normal, Feigned, Community-Dwelling Outpatient, and Inpatient Severe Traumatic Brain Injury Populations

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Objectives: The TOMM, MSVT and NVMSVT was administered, within a neuropsychological test battery for severe brain injured adults that attended a community based pre-vocational workshop and within a neurobehavioral inpatient residential unit, as well as to randomized normal and feigned brain injured students in a doctoral psychology program. The purpose of this study was to examine the differential performance of the effort measures on individuals with severe brain injury compared to normals and individuals told to feign brain injury to inform clinical practice.

Method: There were 51 participants total, 12 inpatients, 12 community based brain injured adults, 13 students told to feign brain injury and 11 students performing normally. The brain injured populations were similar in age and number of years post-injury. The inpatient unit ages ranged from 27 – 54 (M = 42.82, SD = 8.42), 3 were female and 9 were male, and time since injury ranged from

10 – 20 years. The community based group age ranged from 25 – 50 ($M = 41.33$, $SD = 8.96$), 5 were male and 7 were female, and the time since injury ranged from 8 – 17 years. The neuropsychological test battery for the brain injured populations: an Expanded Mini Mental Status Examination, Cognitive Estimation Test, Benton Temporal Orientation Test, Ranchos Los Amigos Cognitive Scale and a Neurobehavioral rating. Measures of effort included the Test of Memory Malinger, Green's Non-Verbal Medical Symptom Validity Test, and Green's Medical Symptom Validity Test. Additionally, measures of mood were administered, the Geriatric Depression Rating Scale, Beck Anxiety Inventory, and Personality Assessment Screener (PAS). Finally, each individual was also administered the Repeatable Battery for the Assessment of Neuropsychological Status.

Results: The test results depicted greater impairment in the inpatient unit compared to the community dwelling group, and yet both produced better scores on the effort measures compared to the students told to feign brain injury. Another interesting finding was that the greater the severity of the brain injury, as measured by neuropsychological tests, the greater the error the participants made when estimating their age. That is they knew their birth date but were increasingly incorrect in stating their age the greater the impairment on the neuropsychological test battery. On the other hand the students who were told to feign brain injury performed without error in stating their age.

Conclusions: This study highlights differences between severe traumatic brain injured population's cognitive performance but with good effort, and yet the greater their cognitive impairment the further they were wrong in stating their age. Yet normal students told to feign brain injured who failed the effort tests, performed without error in stating their ages. These findings have implications for cognitive symptom validity testing in both clinical and forensic settings.

0545

Effects Of Using An Energy Efficient Brace On Gait, Function And Vocational Program Of An Adult High School Student With Chronic TBI: A Case Report

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Objectives: To assess the effectiveness of the ToeOFF[®] brace in enhancing independence in a school-based vocational program of an adult high school student with chronic TBI.

Method: Subject is a 20 year adult female high school student with chronic TBI sustained 18 years ago. Subject exhibited left knee hyperextension and foot drop which affected her stability in dynamic standing and gait. Subject presented with severe physical limitations including the need for hand held assistance when moving around the campus and difficulty in performing simple vocational tasks in standing and walking. The ToeOFF[®] brace (made of carbon fiber, kevlar and fiberglass) was recommended in supporting weak lower extremity during standing and gait. The School Function Assessment (SFA) was used to track student's progress. Prior to wearing the brace, subject's SFA criterion score on the Travel section was 52 (95%CI: 48.08–55.92) and 42 (95%CI: 36.12–47.88) on Manipulation with Movement both on a 0–100 scale.

Results: Three months after wearing the ToeOFF[®] brace, subject's change in scores were greater than change that could have been accounted for by errors of measurement. Subject's scores were 70 (95%CI: 64.12–75.88) on Travel and 65 (95% CI: 59.12–70.88) on Manipulation with Movement. Subject is now able to travel in the campus mostly without handheld assistance. This includes delivering materials in campus as part of subject's vocational program. Subject is also now able to use her right upper extremity for functional activities (such as opening doors or grabbing materials in a work distribution line) without losing balance. *Conclusions:* The ToeOFF[®] brace is an invaluable tool in supporting weak lower extremity and providing stability for dynamic standing and gait activities. Improved balance and gait can result in enhanced quality of life through greater independence.

0546

A comparison of bedside assessment and the use of the Sensory Modality Assessment and Rehabilitation Technique (SMART) in diagnosing Disorders of Consciousness at the National Rehabilitation Hospital, Ireland.

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Objectives: Misdiagnosis of level of awareness in people who have a disorder of consciousness has been shown to be common (Andrews et al. 1996 &

Childs et al., 1993). A number of factors may be attributed to reaching an incorrect diagnosis. These include sole reliance on bedside assessment, insufficient attention to reducing clinical and environmental variables that may trigger responses, and allowing insufficient response time to stimuli. Clinical examination has been described as the 'gold standard' in defining and diagnosing conscious awareness (Noirhomme et al. 2008). The objective is to compare the anticipated level of awareness following pre-admission bedside assessment with the level of awareness identified upon the completion of the SMART assessment.

Method: A retrospective study involving the review of medical and occupational therapy records was completed for 35 patients admitted to an inpatient rehabilitation unit at the National Rehabilitation Hospital between 2002 and 2009 with an unknown level of consciousness or who were perceived to be in a vegetative (VS) or minimally conscious state (MCS).

Results: A total of 35 patients were referred for SMART assessment since 2002. 74% were male. The mean age of the patients was 34 years. Most common aetiology was traumatic brain injury (48%). Twenty eight percent of all patients were resuscitated from cardiac arrest. The majority of patients were referred because of difficulty in establishing a level of awareness. The average duration of time between injury and SMART assessment was 18 months (range: 7 months – 7 years). Fifty four percent were established to be in a minimally conscious state following the SMART assessment. Ten were found to have a level of awareness higher than that assessed by the SMART, with four patients admitted for the programme but not requiring it and one having their SMART assessment discontinued. Where patients had a prior perceived level of awareness, this was found to be inaccurate in 30% of cases with poor appreciation of greater awareness in the majority.

Conclusions: Infrequent, brief bedside assessments are insufficient to make an accurate diagnosis of VS or MCS albeit an experienced clinician completing the assessment. The SMART, a standardised, structured tool that compares the behaviours at rest with those behaviours elicited through multimodal sensory stimulation has shown to be effective in accurately defining and diagnosing levels of awareness in a population of patients with a disorder of consciousness within our rehabilitation unit. Additionally the SMART advocates the strict control of assessment variables and promotes the involvement of family members and carers and the incorporation of personally meaningful stimuli in the treatment phase which may further promote purposeful conscious responses.

0548

Effects of Ginkgo biloba extract and progesterone on expression of glucocorticoid receptor in cortex of the rat after recurrent seizures

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Objectives: To investigate the expression of glucocorticoid receptor (GR) in the cortex of the infantile rats following recurrent seizures and the effects of Ginkgo biloba extract and progesterone on them, and discuss the relationship between GR and developing brain hurt and the protective mechanisms of Ginkgo biloba extract and progesterone on the brain injury.

Method: 96 of 7-day-old SD rats were randomly divided into four groups: the control group, the seizure group, the Ginkgo biloba extract intervention group and the progesterone intervention group. Seizures in rats were induced by inhalant flurothyl daily in six consecutive days. Brain tissue was sampled at different time points (1d,3d,7d) in each group after last seizure. The expression of glucocorticoid receptor proteins in the cortex were detected by immunohistochemistry and Western blot methods.

Results: Western blot method was used in comparing the protein expression of glucocorticoid receptor among the three groups in cortex. In the control group, the expression of cytoplasmic GR protein were extensive, the more older the creaser. The expression of cytoplasmic GR protein in the seizure group significantly decreased than those in the control group and the Ginkgo biloba extract intervention group on PN-15d and PN-19d ($P < 0.05$). Then the expression of cytoplasmic GR protein was no significant difference on PN-13d ($P > 0.05$). The expression of cortical cytoplasm of GR protein in the progesterone intervention group was significantly higher than those in the seizure group on PN-13d ($P < 0.05$). And on PN-15d, the expression of cytoplasmic GR protein in the seizure group was significantly decreased than those in the control group and the progesterone intervention group ($P < 0.05$), then the expression of cortical cytoplasm of GR protein was similar on PN-19d ($P > 0.05$). In immunohistochemistry method showed that they were significantly lower than the control group ($P < 0.05$) on ARS-3d (PN-15d) and ARS-7 d (PN-19d). Comparing with the seizure group, the expression of GR in the cerebral cortex in the Ginkgo biloba extract intervention group were no significant difference between the two groups on

PN-13d ($P > 0.05$). But on PN-15d and PN-19d they were significantly higher than the seizure group ($P < 0.05$). The expression of GR in the cerebral cortex in the Progesterone intervention group were significantly higher than the seizure group on PN-13d and PN-15d. Between the two groups was no significant difference ($P > 0.05$) on PN-19d.

Conclusions: recurrent seizures in neonatal rats modify GR expression in the cortex of rats. This phenomenon raised the possibility that abnormal GR expression might play an important role in developmental brain injury. The increase of the abnormal levels of GR in the cortex is probably related to the protective effects of Ginkgo biloba extract and Progesterone on the infantile brain injury induced by seizures.

0549

Impact of Different Injury Sites in S-D Rats' Oculomotor Nerves on their Functional Recovery

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Objectives: In order to probe the effect of different injury sites in an S-D rat's oculomotor nerves on their functional recoveries and potential mechanisms.

Method: The Oculomotor nerves were sectioned and repaired in subtentorium and superior orbital fissure respectively. After operation, functional recoveries were evaluated by measuring horizontal and vertical vestibule-ocular reflexes, and anatomic and histological studies on the oculomotor nerve were performed by retrograde-tracing the distribution of neurons within the oculomotor nerve nucleus in midbrain through injection of HRP into the right superior rectus.

Results: The results showed that the regenerating nerve fibers by the rats in the experimental group, which had the oculomotor nerve intervention in superior orbital fissure, had a high specificity in innervating extraocular muscles. The functional recovery level of their extraocular muscles was remarkably superior to that by the rats in the experimental group, which had the oculomotor nerve intervention in subtentorium.

Conclusions: The conclusion from this study was that the closer the injured site of the oculomotor nerve to the extraocular muscle, the better the degree of final nervous function recoveries. The mechanism may be associated with the aberrant level when regenerated nerve fibers pass through the injure site.

0551

Realationship among Nerve Cell Apoptosis and the Expression and Activity of Cysteine Aspartyl Proteinase 3 in Rats with Moderate Trauma Brain Injury in a Time-effect Manner

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Objectives: To observe the nerve cell apoptosis in rats with moderate trauma craniocerebral injury and the changes in the expression and activity of cysteine aspartyl proteinase 3, and discuss the time-effect relation among them.

Method: Forty-eight SD rats were selected and divided randomly into supposed injured group with 8 rats and injured group with 40 rats. Rats according to the time of injury were divided into 5 points, that was, 2,12,24,48,72hours points with 8 rats in each part. Rats in injured group were made into moderate trauma brain injury model,while rats in supposed injured group were made into cranial drill without injury; All the rats were killed 24 hours after operation. Apoptosis condition in injured cerebral cortex, and hippocampi was observed by in situ end-labeling (ISEL) technique at 2 hours to 3 days after injury. Changes of expression and activity of cysteine aspartyl proteinase 3 were observed by immunohistochemistry and immunofluorescence technique.

Results: Totally 48 rats were involved in the analysis of results. (1) Apoptosis condition of cerebral cortex, hippocampi nerve cell after middling brain damage in rats in each group: A small quantity apoptosis cells were seen immediately in injured side cortex and hippocampi area, and it increased gradually, distribution around injured side cortex, white matter under cortex and hippocampi area,etc. Apoptosis cells became more between 12 and 24 hours, and reached a peak between 48 and 72 hours, which were higher significantly than those of injured group. (2) Expression of cysteine aspartyl proteinase 3 in rats after moderate brain injury at different time: Two hours after brain injury, there were a small quantity of positive cells of cysteine aspartyl proteinase 3 in and around cortex of injured part, which were increased from twenty-four to forty-eight hours significantly. Seventy-two hours after cerebral contusion, positive cells of cysteine aspartyl proteinase 3 decreased at a small quantity. In supposed injured group positive cells of cysteine aspartyl proteinase 3 were rare. (3) Changes of activity of cysteine aspartyl proteinase 3 in rats after moderate brain injury at different times: Two hours after brain injury, activity

of cysteine aspartyl proteinase 3 in and around cortex of injured part began to increase, and forty-eight hours later reached the peak. Two hours later, activity of cysteine aspartyl proteinase 3 in nerve cells of damaged hippocampi area began to increase, and at twenty-four hours reached the peak, and then began to decrease.

Conclusions: CONCLUSION The changes in the quantity of apoptotic cells in the injured. Hippocampi and cortex in rats with trauma brain injury have a relationship with the time after injury. The increase of activity of cysteine aspartyl proteinase 3 maybe leads to cell apoptosis.

0553

Benefits, Rewards and Inventions from Establishing a Vision Clinic in an Acute Care Rehabilitation Hospital

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Objectives: Establishing a vision clinic in an acute care rehabilitation hospital has many benefits. Research and clinical experience show a high prevalence of vision problems in the acquired brain injury patient population. A system and paradigm of care is presented to:

- (1) Give interested parties the information to start a vision clinic in their hospital
- (2) Teach some basic methods to treat double vision, visual field loss and visual neglect
- (3) Share inventions that have come from a Rehabilitation Hospital Vision Clinic

Method: N/A

Results: It has been found that dealing with vision problems early enhances functional outcomes. For example, correcting double vision enhances speech therapy in re-training reading. Addressing visual field loss helps physical therapy in re-training ambulation. Remediating visual neglect helps ADL's such as self care and eating. Effective management of exposure keratitis from lagophthalmos secondary to CN7 injury helps pain management.

Conclusions: In the model presented, the optometrist serves as the primary doctor for evaluation and management of vision problems. He or she must possess superb clinical skills and a good understanding of neuro-anatomy, physiology, neurology, and rehabilitation. He or she must be a committed

team member and be able to appreciate the "big picture" of how to achieve desired future outcomes with an understanding that vision is just one piece of the puzzle. The optometrist works closely with the attending physician and therapy staff. Sub-specialties referred to include: neuro-ophthalmology, cornea, oculo-plastics, retinal specialists, and general ophthalmology. In this model it has been found that vision problems are identified early, treated effectively in a team approach, and functional outcomes are improved.

0554

What Educators Need to Know About Traumatic Brain Injury: Improving Academic Success

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Objectives: Known as the silent epidemic Traumatic Brain Injury (TBI) is the leading cause of death and disability for children and adults up to the age of 44. Many children who sustain a TBI return to their academic setting (e.g., elementary school through college) and experience difficulties with thinking and learning. As a result, educators and students face a set of challenges that are unique to this population. Educators need to identify the unique learning needs of this population and to accommodate this diverse population. This session will explain how a Traumatic Brain Injury (TBI) impacts the academic success of students and how their needs are different from students with other disabilities. Specifically, the effects of a TBI on academic achievement will be explored along with strategies that improve academic performance of students who have sustained a TBI will be presented. An overview of the current research on TBI will be presented along with the characteristics (i.e., physical, linguistic, cognitive, social-emotional) of students diagnosed with this condition. Effects of a TBI on memory, organization, thinking, and learning will be presented. Strategies that improve academic performance for this population will be discussed for practical application in all classrooms.

Method: LCD projector and screen
Laptop

Results: As a result of this session, participants will be able to do the following:

- (1) Identify the executive functions that are required for enhanced learning for students with traumatic brain injury

- (2) Identify the unique learning needs of learners with TBI
- (3) Identify methods of improving the academic performance of students with TBI
- (4) identify the diverse learning needs of students who have sustained a TBI
- (5) identify strategies to improve organization, memory, and learning for learners with TBI
- (6) identify sources of current research on the effects of TBI

Conclusions: Each year in the United States approximately five million individuals sustain a traumatic brain injury. More than half of these people are children. An estimated 2%-5% of these children develop severe neurological complications, which have a direct effect on thinking and learning. This session will be of particular interest to educators and service providers in understanding the diverse learning needs of this unique population.

0555

Poloxamer 188, A Membrane Resealing Agent, Attenuates Plasma Membrane Permeability and Improves Histopathological and Functional Outcome Following Traumatic Brain Injury in Mice

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Objectives: Loss of plasma membrane integrity after traumatic brain injury is a marker of cell death. Poloxamer P188 (P188) is a non-ionic copolymer that promotes membrane resealing in injured cells. We tested the hypothesis that P188 reseals damaged cell membranes and promotes histopathological and functional recovery following controlled cortical impact (CCI) in mice.

Method: Adult CD1 or C57/BL6 mice were administered the green fluorescent cell membrane impermeant dye YOYO-1 intravenously (IV) immediately before CCI. At 1 hour, P188 (5 mM, 20 ml/kg) or PBS was administered IV. Propidium iodide (PI) was administered IV at various times after injury and mice were killed 10 min later. Resealed cells were identified as YOYO-1+/PI-. Brain edema was assessed at 24 h by the wet-dry weight and magnetic resonance imaging methods, blood brain barrier (BBB) leakage (1-24 h) was quantitated using Evans Blue extravasation, and lesion size was determined by image analysis at 2 weeks after CCI. Motor and

cognitive function was determined by wire grip and Morris water maze tests, respectively.

Results: P188 induced plasma membrane resealing in over 50% of initially permeabilized cells in injured cortex and hippocampus. Spontaneous membrane resealing was observed after 6 h in the absence of P188. P188 also reduced brain edema by 45% ($p < 0.005$), BBB leakage by 94% ($p < 0.005$), brain tissue loss by 29% ($p < 0.05$), motor deficits ($p < 0.05$ group effect), and improved cognitive function ($p < 0.05$ vs. vehicle) after CCI. In PI-pulse labeling experiments designed to follow the fate of injured cells over time, P188 did not rescue injured cells from eventual death after CCI.

Conclusions: Postinjury administration of P188 reseals permeable cell membranes and improves clinically-relevant outcome measures after CCI in mice. These beneficial effects are not associated with long term survival of resealed cells in brain, implicating mechanisms other than rescue of injured cells per se.

0556

Prospective Controlled Randomized Study of Resource Facilitation on Vocational Outcome following Brain Injury

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Objectives: Evaluate the impact of six months of resource facilitation on return to work after brain injury.

Method: Design: Randomized controlled trial. Setting: Acute rehabilitation hospital and community-based brain injury association. Participants: 23 people with acute acquired brain injury were randomly assigned to a resource facilitation (RF) treatment group (n = 12), or a regular follow-up, control (Con) group (n = 11). Interventions: All participants received standard follow-up services, but participants in the RF group were assigned a resource facilitator. Subjects in the RF group received an average of 10.6 hours of resource facilitation services during the six months of treatment. Services were provided according to the model developed by the Brain Injury Association (Connors, 2001). Main Outcome Measures: Return to work status and hours per week working, Mayo-Portland Adaptability Inventory 4-Participation Index, PHQ-9.

Results: After six months, 67% of the participants in the RF group had returned to work compared to 36% in the Con group. All subjects improved on the MPAAI4-P over time ($F = 75.94$, $p = .000$) and a repeated measures analyses of variance revealed that the RF group also demonstrated significantly better community re-integration when compared to controls ($F = 4.55$, $p = 0.05$). There were no significant between groups or within-subjects changes on PHQ-9.

Conclusions: Services framed as “resource facilitation” that have a clear focus on return to work may have a substantial impact on rate of unemployment after brain injury and community re-integration.

0557

Writing Club: Executive Strategies for Children with Acquired Brain Injuries

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Objectives: The poster will highlight an interdisciplinary group model for children with Acquired Brain Injuries aged 7–10 years targeted to use executive function strategies and support the development of writing skills. A concurrent parent group provided education and support on acquired brain injury, strategy use, and facilitated the generalization of these strategies and skills to natural environments.

Method: A poster providing an overview of the interdisciplinary cognitive communication groups therapy for children with ABI and their parents, The poster highlights the approaches used to achieve cognitive communication goals including generalizing skills to home and school, shares the results and outcome measures, and the future directions for the group.

Results: Improvements were found in the children’s story construction skills on the Test of Written Language and written output and speed of the Children’s Handwriting Scale. Positive outcomes were found on the child’s performance and satisfaction with writing using the Canadian Occupational Performance Measure.

Qualitatively parent’s awareness of their child’s needs improved and parents reported that they became better advocates for their child’s needs in school system.

Conclusions: This interdisciplinary collaboration group reinforces skill building amongst children with acquired brain injury and promotes parental

involvement & reinforces generalization to natural environments.

0558

The Effect of Pharmacological Interventions on Disruptive Behaviour after ABI: the Results of Single Case Experimental Design Studies

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Objectives: Disruptive behaviour is probably the most invalidating outcome of acquired brain injury (ABI). In the Netherlands, a few psychiatric hospitals are specialized in the treatment of these problems. Until now, no studies have been executed to evaluate the different treatments that have been offered. Recently, in GGZ Oost-Brabant a pilot project has been undertaken to develop a research programme in order to evaluate the different treatments.

One of the treatments is to regulate behaviour by prescribing medication. For instance in many cases, because of underlying disrupted attentional mechanisms, stimulant medication is prescribed like Amantadine or Methylphenidate. Also mood regulating medication like Valproic Acid or Carbamazepine is prescribed. In some other cases SSRI’s such as Fluoxetine or Sertraline are prescribed. Although all substances are well known for their general effects, only a few studies are known related to disruptive behaviour in ABI-patients.

The aim of the first phase of the research programme is to evaluate the treatment effects of the different substances on specific behaviour problems.

Method: The ABI patients that are admitted to GGZ Oost-Brabant differ considerable in terms of age (18–80 years), educational level, socio-economic state, cause of injury, time since injury, physical and cognitive skills, etc. It is impossible to create groups in order to compare treated patients vs. untreated patients. Insight is growing, that other scientific methods are available to evaluate treatment in individuals, for instance by using Single-Case Experimental Designs (SCED). In this research project, individual-based SCED’s will be developed and applied, resulting in unique research data.

Results: The results will be presented of two or three SCED’s. If possible, the cases to be presented will differ as much as possible in background, in kind of problems, in prescribed medications and in used outcome measurements.

Also the advantages and disadvantages of the application of SCED's in clinical settings will be discussed.
Conclusions: Conclusions cannot be given yet.

0559

Location of Eloquent Areas by Functional Magnetic Resonance Images (fMRI) in the Pre-operative Evaluation of Brain Gliomas.

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Objectives: For obtaining the best results in the surgical treatment of cerebral gliomas, the association between the largest possible amount of tumor resection and minimal permanent neurological changes after surgery should be the goal. However, due to the infiltrative nature of these lesions, the visual identification of the boundaries between the tumor and normal tissue is not possible and requires the help of additional resources. Among these, the magnetic resonance imaging (fMRI) offers the possibility for non-invasive evaluation in the pre-operative period.

Method: To assess the potential of fMRI in the surgical treatment of cerebral gliomas, we analyzed the results of 16 patients in good functional status submitted to the fMRI study before surgery.

Results: In each of the patients, the areas related with the tested tools were localized. Not only the primary motor and sensitive areas but also the cognitive and associative areas related to memory, vision and language could be determined and defined as their location and hemispheric dominance.

Conclusions: Functional MRI was effective in: localizing cortical areas involved in primary motor and sensory activities. 2 – localizing cortical areas related to complex cognitive activities as speech, writing and memory, including hemispheric dominance, as well as the association areas involved in these activities; 3 – detecting changes in location of these areas produced by cortical neuroplasticity in slow-growing lesions such as low-grade gliomas.

0560

Veterans with Mild TBI from Combat Explosions Had Persisting Neurological Deficits Compared with Veterans who had Civilian TBI.

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Objectives: TBI is a common injury type among veterans of Operations Iraqi or Enduring Freedom (OIF/OEF). Prolonged post-concussive symptoms are a disturbing feature of combat mTBI. Primary hypothesis was that veterans who sustained mild traumatic brain injury (mTBI) in combat due to an explosion would have a higher frequency of abnormalities on physical examination. Secondary hypotheses were that combat veterans would have 1) higher prevalence of headaches; 2) lower scores on cognitive function testing, 4) higher prevalence of post traumatic stress disorder (PTSD) and 5) excessive daytime sleepiness.

Method: We examined two groups of veterans with mTBI associated with an episode of loss of consciousness (LOC). Group 1 contained 126 OIF/OEF veterans with mTBI caused by combat explosions. Group 2 was 21 veterans with mild TBI occurring as civilians. Both groups were evaluated concurrently with a standardized neurological examination. The primary outcome measure was abnormalities on neurological examination. Secondary outcome measures included the presence of headaches, headache intensity, headache frequency, performance on the Montreal Cognitive Assessment Test (MOCA), PTSD, and impaired sleep. Daytime sleepiness was assessed with Epworth Sleepiness Scale (ESS).

Results: The two groups of veterans had similar ages (combat -29.2 ± 2.6 years, civilian -35.1 ± 2.2 years), similar fractions of women (combat TBI – 7.94% and civilian TBI – 9.52%) and similar education levels. Combat veterans had a higher prevalence of neurological examination abnormalities (52% vs. 9.5%, Risk Ratio (RR) = 5.417, 95% CI = 1.43–20.5); were more likely to have headaches (63.5% vs. 33.3%, RR = 1.91, 95% CI 1.03 – 3.54), PTSD (65.9% vs. 4.8%, RR = 13.8, 95% CI of 2.03 to 94.1), lower MOCA scores (25.1 ± 0.18 vs. 28.4 ± 0.23 , $p < 0.001$), impaired sleep (56.4% vs. 14.3%, RR = 3.94, 95% CI of 1.37 to 11.4) and excessive daytime sleepiness (ESS scores 12.42 ± 0.46 vs. 5.48 ± 0.72 , $p < 0.001$). Combat veterans were seen on average 123 weeks after the last TBI compared with 7.8 weeks for non-combat veterans. Therefore, combat veterans had persistent deficits. Combat veterans sustained more episodes of LOC or alteration of consciousness (3.78 ± 0.18 vs. 1.09 ± 0.07 , $p < 0.001$). Abnormalities on neurological examination and PTSD each were correlated with number of episodes of LOC for combat TBI. All combat veterans who had ≥ 5 episodes of LOC had

PTSD and all with ≥ 7 episodes of LOC had abnormalities on neurological examinations.

Conclusions: Veterans with combat mTBI were more likely to have persisting abnormalities on neurological examination, headaches, impaired sleep and PTSD. Presence of neurological deficits and PTSD correlated with episodes of LOC for combat TBI. Differences in the post-TBI deficits could be caused by exposure to explosions and more episodes of LOC for combat veterans.

0561

Upper and Lower Extremity Changes After Constraint Induced Movement Therapy in Children with TBI: A Case Series

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Objectives: Pediatric CIMT is an emerging, evidence-based treatment approach that has demonstrated improved functional outcomes in children with both congenital and acquired hemiparesis (Taub et al. 2007). Pediatric CIMT involves two key components: 1) restraint of the nonparetic upper extremity in order to minimize sensory and motor feedback input to nonimpaired cortex, coupled with 2) intensive, repetitive practice with the paretic UE, to shape new motor behaviors and to enhance neural activity in the impaired cortex. Numerous studies have demonstrated functional gains in upper extremity function. Anecdotal evidence exists of gains in non-targeted domains such as gait, speech and school performance (Brady & Garcia, 2009). Few if any studies have formally measured these changes. After receiving parent report and clinically observing improvements in gait these clinicians began using various standardized and non-standardized assessments to document changes. They hypothesized that intensive stimulation restricted to one hemisphere of the brain while simultaneously reducing motor and sensory input to the other hemisphere, would result in gait changes as well as upper extremity motor changes.

Method: This poster documents the results of immediate pre and post assessment of activities daily living, bimanual integration, fine motor skills, gross motor skills, and gait of 3 patients with TBI receiving CIMT. The following measures were used: GAITRite, Canadian Occupational Performance Measure(COPM), the Melbourne Test of

Unilateral Upper Limb Function, and the Assisting Hand Assessment.

Results: Preliminary analysis reveals improvements in GaitRite, and UE motor scores. Parent report via the COPM reports improvements in functional activities and activities of daily living immediately post intervention. In all cases bimanual integration improved from pre to post testing.

Conclusions: Intense, repetitive motor stimulation to the lesioned cortex, in conjunction with reduction of motor feedback and sensory stimulation to the non-lesioned hemisphere in children with hemiparesis secondary to TBI, may lead to improvement in motor skills. Further studies with larger samples are warranted to determine if CIMT may have benefits beyond gains in upper extremity motor function, including gait.

0562

Efficacy evaluation of human neural precursor cell transplantation for treating cerebral palsy children

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Objectives: Introduction : Rehabilitation is effect for cerebral palsy (CP). But t is usually partly, slowly and even little effect for severe CP. Based on our many years' animal experiments, we treated severe CP by human neural precursor cells (hNPCs) Transplantation.

Method: 45 of 94 infants aged from 6 to 36 months with sever CP hospitalized by our hospital from May 2005 to June 2006 were treated by neural precursor cells transplantation. 7×10^6 of human neural precursor cells derived were injected into the lateral ventricle of the patients. Psychomotor evaluation, video recording and related examination were performed for patients before and 28 days, 3 months, 6 months and patients were followed up by telephone and letter 12 months after transplantation. Improvement of clinical psychomotor manifestation was evaluated according to the common approval by the doctors and the parents with evident increase in scores of scale evaluation.

Results: 27 of the 45 cases after transplantation were effective, and the effective rate was 60%. The effect of transplantation appeared 28 days after transplantation for 24 patients and 3 months for 3 patients, respectively. All the effective cases there showed different degrees of psychomotor improvement

within 3 months and slowing down improvement from 3 to 6 months after transplantation. But no regression or disappearance of the efficacy was observed. Psychomotor scale evaluation suggested: (1) 1 month after transplantation, gross motor and intelligence age of the patients improved obviously, there was significant difference before and after transplantation ($P < 0.05$), The scoring on fine motor had no obvious increases ($P > 0.05$). (2) 3 months later, gross motor, fine motor and intelligence age increased obviously ($P < 0.05$). Among the 45 patients, there are 20 cases of spastic cerebral palsy including 17 cases of quadriplegia, among which 9 cases show effectiveness, the effective rate is 52.9%, and 3 cases of diplegia, among which 2 cases show effectiveness, the effective rate is 66.7%; there are 7 effective cases among 10 cases of athetosis type, the effective rate is 70%; 5 effective cases among 10 cases of mixed type, the effective rate is 50%; 4 effective cases among 5 cases of unclassified cases, the effective rate is 80%. (4) Among 25 cases who kept up training after transplantation, 10 cases showed effectiveness; and 17 cases showed effectiveness among 20 cases who didn't keep up rehabilitation training (5). The psychomotor functions of hNPCsT group were much better than control group ($P < 0.001$).

Conclusions: our results indicate that treatment cerebral palsy by neural precursor cells transplantation is a safe and effective method.

0563

Long term outcome following mild traumatic brain injury in Moroccan patients

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Objectives: The primary objectives of this study are to describe the symptoms of chronic post concussion syndrome (PCS) and to investigate the relationship between the persistence of these symptoms and different aspects of social life (return to work, quality of life, sport and leisure activities and family relationships) in Moroccan patients with mild traumatic brain injury (MTBI), one year after the trauma.

Method: Forty-two adult patients with MTBI were reviewed 1 year after trauma. We investigated the persistence of PCS by using the "Problem Checklist Questionnaire. We also assessed their quality of life

using a visual analogue scale, and noted the changes in employment status, social activities and family relationships. Then, we examined whether there were significant relationships between these different data *Results:* More than half patients ($n = 23$, 54.8%) were found with persistent post-concussion symptoms at one year post-injury. Chronic PCS was significantly more common in married persons ($p = 0.008$) and significantly related to both non return to work ($p < 0.01$), and QoL deterioration ($p < 0.001$).

Conclusions: A large proportion of Moroccan persons with MTBI experienced chronic PCS one year after trauma with important psychosocial consequences. MTBI can have significant and lasting impact on the quality of life, which is to be taken into consideration in the management of patients.

0564

Treatment of cortical visual impairment of infants with cerebral palsy by transplantation of human neural precursor cells into cerebral ventricle

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Objectives: Introduction To investigate the effects of human neural stem cells transplantation in treatment of children with cortical visual impairment.

Method: 34 children aged from 42 days to 6 years old with severe cortical visual impairment hospitalized by our hospital from May 2005 to June 2009. All patients had no visual improvement after months' rehabilitation training before transplantation. 28 patients rejected human neural precursor cells (hNPCs) transplantation, hNPCs transplantation was performed for rest 16 patients. There are no significant difference between control and transplant groups in age, severe degree of cortical visual impairment and degree of injured brain. hNPCs were injected into cerebral ventricle of patients of transplant group. 15 patients had light perception but no visual in transplant group. All patients had prolonged F-VEP P100 wave's incubation period, 9 patients were examined by fMRI before transplantation, of which 7 cases had no positive or negative signal in visual cortex and visual pathway, 1 case had a little negative activated signal in occipital lobe.

Results: There was no improvement in visual function, F-VEP and fMRI for 5 cases in transplant group (31.3%) and 20 cases in control group (71.4%). Obvious improvements in visual function

appeared in 11 cases (68.7%) of transplant group and 8 cases (28.6%) of control group ($X_2 = 6.69$, $X_{20.05,1} = 3.84$, $X_{20.01,1} = 6.63$, $P < 0.01$). Patients had visual improvement and could follow the moving object 3 days to 2 months after transplantation in transplant group and 2 months to 2 years later in control group. There were 4 patients who had visual improvement did fMRI recheck. 2 of which had obvious changes of fMRI. Their fMRI showed activated signal in occipital lobes and visual pathway. Other 2 children's fMRI had a little positive and negative activated signal after transplantation. When rechecked, effective transplant patients' visual function continued to progress and no retrogression occurred in following duration of 4 months to 4 years.

Conclusions: Conclusion Neural precursor cells transplantation has positive effects on children with severe cortical visual impairment.

0565

Treatment of newborns with severe injured brain with transplantation of human neural precursor cells

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Objectives: Introduction: Severe brain injury in newborns has a very high rate of disability. The present study aimed to evaluate the feasibility of human neural precursor cells transplantation for treatment of it.

Method: The transplantation was performed on 7 newborns. One of them was diagnosed as extremely severe carbon monoxide poisoning at 5th day after birth. One of them was diagnosed as severe hypoglycemia, The others of them were accompanied by asphyxia at birth with Apgar scoring from 1 to 3 and diagnosed as severe neonatal asphyxia, severe hypoxic ischemic encephalopathy according to images, electroencephalogram, biochemical examination and clinical manifestation. Their primal reflexes were extremely phlegmatic and even disappeared. They didn't cry under strong stimulation. Their muscular tension was very weak. Some of them were in the condition of coma or sustainable convulsion. Active drugs treatment was inefficient to them. Under the agreement of hospital ethical committee and informed consent of the family members, the newborns received human neural precursor cells transplantation at

the 6th to 20th day after birth. Under the agreement of the pregnant woman, fetal brain cells were obtained from the brain of an 11–13-week old fetus when the pregnant woman requested for induced abortion. And the cells from fetal brain were amplified and differentiated into neural precursor cells in vitro. The neural precursor cells from human fetal brain were injected into the cerebral ventricle of the patients.

Results: On the 2th day after transplantation, crying, sucking and swallowing reflexes gradually appeared on all the patients, muscular tension also improved, and convulsion stopped. NBNA scoring in 3 of the patients reached to the normal level on the 28th day after birth. 7 patient were followed up for 7 to 36 months. 5 patients were normal in psychomotor development and scores of each scale reached to the normal level. 2 patients have Cerebral palsy One of them with cerebral palsy had abandoned treatment voluntarily due to intestinal obstruction, severe pneumonia and cataract during the stage of newborn.

Conclusions: NPSCs transplantation for treating severe neonatal brain injury is safe and effective. More clinical trial and further observation are needed.

0567

Mild traumatic brain injury and the frontal lobes: role of DTI

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Objectives: The Orbitofrontal region of the brain remains a crucial area for understanding complex HUMAN behaviour; it is the brain area most frequently damaged following TBI; it also represents the least understood area of human brain and yet the least accessible brain area to clinical as well as instrumental investigation. Damage to this area of the brain causes serious barriers to community and vocational re-entry, as well as adaptive functioning in a complex, competitive and ever- challenging world (Satish et al. 1999).

Method: DTI is a relatively new MRI modality that non-invasively provides information regarding the degree and directionality of tissue water diffusion (Basser et al. 1994). DTI presents a more promising approach to the characterization of microscopic brain damage following TBI, providing a valuable

marker of the severity of traumatic injury and prognostic indicator of recovery pattern of non-motor functions such as cognitive-behavioural sequelae (Huisman et al. 2004; Inglese et al. 2005). *Results:* DTI represents a very promising methodology especially in less severe traumatic injury and their chronic clinical manifestations. It is more sensitive to changes in the microstructure of white matter. Its application in chronic TBI is very promising, allowing correlation with most cognitive and behavioural disturbances that follow TBI and prevent full competitive recovery of higher cortical functions and adaptation in the “real world” (Zappalà, 2001).

Conclusions: DTI provides original and undisputable information about the degree of axonal degeneration following TBI of any severity, although not specific. DTI is a very promising new marker of biological damage following TBI and it also gives us the opportunity to follow the degree of functional recovery and neuroplasticity of the cerebral tissue, determining an advantageous prognostic approach to the full spectrum of traumatic injury. Traumatic damage to cerebral tissue following a head injury is mostly contusive and dys-connective, secondary to the mechanical forces established during the traumatic event and to the physical characteristics of the impact. The preponderance of traumatic brain injury (from 70–80% of cases) is of mild-to moderate entity. In most such cases the salient clinical symptomatology is cognitive-behavioral, affecting attention, memory, executive behavior, reasoning and full time integration in a psychosocial competitive world. Clinical evidence suggest that frontal and temporal brain areas seem “dysconnected” and not completely functional. One key area of traumatic damage seems represented by the “orbito-frontal/temporal pole area”. The uncinate fasciculus seems then a target for DTI exploration and could reveal significant neuroradiological, anatomo-clinical and prognostic indication of TBI pathophysiology and its recovery pattern, according to the initial severity of the injury.

0568

Verbal Learning Impairments in Mild Traumatic Brain Injury

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Objectives: Following mild traumatic brain injury (TBI), a percentage of individuals report chronic memory and attention difficulties. While historically considered a “benign” injury with complete recovery expected within three months, it is believed that a minority of individuals experience post concussive symptoms beyond this period. That mild TBI is the casual factor underlying these complaints is controversial, especially given the inconsistent objective evidence supporting the complaints (e.g., evidence of neuropsychological impairment or observable lesions on MRI). Previous work in our lab has identified evidence in white matter microstructure in patients with mild TBI. However, despite a high number of subjective memory difficulties, we did not detect any difference in overall memory performance. We hypothesized that memory complaints in mild TBI may be attributable to subtle cognitive deficits that reflect diminished initial learning ability that can be explained by changes in cerebral white matter microstructure.

Method: Forty subjects with a history of mild TBI at least 6 months post-injury and 35 healthy control subjects participated. The healthy control group was not significantly different from the TBI groups in age, years of education, years of employment, or estimated premorbid intelligence. Experimental procedures complied with the standards of the University of Illinois Institutional Review Board. All subjects underwent an extensive neuropsychological assessment including measures of memory, effort, and mood. Subjects also completed whole brain magnetic resonance imaging, including a customized diffusion tensor imaging sequence. Region of interest analyses were carried out on data from each individual subject to calculate fractional anisotropy (FA) of each region as an indicator of white matter integrity.

Results: Groups were compared on performance on the California Learning Test-Second Edition (CVLT-II). A test of independent means revealed that the mild TBI group differed significantly from the control group on the first learning trial of the CVLT-II verbal list learning measure $t(73) = 2.341$, $p = 0.020$, $\eta^2 = 0.070$, but not on the composite total learning or memory variables. Performance on this first learning trial was associated with reduced fractional anisotropy in the uncinate fasciculus and the superior longitudinal fasciculus providing an anatomical correlate for the cognitive findings. Performance on the initial learning trial was not related to any psychological variables including mood.

Conclusions: We offer that the subjective day-to-day memory complaints reported by some patients with mild TBI may reflect diminished initial learning ability that is not often interpreted in standard

neuropsychological assessment. The subjective memory complaints may reflect the initial trial acquisition deficit exacerbated by the qualities of day-to-day interaction versus constitute a generalized encoding, consolidation, and/or retrieval-based “memory” deficit.

0569

Treatment of the Minimally Conscious Patient: A Therapeutic Approach

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Objectives: With decreased length of acute care stays, there have been an increased number of minimally conscious patients entering into a variety of rehabilitation settings at all stages of recovery. Assessments and treatment protocols for these patients are many times vague, unstructured or functionally impractical. From dysphagia to functional outcomes in daily living, this session focuses on the continuum of care, evidence, and current research based strategies and techniques for treating the minimally conscious patient.

Method: Therapeutic standards of treatment with this patient population are not limited to just communication but must also include cognition and swallowing.

When evaluating and treating a communication deficit with this population, it is vital that the therapist access all communication modules. Without the ability to express oneself, accurately follow commands or even provide a reliable yes/no response, it is challenging for family members and care providers, not to mention the patient.

Cognitive deficits following traumatic brain injury can be diffuse, affecting a variety of areas in the brain and varying in intensity. Often times, in the initial stages of recovery, cognitive rehabilitation may include stimulation of the patient’s sense of sight, sound, touch, and taste, in addition to a variety of other therapeutic interventions. As the patient continues to heal and emerge, they may progress to more complex tasks involving such areas as organization, problem solving, safety awareness and insight into their injury.

The risk of acquiring pneumonia can further complicate the recovery process. Whether it be stretching exercises, thermal stimulation, use of

functional objects like a cup or spoon, or full swallow evaluations, dysphagia management is critical to the effective treatment of the minimally conscious patient. The treating clinician should not shy away from fully evaluating a patient’s ability to safely eat and drink – as this ability many times can develop well before the patient is effectively communicating and can greatly aid in growing the patient’s functional ability to participate in activities of daily living.

Results: None - this presentation focuses on general review of current research and treatment methods being used in functional intervention with the minimally conscious patient. This is not an independently designed study.

Conclusions: Keeping all of these clinical concerns and outcomes in mind, the need for efficient and effective rehabilitation is at its greatest now more than ever. The approach that we have been taking has been ambitious and resolute in focus and vision with much credit due to the collaborative efforts of many disciplines. These collaborations include physical therapy, occupational therapy, respiratory therapy, therapeutic recreation, music therapy, neuropsychology, dieticians, physicians and nursing, in addition to the treating Speech Language Pathologist. Using a variety of diagnostic tools, aggressive therapeutic means and an interdisciplinary approach, progress has been documented and outcomes have been nothing short of miraculous for some. Knowing that recovery can occur in a variety of places and settings from the acute stage all the way through to home bound care, it is of the greatest priority to instill confidence in all who interact with these patients so that optimal outcomes can be attained.

0570

Emotional distress and quality of life in relatives of patients with severe brain injury: the first month after injury.

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Objectives: To investigate emotional distress, defined as depression and anxiety, and quality of life in a sample of relatives of patients with severe brain injury at admission to intensive rehabilitation in the

sub-acute phase. Furthermore, associations between the relatives' emotional wellbeing and characteristics of the patients and the relatives were examined.

Method: This exploratory study included 31 primary relatives of patients with severe brain injury. The participants were recruited at admission to Traumatic Brain Injury Unit, Copenhagen University Hospital, Glostrup, and completed the depression and anxiety scales from SCL-90-R (Symptom Checklist) and the Role Emotional, Social Function, Mental Health and Vitality scale of the SF-36 approximately 36 days after injury. Characteristics of the patient (age, Injury Severity Score (ISS), Early Functional Abilities (EFA), Functional Independence Measure (FIM), Rancho Los Amigos (RLA) and Glasgow Coma Score (GCS) initial and at admission) and the relative (gender, age, relationship to the patient) were registered.

Results: One sample T-tests revealed that the participants had significantly lower scores on all quality of life scales ($p < 0.01$) and significantly more symptoms of anxiety ($p < 0.01$) and depression ($p < 0.01$) than normal reference populations. 61% (19/31) of the sample scored above suggested cut-off on the anxiety scale and on the depression scale. 55% (17/31) of the relatives met the criteria for caseness defined as a T-score equal to or above 63 on at least two subscales.

Spearman's rho rank correlations identified a significant correlation between the patient's EFA score at admission and the relative's depression score ($r_s = -0.44$, $p = 0.02$). This indicated that the higher EFA score at admission, the fewer symptoms of depression reported by the relative. Significant correlations were also found between the patient's RLA score and the relative's depression score ($r_s = -0.45$, $p = 0.04$) and anxiety score ($r_s = -0.45$, $p = 0.04$) indicating that relatives of a patient with a low level of consciousness experienced more symptoms of anxiety and depression. No other correlations were found between characteristics of the patient and the relatives' emotional wellbeing, and no differences were found between the levels of impaired quality of life and anxiety of spouses and parents. However, an independent t-test revealed that the difference between the two groups almost reached significance in terms of depression ($t = 2.035$, $p = 0.06$) reporting that spouses had more symptoms of depression than parents.

Conclusions: The results of this study support our clinical experience of relatives being in a difficult and emotionally draining situation. At time of admission to sub-acute rehabilitation, the majority of relatives had severely impaired quality of life and symptoms of anxiety and depression.

The high prevalence of mental symptoms emphasises the need for psychological support in the acute phase. Future research should focus on developing and evaluating interventions in the acute phase.

0571

Augmentative and Alternative Communication in Adult Brain Injury Patients with Cognitive and Communication Deficits

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Objectives: The vast number of technological options, ethical concerns and clinical components involved in the evaluation and selection of an appropriate augmentative or alternative communication device in adult brain injury patients is more complicated today than ever. This presentation will focus on evaluation and treatment from a therapeutic clinician's perspective (PT, OT and SLP). The purpose of this presentation is to identify common etiologies, clinical concerns, introduce current technological options and delve into the appropriate implementation of an interdisciplinary treatment plan for adult brain injury patients requiring augmentative or alternative communication options.

Method: This presentation will primarily utilize a general review of current research and treatment methods being functionally utilized in interdisciplinary treatment in the acute care, inpatient rehabilitation and outpatient settings. Specific topics to be covered include:

- Etiologies commonly resulting in conditions requiring AAC
- Acute care evaluation procedure
- Inpatient rehabilitation evaluation procedure
- Outpatient/Long term evaluation procedure
- Interdisciplinary Treatment methods (PT, OT, SLP)
- Medical complications and treatment options
- Discipline specific concerns in treatment/barriers to treatment (primarily SLP and OT)
- Current technology options
- Prognosis and Long term outcomes
- Ethical Concerns
- Funding options and concerns
- Family training and home programs

- Target case studies demonstrating real world ethical concerns, treatment options and outcomes will also be included.

Results: None – this presentation is a general review of current research and treatment methods, not an independently designed study.

Conclusions: Whether treating a severe aphasic or apraxic, congenitally nonverbal, traumatic brain injury patient or a patient exhibiting locked-in syndrome, the treatment options and outcomes are extremely variable and require extensive clinical knowledge and skill to properly treat. It is imperative that the treating clinicians work as a team with their interdisciplinary counterparts; aware of all possible treatment options, barriers to treatment and ethical concerns as well as long term treatment outcomes for this many times misunderstood and underserved population.

0572

Severe Heterotopic Ossification in Nonaffected Limbs of a Hemiplegic Patient with Traumatic Brain Injury

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Objectives: Heterotopic ossification characterized by new bone formation in periarticular areas of big joints in patients with neurologic injury most commonly occur in neurologically involved side. We present a very rare localization of heterotopic ossification developed in nonparetic limbs of a hemiplegic patient with traumatic brain injury.

Method: Case study.

Results: A 25-year-old man with traumatic brain injury from a gunshot wound to his head had a left hemiplegia, painful and limited range of motion in the bilateral hip, bilateral elbow and right knee joints. Upper motor neuron lesion findings in neurological exam were seen only on left side. Plain radiographs of joints revealed heterotopic ossification which is more severe on nonparetic side compared to other side.

Conclusions: It should be kept in mind that heterotopic ossification may take place in nonhemiplegic extremities as well as hemiplegic extremities, especially in patients with traumatic brain injury that the extent of neurologic damage cannot be established definitely.

0574

Arrhythmia Resulting from Brainstem Infarction

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Objectives: Although stroke is frequently seen in rehabilitation clinics, bilateral vagal nerve dysfunction resulting from brainstem infarction is not common. Nervus vagus is the longest cranial nerve that contains motor, sensory and parasympathetic fibers which contributes to the innervation of viscera. Vagal nerve has negative chronotropic, inotropic, dromotropic effects on heart. Suppressed vagal activity resulting from brainstem infarction seems to be an unfavorable phenomenon leading to unopposed sympathetic activity and imbalance between the sympathetic and the parasympathetic cardiovascular autonomic regulatory systems. Derangements of autonomic dysfunction are responsible for disturbances of rate, rhythm and conduction. Vagal nerve has also essential function at swallowing. In case of bilateral vagal dysfunction, severe dysphagia can exist. These patients have high risk for aspiration pneumonia.

Method: Case: 58 years old man who had stroke 3 months ago, applied to our hospital with the complaints; strength loss in his arms and legs, difficulty in speaking and eating, and palpitation. He mentioned that his complaints started immediately after stroke. Brainstem infarction was detected in cranial MRI and he had been treated in a neurology service for 1 month, then he had been discharged to home. In physical examination we detected that bilateral both upper and lower extremities were Brunnstrom stage 1. He was cooperated, had dysphonia and dysphagia. His blood pressure was 140/90 mmHg and heart rate was 120 beats/min. Ventricular extrasistoles was detected at a rate of 1/3 – 1/4 as well as sinus tachycardia in ECG.

Results: We started Metoprolol 50 mg/day. After a while, his palpitation disappeared, heart rate reduced under 90 beats/min and his blood pressure came into normal limits. We also performed Percutaneous Endoscopic Gastrostomy in order to avoid aspiration pneumonia.

Conclusions: In conclusion, it should be kept in mind that vagal nerve dysfunction may be seen in brainstem infarcts. In such cases, patients should be evaluated with ECG and monitored for aspiration pneumonia.

0575

Awareness and Depression - A Teaching Model for Understanding Brain Injury Recovery

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Objectives: Awareness is an important cornerstone of successful rehabilitation. Pioneers in the field such as Yehuda Ben-Yishay, Ph.D. and George Prigatano, Ph.D. have looked at many factors that go into successful brain injury rehabilitation and awareness. What often is not discussed is the link between awareness and depression. At the outset of a brain injury, most people are not aware of changes to their cognitive abilities. Often family members will be in a state of denial in the early going, assuming that everything will be okay and that the fairy tale ending of most movies is reality.

Method: Having created a graphic display of the path that awareness takes, survivors and family members can more quickly grasp the concept and understand the many factors that lead to depression as well as the factors that lead to acceptance and recovery.

Results: The road to awareness is sometimes a long road with many ups and downs. Awareness is not always consistent from one day to the next as insight changes. Also, as a person with brain injury gains awareness into his or her changes, depression begins to increase. This cognitive/emotional link often presents one of the most challenging times for a person with brain injury as depression can lead to a decrease in motivation. This further supports the need for holistic brain injury rehabilitation—addressing more than just the cognitive components of brain injury.

During the phase in which awareness and depression increase there are several factors that impact the ultimate outcomes of each person. Those factors include receiving rehabilitation, counseling, willingness and ability to learn compensation techniques, family acceptance and support, connection with brain injury support groups and other people with brain injury, the severity of the person's injury, and his or her pre-morbid personality traits.

Conclusions: Acceptance and understanding of brain injury (but not complacency) as well as finding new meaning in life and re-evaluating goals leads to diminished depression. Though awareness can continue improving throughout each person's life, ideally depression recedes as a new focus is discovered and the person connects with others and learns to be productive again though that

productivity may be different than it was prior to the brain injury.

The graphic display enables family members, survivors and clinicians to better understand at a glance the factors involved in awareness, depression and recovery as it is linked to brain injury.

0576

The Natural History of Post-traumatic Headache: Prevalence and Characteristics at 6 Months

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Objectives: To assess the prevalence, disability impact, and treatments received for post-traumatic headache (PTH) soon after, 3 and 6 months after injury, as well as clinical characteristics of the headaches.

Background: Little is known about prevalence and clinical characteristics of PTH or its evolution over time post injury. Understanding the frequency and course of PTH may optimize assessment and treatment in patient following traumatic brain injury (TBI).

Method: Seven US rehabilitation centers (TBI Model Systems) administered questionnaires to patients over the age of 16 following acute complicated mild to severe TBI. These patients were receiving acute inpatient rehabilitation. Assessment included prior headache history, clinical characteristics of current headaches using IHC classification systems immediately following injury, disability impact, and treatment utilization, 3 and 6 months post injury.

Results: To date, 374 individuals were neurologically intact to provide information. Of those, 71% are male, 75% are white, with an average age of 42 years. 56% were involved in vehicular accidents and 26% were injured in a fall. 17.6% reported headaches prior to injury, and 46% endorsed headache post injury. Data collected at 3 months showed 33% and at 6 months showed 29% reporting ongoing headaches. Most headaches had features consistent with migraine, probable migraine, tension or cervicogenic headache.

Conclusions: A significant number of individuals endorse headache immediately after a complicated mild to severe TBI. Some individuals describe prior history of headache and further evaluation is ongoing to compare clinical features of pre and post-injury

headaches. Prevalence of PTH continues to remain similar at 3 and 6 months post-injury, suggesting that PTH persists in approximately one-third of TBI patients. Further evaluation of characteristics of PTH and its natural history is important in developing appropriate assessment tools and treatment modalities.

0577

The therapeutic effect and mechanism of urinary trypsin inhibitor on patients with traumatic brain injury

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Objectives: Exploring the therapeutic effect and mechanism of urinary trypsin inhibitor on patients with traumatic brain injury.

Method: Twenty two patients with traumatic brain injury, admitted to our hospital in 24 hours postinjury from Jan.2006 to Feb.2007, were chosen into our research group and received injection of urinary trypsin inhibitor intravenously, 200 thousand units every time, twice a day from the first day to the seventh days post-injury. Thirty six patients with traumatic brain injury, admitted to our hospital at the same time but without receiving treatment of urinary trypsin inhibitor, were chosen as control group. The values of plasma CD3+, CD4+, CD8+, CD4+/CD8+, CD34+, NK cell and CRP, NSE, complement C3 were detected in all of these patients at the first, third, fifth and seventh day post-injury.

Results: Compared to the contrast, plasma CD3+of patients in research group was decreased greatly in the 5th day after trauma ($P < 0.05$), CD4+ increased greatly in the 5th and 7th days after trauma ($P < 0.01$), And the CD8+ was decreased in the 5th and 7th days post injury ($P < 0.05$). The CD4+/CD8+ was elevated in the 5th and 7th days after trauma ($P < 0.01$). As to the CD34+, it is decreased in the 1st day ($P < 0.05$), while higher than that of the control in the 3rd and 5th days ($P < 0.01$). NK cell was proved higher than that of the control in the 5th and 7th days ($P < 0.05$). Complement C3 was decreased significantly in the 5th and 7th days. Both CRP and NSE were decreased in the 5th and 7th days ($P < 0.05$). The result showed that patients treated with urinary trypsin inhibitor have a better outcome.

Conclusions: Urinary trypsin inhibitor can regulate the immunologic system and prevent the central nervous system from secondary injury.

0578

The neural substrates while operating a driving simulator – a functional near-infrared study

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Objectives: A driving simulator was used to set up realistic driving scenes in order to investigate fundamental region of neural activity in healthy subjects, believed to be necessary in driving ability.

Method: Subjects were seven healthy adults, who were given three tasks using a driving simulator. The tasks were turning into left and right curves from a straight road (Task A), braking in response to visual warning signal while on a straight road (Task B-1), and braking upon the sudden appearance of a truck blocking the road, without being given an advance warning signal (Task B-2). In Task A the change in oxy-Hb during driving was compared with the level at rest. In Task B the level of oxy-Hb over the two seconds following the initiation of driving was compared with the level over the four seconds just before brakes were applied in Task B1 and the level over the four seconds just before brakes were applied in Task B-2. Changes in oxy-Hb levels were measured using functional near-infrared spectroscopy in a total of 34 sites including both hemispheres, with the areas measured including the dorsolateral frontal cortex in the anterior region, the inferior parietal lobule in the posterior region, and the superior temporal gyrus in the inferior region.

Results: The areas that showed significant activity in Task A spanned from the frontal region to the temporal and parietal regions, and were more prominent in the right cerebral hemisphere than in the left cerebral hemisphere. However, activity in the left parietal region was significantly increased in only a few subjects. In Task B, the concentration of oxy-Hb increased significantly at the time of Task B-1 when compared with just after initiation of driving, except for in the left inferior dorsolateral frontal cortex. Additionally, oxy-Hb concentration further increased at the time of Task B-2 in the left and right

hemispheres of each of the superior and inferior dorsolateral frontal cortex and temporal region.

Conclusions: We consider it important to provide sufficient real car driving practice for people who have suffered brain damage who resume driving, after checking site of the brain damage and the region in which it is located.

0579

The Long-term Quality of Life in Children, Youth, and Young Adults after Acquired Brain Injury

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Objectives: Little is known about the impact of acquired brain injury (ABI) on the long-term quality of life (QoL) in children, youth and young adults. The objectives of this presentation are to (1) illustrate the QoL trajectory up to at least five years post ABI, (2) examine the predictors of QoL outcome for all severities at specified time points post ABI, and (3) discuss the implications on service provisions and future research directions.

Method: Children and youth between the ages of 5 and 18 years admitted to McMaster Children's Hospital with an ABI, and their families, were assessed longitudinally on a variety of measures which included health status, participation, and QoL. For participants under age of 18 years, QoL was assessed using the Child Health Questionnaire (CHQ). As the participants matured during the course of this long-term follow-up study, the QoL outcome was then assessed using World Health Organization – QoL (WHOQOL) for those who had turned 18. Descriptive statistics were used to analyze the QoL outcome at different time points, Student's t-test was used to examine the differences between the study cohort and the normative sample, and mixed-effects models were used to identify possible predictors for the QoL at different points in time.

Results: Preliminary analysis illustrates that QoL was negatively impacted after ABI, especially at the time of discharge. When compared with the normative data, the study cohort had significantly poorer QoL ($P < 0.05$) at corresponding ages and on all domains.

No medical variables were found to be the significant predictors for the CHQ summary scores.

Conclusions: This presentation will illustrate the data for QoL over the course of study (i.e., five to seven years), and the predictors associated with QoL for all severities. QoL for children and adolescents is indeed impacted by sustaining ABI of any severity. This impact is further affected by time post injury and age of the child.

0580

Achievement of client-centered goals by persons with acquired brain injury in comprehensive day treatment is associated with greater vocational and residential independence at discharge and 1 year follow-up.

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Objectives: Between 1988 and 2006 162 persons with acquired brain injuries (ABI) have completed the Mayo Comprehensive Day Treatment (CDT) Program. In this program, individual and group interventions are facilitated by an integrated multi-disciplinary team and focus on improving patient independence in the community and vocational attainment. The current study examined the relationship between patient achievement of individualized goals at program discharge with vocational and independent living status at discharge and 1 year follow-up.

Method: Outcomes were examined in participants with complete data from the first 18 years of the program ($N = 154$), 72% of whom were male. There was notable variability in the length of time between participant injury and admission into the program; however, the mean length of time was 3 years. Participant diagnoses included 62% traumatic brain injury, 10% stroke, 6% anoxic injuries, 14% aneurysms, and 8% other (e.g., brain tumors). Each participant worked with therapists to generate individualized goals across four primary domains (Orientation, Cognitive, Social Awareness, Communication) within the first 2 months after admission into the program. Participants who achieved their goals in all four domains were included in the "goals met" group. Dichotomously coded scores on the Vocational Independence Scale (VIS) and Independent Living Scale (ILS) were used

to classify patient independence vs. dependence and were the primary outcome variables at discharge and 1 year follow-up. Chi-square analyses were utilized to compare “met” vs. “unmet” goal group differences in independent living and vocational outcomes.

Results: Forty-eight percent of program participants achieved all of their goals. This group was compared to the 52% of participants who did not achieve all of their goals. There were no differences in independence and vocational attainment at program admission between groups. At the time of discharge, 68% of participants who met their goals were living independently compared to 49% of participants in the unmet goal group ($\chi^2 = 5.6, p < .02$). Similarly at 1 year follow-up, 72% of participants who met their goals were living independently compared to 56% of participants who did not meet all of their goals ($\chi^2 = 3.9, p < .05$). Sixty-two percent of participants who met their goals were engaged in community based employment at discharge relative to 46% in the goals unmet group ($\chi^2 = 3.9, p < .05$). At one year follow-up this discrepancy was greater, with community-based employment rates at 73% in goal-met participants and 51% in goal not-met participants ($\chi^2 = 8.1, p < .01$).

Conclusions: Participant goal achievement is associated with meaningful changes in functioning that result from patient participation in a CDT program following ABI. Specifically, achievement of individualized goals is associated with greater levels of vocational and residential independence at the time of discharge and 1 year follow-up. The relationship of this finding to goal creation and rehabilitation planning will be discussed.

0581

Neuropsychological Outcomes in Children and Youth after Acquired Brain Injury: A long-term Perspective.

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Objectives: Acquired brain injury (ABI) is the leading cause of long-term disability among the pediatric population. Recovery from pediatric ABI, in

combination with developmental progression and confounded by severity of injury in the child, may lead to highly variable outcomes in neuropsychological function. It is hypothesized that the neuropsychological deficits would still be detectible in children and youth with ABI at five years post injury, and the probability of the persistent neuropsychological problems would increase with the severity, but would still be evident in some children and youth with mild injury. The objectives of this presentation are to (1) illustrate the neuropsychological status of children and youth with ABI at five years post injury, (2) examine the predictors of the neuropsychological outcomes for all severities, and (3) discuss implications for service provision based on the extent of the observed long-term neuropsychological deficits.

Method: Children and youth between the ages of 5 and 18 years admitted to McMaster Children's Hospital with ABI were administered a neuropsychological battery at five years post injury as part of a prospective longitudinal cohort from time of injury. Neuropsychological assessment included well known measures such as, Wechsler Abbreviated Scale of Intelligence (WASI), Rey Complex Figure Test and Recognition Trial (RCFT), and Wisconsin Card Sorting Task (WCST). Mixed linear effects modeling was used to identify the predictors of neuropsychological outcomes at five years post ABI and the association with pre-morbid academic performance and severity of injury.

Results: Detailed analysis is underway, as testing is now complete. Results of preliminary analysis indicate that 51 participants (32 males and 19 females) took part in the neuropsychological assessment session. Fifteen of them had moderate-severe ABI, 36 had mild ABI. The mean age at the injury was 10.69 (SD 3.48) years old. At five-year post ABI, some persistent neuropsychological deficits were still detectible. Four (7.8%) were found to have borderline WASI full scale IQ scores. As for the visual immediate and delayed recall measured by RCFT, 17 (33%) and 20 (39%) showed borderline to severe impairment, respectively; more strikingly, half of these children's injury was considered mild. Regarding the executive functions, four (7.8%) showed borderline to severe impairment in WCST conceptual level responses. These results will be further expanded when all analyses are complete.

Conclusions: While the extent and nature of impairment and effect of time and severity continue to be debated post injury in children and adolescents with ABI, the results of this longitudinal cohort will, contribute further information to the field on the

specific impairment after all severities of injury and the impact of time on recovery trajectories.

0582

Interpersonal relatedness and psychological function following mild-to-moderate traumatic brain injury

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Objectives: To determine whether relationship conflict, social support or sense of belonging were associated with psychological functioning after mild to moderate TBI

Using attachment theory, we tested two hypotheses:

- (1) Interpersonal conflict, sense of belonging and social support will be associated with pre-injury and injury-related factors.
- (2) Interpersonal conflict, sense of belonging, and social support will be associated with psychological functioning when controlling for related covariates.

Method: Cross-sectional design which included 75 persons with TBI and 74 relatives/significant others. We used in-person data collection with surveys, chart abstraction, and interview methods. The outcome, psychological functioning was the emotional and interpersonal subscales of the Patient Competency Rating Scale, while independent variables were assessed with the Tilden Interpersonal Relatedness Inventory, conflict subscale and Hagerty's Sense of Belonging scale.

Results: In participants recruited from out-patient rehabilitation programs within the Midwest who were on average 9 months from their injury aspects of interpersonal relatedness were associated with psychosocial functioning. Specifically, those married and with low levels of belonging were more likely to have poor psychosocial functioning. That is those who felt they did not have valued fit and involvement with others were more likely to report difficulty with controlling emotions, interacting with others, and displaying confidence and sensitivity to others feelings. Further, those in a married relationship were more likely to report poor psychosocial functioning.

Conclusions: One's sense of belonging is shaken by TBI and affects post-injury psychological functioning. Further, the psychosocial outcomes of a TBI are

affected by one's marital status. While interpersonal conflict was not a significant variable, it approached significance and could become a focus for couples interventions following TBI.

0583

Keys to Open "The ABI Cage"

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Objectives: As a career educator, then person with brain injury, then author of 'Doing Up Buttons' (Penguin book about her experience with ABI) and now a sixty-five year old PhD student, the author of this paper set out to examine Freeman's (1998) assertion that long term recovery from brain injury is a process of re-learning and education. 'Keys to the ABI Cage' used an innovative, positive and empowering methodology to help people explore their own lived experience, while raising self-awareness, insight into ABI and coping with a 'new' self.

Method: Thirty people with ABI, 5 carers and 5 professionals participated in the 'Keys to the ABI Cage' project. Participants talked about and placed a series of 'talk-about cards' onto a bird-cage, literally a bird cage, which was used as a metaphor to explore their experiences, as well as a methodological tool for examining both commonality and diversity. The 'talk-about cards', added to as interviewees identified further points, covered a range of differences and difficulties which 'put' the individual in the 'ABI Cage'; and emotional responses to the problems which 'locked' the 'ABI Cage'.

Acknowledging these things allowed participants to think about how they've coped. They then engaged with a variety of 'talk-about cards', identifying positive 'keys' that helped open their 'ABI Cage'.

Results: Participant responses to 'Keys to the ABI Cage' included: "allowed me to open up my own eyes to ABI", "What a relief!", "light for the dark night of the soul". The cage provided many opportunities to take stock, to border cross from one identity to another and make sense of their experiences. It therefore has significant practice as well as research relevance.

Participants were eager to participate and share their personal stories and discoveries to help others with brain injury. In contrast to studies which seek single solutions, this study demonstrates the importance of diverse solutions which draw on personal and

relational strengths and which promote resilience. However, recurrent themes included struggles with the 'old' and 'new' self, anomie, the centrality of hope, trust, strong enduring relationships and support, and the vital nature of empathetic treatment by health professionals.

Conclusions: 'Keys to the ABI Cage' has proved to be a powerful tool to assist reflection and awareness. It has broken through barriers of power, shame, memory problems, lack of self awareness, communication difficulties and reluctance to be tested and contrasts with studies which report a correlation between self awareness and emotional distress (Lezak, M.D. and O' Brien, K.P., 1988). This research has shown that the individual's views of themselves can be strengthened when they have the opportunity to tell their story, reflect on their perceptions and understandings in terms of their validity, (Cochran, 1987).

0584

"Prevalence and correlates of irritability in patients with moderate or severe Traumatic Brain Injury"

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Objectives: Assess the prevalence rate and correlates of irritability in patients with moderate or severe traumatic brain injury (TBI).

Method:

- Consecutive series of 39 outpatients with moderate or severe TBI in the Behavioral Neurology Section of INEBA.
- Structured neuropsychiatric interview conducted by a psychiatrist including evaluation tools for the patient and for family members.

Evaluation tools: - Demographic data, - Data about injury, - Neuropsychiatric Inventory (NPI), - Hamilton Depression Scale, - Irritability Scale, - Apathy Scale, - Yudovsky's Overt Aggression Scale. Statistical Analysis: We determined median, percentage, Chi2, t-test, a factorial and a logistic regression analysis, using the SPSS 15.0.

Results: Due the lack of diagnostic criteria for irritability, we used the NPI as a diagnostic criteria and we divided our sample of patients in "Irritable group" 59% (N=23) and "No Irritable group" 41% (N=16).

The irritable group had statistically significantly higher scores using the Irritability Scale ($p < 0.001$), which validates this classification.

The irritable group showed significantly higher depression ($p < 0,02$) and aggression scores ($p = 0.001$).

We found no significant differences between both groups regarding the demographic and injury location variables.

Irritability-related neuropsychiatric of the NPI were evaluated with a factor analysis (Varimax) and obtained two main factors that amount to 72.66% variance. First factor included the following neuropsychiatric phenomena: desinhibition, euphoria, aggression (desinhibited-euphoric group) (29.4% of irritable group) and a second factor included apathy, aggression and depression (apathic-depressive group) (70.6% of irritable group). Seventy four percent of the irritable patients showed aggression diagnosis regarding the NPI criteria.

We correlated both groups of irritable patients, "desinhibited-euphoric" and "apathic-depressive" with injury location and we found a significant association between the desinhibited-euphoric group and the frontal-temporal injury.

When we compared both groups regarding injury laterality, the only statistically significant association was the Desinhibited Group with bilateral frontal-temporal injury (chi-square = 8.14; 2; $p = 0.017$).

A logistic regression analysis to examined whether certain injuries could predict the irritability likelihood. We obtained a 60% prediction of cases of irritability with a significant coefficient for bilateral frontal-temporal injury, that could predict irritability/desinhibition in subjects with TBI (Wald = 3.7, $p = 0.04$).

Conclusions:

- Fifty nine percent of patients with TBI showed irritability according to the NPI. The division between "irritable" and "no irritable" patients showed a significant association with the irritability and aggression scales.
- We found two main components for irritability: "desinhibition-euphoria" and "apathy/depression".
- Seventy four percent of patients within the irritable group also showed a diagnosis of aggression according to the NPI which confirms the presence of aggression in both sub-groups of irritable patients.
- The "desinhibited-euphoric" irritable group showed a significant association with bilateral frontal-temporal injuries, that lesions could predict irritability with desinhibition features in subjects with moderate or severe TBI.

0585

Transitions to study: Learning from the experiences of people following Traumatic Brain Injury (TBI)

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Objectives: Traumatic Brain Injury is one of the most devastating and life-altering events; I know from experience. Everyday a multitude of people all over the world experience a TBI often with life-long consequences. Many people fail to return to pre-injury levels of academic or working ability and this can have devastating consequences for an individual's self-esteem, physical and emotional adjustment. Recovery is a life-long journey and vocational/educational outcome following TBI is a critical measure of the individual's ability to cultivate a sense of purpose, identity and self-respect. Many people who experience TBI have aspirations to recover and pursue goals such as university study. There are also many individuals who do not see university as a viable option as many young people have a disrupted study life and experience additional barriers to going to university. This may be due to a number of cognitive, psychological and psychosocial factors.

Method: The purpose of this study was to give a voice to those who have made the transition to university study following TBI. The research is phenomenological in nature. Six participants were interviewed using a semi-structured interview format and recorded using multi-speak computer transcription software. Narrative analysis of the transcripts was used to build knowledge of the experiences of the participants.

Results: The stories of the participants as well as my own experience highlight some important aspects that can make a difference in the transition to university study. Seven key themes were identified as characteristic of the experience of the transition to university study; resilience, support, adaptation, the meaning of university participation, discrimination, ongoing task of university participation and university study as part of the recovery process. Recommendations were formulated from analysis of the participant interviews that signified the important aspects that made for a successful transition to university.

Conclusions: The learning from this study will contribute to understanding the impact of TBI on

university study and the responses that can make a difference. There is potential for further research to build on this work and use the recommendations indicated to enhance the academic, social, employment outcomes and ultimately quality of life for people with TBI.

0586

Cognitive dysfunction in multiple sclerosis: Using structural equation modelling to investigate its relationship with mood disturbance, fatigue and quality of life

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Objectives: Cognitive dysfunction is known to affect 40–70% of individuals with multiple sclerosis (MS). Evidence suggests prominent impairments in memory, sustained attention, planning, and speed of information processing, all of which having notable implications for effective daily functioning. Cognitive dysfunction influences individuals' functional independence and role fulfillment in the contexts of work, family life and social activities. Consequently, cognitive dysfunction has an adverse impact on community participation, and quality of life. Mood disturbance and fatigue have also been shown to lead to poor functional outcomes, and there is inconsistent evidence regarding the association of these constructs with cognitive dysfunction in MS.

Method: This study utilized structural equation modelling (SEM) to investigate the interplay between cognitive dysfunction, mood disturbance and fatigue on community participation and quality of life in a sample of 80 community-dwelling individuals with diagnosed MS. Cognitive dysfunction was measured using a battery of standardized neuropsychological tests. Mood disturbance, fatigue, and community participation were measured through self-report questionnaires.

Results: The hypothesized model was found to have good fit. Results suggested that cognitive dysfunction was the only direct predictor of community participation, with greater dysfunction predicting less participation. However, both fatigue and mood disturbance were found to have indirect effects on community participation. Specifically, the effect of fatigue on community participation was mediated by

cognitive dysfunction, while mood disturbance had an indirect effect through fatigue and cognitive dysfunction.

Conclusions: These findings underscore the complex interplay between different symptom domains in MS and their association with functional outcomes. Implications for intervention will be discussed.

0587

Cerebral toxocariasis develops into Alzheimer's-like diseases as emergence of enhanced TGF- β 1, S100B, GFAP, NF-L, TG2, T-tau, BACE1, A β PP-C99, and A β expression as well as impairment of UPS in mice

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Objectives: *Toxocara canis* larvae may invade the brains of paratenic hosts including human and cause brain injury, which then may result in cerebral toxocariasis (CT). However, its effects on the brain are likely too cryptic to be clinically detected in humans with CT because the parasitic burden is light; thus, whether CT may also lead to development of Alzheimer's diseases (AD) or AD-like syndrome in humans was unknown that needs further elucidation.

Method: The present study investigated the expressions of AD-associated neurodegenerative biomarkers including TGF- β 1, S100B, GFAP, NF-L, TG2, T-tau, BACE1, A β PP-C99, and A β as well as whether impairment of UPS is present in brains of mice infected with *T. canis* from 3 days to 20 weeks post infection (dpi or wpi) as assessed by WB and RT-PCR.

Results: *T. canis* larval invasion of the brain might cause brain injury as evidenced by severe astrogliosis with enhanced GFAP expression, although inflammatory cell infiltration was not seen in the injured brains. Levels of TGF- β 1, S100B, GFAP, NF-L, TG2, and T-tau markedly increased with 3~9-folds higher than that of age-matched control group of uninfected mice, suggesting that neurodegenerative protein aggregation resulted from impairment of the UPS as response to accumulated proteins in damaged tissues due to apparent evidence present with ubiquitin conjugates and ubiquitin contents in brains from 3 dpi onward in the trial. Insoluble A β , one of distinct features found in brain of AD, presents with 3~5-folds increases as compared to

that in age-matched control group of uninfected mice; meanwhile BACE1 and A β PP-C99 almost concomitantly present with 2~13-fold increase in the trial.

Conclusions: This is the first study to demonstrate that CT may develop into Alzheimer's-like diseases, particularly of emergence of enhanced BACE1, A β PP-C99, and A β expression in the CT brain.

0588

Post concussion syndrome without head injury? A survey study

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Objectives: According to ICD-10 or DSM-IV criteria Post-Concussion Syndrome (PCS) requires a prior mild traumatic brain injury (mTBI). However, PCS symptoms are non-specific and can also affect non-mTBI populations. Symptoms further overlap with other diagnoses, such as depression. Consequently, the degree to which PCS is specific to or caused by mTBI is still debated. With the present study we aim to investigate the nature of PCS in greater detail by looking whether PCS is specific to mTBI, and the extent to which these symptoms and related factors (depression, anxiety, daytime sleepiness and cognitive failures) exist in the non-mTBI population.

Method: An online survey was sent to University staff and students. Included in this survey were the Rivermead Post Concussion Questionnaire (RPQ), Cognitive Failures Questionnaire (CFQ), Hospital Anxiety and Depression Scale (HADS), Epworth Sleepiness Scale (ESS), along with demographic questions and those related to the mTBI sustained. PCS was diagnosed as 3 or more symptoms within DSM-IV criteria.

Results: The survey created a database of 375 entries, 127 for mTBI and 248 controls (no history of mTBI). Within these groups the proportion of individuals experiencing PCS symptoms was not statistically different (39% for mTBI, 32% for control; Chi squared $p=0.2$), and there was no group difference for the RPQ, HADS or ESS. However, respondents with a history of mTBI showed significantly higher CFQ scores ($p < 0.001$) than controls. In contrast, when split by PCS diagnosis, those with PCS revealed significantly greater scores for all questionnaires ($p < 0.001$).

When split into subgroups (mTBI+PCS, mTBI-PCS, Control+PCS, Control-PCS), a similar pattern was observed. The two groups with PCS both had greater scores for the RPQ, CFQ and HADS than both groups without PCS ($p < 0.005$). There was only one difference when comparing the two groups with mTBI to those without (CFQ: mTBI+PCS greater than Control+PCS ($p < 0.05$)). The ESS score for Control+PCS was greater when compared to both groups without PCS (mTBI-PCS ($p < 0.01$); Control-PCS ($p < 0.005$)). *Conclusions:* The study suggests that PCS is equally common in a self-selected sample of persons with and without brain injury. Data on depression, anxiety, cognitive failures and daytime sleepiness scores show no increase in those with mTBI, but are significantly higher in those with PCS. Analysis of the four subgroups revealed no interaction between mTBI and PCS. This suggests that PCS is associated with but not specific to mTBI, as it is observed in the general population in similar proportions. It is worth considering how the presence of PCS in the control group may affect the data when designing prospective experiments. In addition to depression, anxiety and cognitive failures, this study suggests that those with PCS experience greater daytime sleepiness, a possible direction for future research.

0589

Protective effects of melanocortins on short-term changes in a rat model of traumatic brain injury.

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Objectives: A treatment for traumatic brain injury (TBI) remains elusive despite compelling evidence from animal models for a variety of therapeutic targets. Numerous animal models have been developed to address the wide spectrum of mechanisms involved in the progression of secondary injury after TBI. To further compromise the patient's prognosis is the lack of clinically effective treatments to assist recovery from injury. Those individuals that survive TBI continue to live for many years with disabilities conferring large emotional and financial burdens. We used a rat model of diffuse traumatic brain injury (TBI) the impact-acceleration model. In this study,

we investigated the molecular and histological changes induced by TBI and the possible protective effects of melanocortins.

Method: Brain tissue nitric oxide (NO) synthesis, by Griess reaction; phosphorylation level of two protein kinases ERK 1/2 and JNK, TNF-alpha expression by western blot; and brain histological damage were evaluated 24 and 48 hrs after insult.

Results: Posttraumatic administration of melanocortin (3 and 6 hrs after injury) reduced TBI-induced upregulation of ERK and JNK phosphorylation, and TNF-alpha expression. These molecular changes were associated with a reduction in brain NO synthesis at both time points. These results were in agreement with a reduced brain tissue damage as highlighted by histopathological findings.

Conclusions: The findings of our study clearly indicate that anti-inflammatory effect of melanocortins could be useful for the treatment of diffuse TBI.

0590

Race, Ethnicity, and Neurobehavioral Outcomes One Year After Traumatic Brain Injury

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Objectives: Introduction: Neurobehavioral problems are among the most important barriers to engaging in employment, recreational activities and social relationships after TBI. These problems are also the main source of stress and burden for family members and caregivers. Even though there are previous studies that have investigated neurobehavioral problems after TBI, there is a lack of research examining this issue in conjunction with race/ethnicity. Objective: To investigate whether Caucasian, African American, and Hispanic individuals with TBI express differences in neurobehavioral symptoms at one year post injury after adjusting for demographic and injury characteristics.

Method: Design: Retrospective study. Participants: 1,339 individuals from the TBI Model Systems National Database with primarily moderate to

severe TBI (978 Caucasian, 288 African American, and 73 Hispanic) hospitalized between 1996 and 2001. Main Outcome Measures: Neurobehavioral functioning inventory at 1 year post moderate to severe injury. ANCOVA models were fit for each response including an effect for race/ethnicity, as well as effects for gender, age, marital status, education level, and employment status at injury, cause of injury, FIM and DRS at discharge, and total number of days in acute and rehabilitation care.

Results: There was evidence of significant differences in NFI scores among the races/ethnicities for the depression, somatic, memory/attention, communication, and motor subscales, after adjusting for demographic and injury characteristics; there were not significant differences in the aggression subscale. In general, Hispanics had higher levels of symptom reporting than African Americans and Caucasians, while differences between African Americans and Caucasians were not significant.

Conclusions: More research is needed to identify ethnicity and race related differences in neurobehavioral outcomes for patients with mild, moderate, and severe injuries. Intervention programs need to be designed especially to reflect differential outcomes.

0591

Family Needs and Psychological Well-being in Caregivers of Individuals with Traumatic Brain Injury in Guadalajara, Mexico

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Objectives: Introduction: Traumatic brain injury is a major cause of death and disability in people around the world. The physical changes caused by a TBI are apparent, but emotions, behavior, and personality can also be altered as a result of this life-changing event. When an individual sustains a traumatic brain injury, family members and significant others are affected, often through the role of caregiving which creates a large increase in family needs in the caregiver, who is often

overlooked in comparison to the patient. While there is a large amount of research on the needs of individuals with TBI, there is a lack of research focusing on the family needs of caregivers of individuals with TBI in Mexico.

Objective: To determine the relationship between caregiver needs and psychological well-being in a group of family caregivers of individuals with Traumatic Brain Injury (TBI) in Guadalajara, Mexico.

Method: Participants/Methods: 50 caregivers completed the Family Needs Questionnaire (FNQ) composed of 27 needs (1–5 scale) and 9 subscales, including emotional, informational, economic, household, and community support; respite; physical health; sleep; and psychological health needs. Caregivers also completed the Patient Health Questionnaire (PHQ-9) to measure depression, the Zarit Burden Interview (ZBI), and the Satisfaction with Life Scale (SWLS).

Results: The FNQ sub-scales with means greater than 3.0 were emotional support, informational support, economic support, community support, respite, and physical health. Participants experienced a range of depression levels with 36% of caregivers scoring as mildly depressed, 26% as moderately depressed and 8% as moderately to severely depressed. Mild to moderate burden was experienced by 38% of caregivers, moderate to severe burden was experienced by 48% of caregivers, and 8% classified as severely burdened. Thirty-eight percent of caregivers were extremely dissatisfied with their lives, 30% were dissatisfied, 14% were slightly dissatisfied, 14% were slightly satisfied, and 4% were satisfied. Caregivers reporting more emotional, physical, and psychological needs scored higher on the ZBI, PHQ-9 and lower on SWLS. Individuals that need more household support and time to sleep had higher ZBI scores, while those with more community support needs had lower SWLS scores. Caregivers with more economic needs had lower SWLS scores and higher ZBI scores. Caregivers with more respite needs had higher ZBI and PHQ-9 scores.

Conclusions: This study illustrates that family caregivers of individuals with TBI from Guadalajara, Mexico were more likely to present needs in the areas of emotional, informational, economic, and community support, and respite and physical health. Seventy percent of caregivers reported depression, 94% reported burden, and 82% reported dissatisfaction with their lives. Future program design and implementation should be aimed at reducing stress, burden, and depression and improving family needs and satisfaction with life of caregivers of individuals with TBI.

0592

Factors influencing long-term outcome after epidural hematoma

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Objectives: Traumatic epidural hematoma (EDH) is a common injury. The goal of this paper was to investigate which factors contribute to the one-year outcomes of patients with EDH.

Method: Between 01/2001 and 12/2005 13 European centers enrolled patients with severe TBI (=Glasgow Coma Scale <9). Only patients who survived at least until admission to the intensive care unit (ICU) were enrolled. Data on accident, pre-hospital treatment, hospital treatment, and outcomes (ICU, 3, 6, 12 months) was collected prospectively using a web-based database. Data sets of all patients who had had an EDH were retrieved from the database. The Glasgow Outcome Scale (GOS) at 12 months after trauma was used to classify the patients into 3 groups: "good" (GOS scores 5–4), "poor" (GOS scores 3–2), and "dead" (GOS score 1). Data is presented as median and interquartile range or as proportions with 95% confidence interval (CI). Statistical analysis was performed with the open source statistical package "R". Univariate analyses were used to identify differences between the three groups of patients. Relevant data was then used as covariates in logistic regression models. The results are given as odds ratio (OR) and CI. A p-value of <0.05 was considered statistically significant.

Results: 195 (17%) of the 1172 patients in the database had an EDH as a single diagnosis, or in combination with subdural hematoma (SDH), contusions or edema. Most patients (n=155; 80%) were male, and the most common cause of injury (24%) was fall <3m in all 3 groups. Of the 195 patients, 170 (87%) required cranial surgery. Evacuation of the EDH was the most frequently observed indication for surgery (n=147; 75%) followed by evacuation of SDH. At 12 month after trauma 98 patients (50.3%) had recovered well (group good), 14 (7.2%) had poor outcome, and 83 patients (42.6%) died. Mean age was lowest in group "good" (35 years), followed by groups "poor" (42 years) and "dead" (47 years). Injury severity score (24 vs. 28 and 43) was lower, and initial GCS

score (7 vs. 5 and 4) was higher in patients with good recovery. Significant midline shift was observed less frequently, and open basal cisterns were observed more frequently in patients with good recovery. SDH was present more frequently in patients with poor recovery or death (28% in group "good", 36% in group "poor", 54% in group "dead"). Logistic regression revealed that age, GCS scores, midline shift, and absence of additional SDH were factors that significantly influenced good recovery at 12 months after trauma. GCS score and midline shift significantly influenced survival.

Conclusions: Morbidity and mortality after EDH are mostly influenced by age and trauma severity as reflected by GCS scores, additional SDH, and midline shift.

0593

Falls in Chronic Post-Stroke Patients and Predictive Value of Functional Tests

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Objectives: The aim of this study was to investigate the fall rates of community dwelling chronic post stroke patients and to evaluate the predictive power of Berg balance scale (BERG) and fall risk test (FRT) of Biodex balance system in regard to fall.

Method: Thirty two chronic post-stroke hemiplegic patients who were able to walk independently at least 100 m were recruited. All of the patients were using a single ankle foot orthosis on their affected lower limb. Patients were assessed with BERG and FRT at baseline. Approximately one year later all of the patients were called by telephone and fall history was questioned.

Results: 28 of the patients were reached and the data about fall were taken successfully. The mean follow-up duration was 9.4 ± 2.6 months. 18 (64.3%) patients reported one or more falls and two (7.1%) reported hospitalization due to fall. FRT had a sensitivity of 62.5% and specificity of 80% in regard to fall. There was statistically significant correlation between the FRT score and falls ($p = 0.03$; $r = 0.41$). The cutoff value for FRT score was found 2.5 ($p = 0.04$; $\exp(b) = 0.15$). BERG had a sensitivity of only 38.9% and specificity of 90% and there was not any significant correlation between the BERG score and falls ($p = 0.42$; $r = 0.15$).

Conclusions: Special attention must be given to improve balance during the post-stroke rehabilitation because of high fall rates. FRT of Biodex balance system was a successful tool for predicting the chronic post-stroke ambulatory patients who were prone to fall.

0594

Young Adult Survivors of Brain Injury in Nursing Homes: A Model Project for Appropriate Care and Successful Outcomes.

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Objectives: Nursing homes serve as a much needed resource in the community, but provide inappropriate institutionalization for young adults with inadequate rehabilitation, a focus on maintenance, limited medical intervention, and insufficient peer interaction, activities, stimulation or structured focus.

Objectives:

- (1) Describe the nursing home/long term care environment for its resources and limitations and how these impact the young adult survivor.
- (2) Identify options for designing a program within the environment to facilitate recovery and improve quality of life for the young adult survivor.
- (3) Identify community resources to complement the objectives for the young adult survivor.

Method: Clinical observation, documentation and outcome measurement tool designed by the program clinical team.

Results: 33% of the residents participated in activities in the community.

70% demonstrated significant increased participation in internal and/or external activities meaningful to the individual.

30% of those served moved from the facility to return to the community.

19% of those remaining in the facility demonstrated significant functional improvement.

Conclusions: The limited additional structure, stimulation and interventions provided to the residents in the program facilitated significant functional advances.

0595

The Effect of Ankle Foot Orthosis on Balance and Fall Risk of Post-Stroke Hemiplegic Patients: Preliminary Results

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Objectives: The objective of this study is to assess the relative effect of ankle foot orthosis on static balance and fall risk of chronic post-stroke hemiplegic patients.

Method: Twenty-six consecutive chronic post-stroke patients were recruited. All of the patients were using AFO on their affected lower limb and also were able to walk independently at least 100 m. All of the patients were assessed with Berg balance scale (BERG) and postural stability test (PST) and fall risk test (FRT) of Biodex balance system with AFO and without AFO. All assessments were made with footwear.

Results: Mean age was 61.0 ± 11.5 years and mean post-stroke duration was 21.2 ± 6.7 months. The BERG score and overall stability score of FRT were statistically improved while AFO was worn ($p < 0.001$). There were no statistically significant differences between the postural stability test scores (overall, medial/lateral index, anterior/posterior index) with or without AFO ($p > 0.05$) (Table 1).

Conclusions: AFO was commonly prescribed orthosis for post-stroke hemiplegic patients in order to enable passive dorsiflexion at the stance phase and prevent drop foot during the swing phase of walking. It was obviously seen that AFO also had some positive effects on balance and especially on fall risk improvement.

0596

The perfluorocarbon emulsion Oxycyte™ reduces axonal injury following diffuse traumatic brain injury coupled with secondary insults of hypoxia and hypotension.

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Objectives: Traumatic axonal injury (TAI) is a major cause of morbidity/mortality following severe closed head traumatic brain injury (TBI) and blast combat casualties. To date there is no revolutionary therapeutic intervention. Perfluorocarbon emulsions (PFCs) are intravenous oxygen (O₂) therapeutics capable of enhanced O₂ delivery. Previous work with PFCs have demonstrated their capability for preserving brain function to tissues rendered hypoxic due to edema, microcirculation dysfunction, ischemia and TBI. Our study examined the effect of a 3rd generation PFC emulsion, Oxycyte™ (Oxygen Biotherapeutics Inc. Durham, NC) to attenuate axonal damage following a rat impact-acceleration model of TBI coupled with secondary insults of hypoxia and hypotension (HH).

Method: Sprague-Dawley rats were randomly assigned to 1) Sham operated-vehicle (saline); 2) HH-alone- vehicle; 3) TBI-vehicle; 4) TBI-treated with Oxycyte™ and 5) TBI-HH treated with Oxycyte™. Oxycyte™ (6.0ml/kg) was administered I.V., 10 min. post-injury, over a 30 min period using 100% O₂ and 2.0% isoflurane for 3 h post-injury. Animals were sacrificed at 24 h for histological assessment of injured axons in the white matter tracts of the brain stem detected using antibodies against amyloid-precursor protein (APP) and markers for neurofilament compaction (NFC).

Results: We found that secondary insults of HH in conjunction with TBI increased axonal injury when compared to TBI alone ($p \leq 0.05$). Oxycyte™ treatment effectively reduced axonal injury in the TBI-HH groups ($p \leq 0.05$).

Conclusions: The results of the current study demonstrate that Oxycyte™ is an effective therapeutic treatment to reduce TAI following TBI-HH. These data provide further support for the use of PFC emulsion for clinical trials in severe TBI patients and suggest that PFC treatment may be useful in reducing TAI following blast injury incurred during combat casualties.

0597

The Etiology of Symptom Reporting and Cognitive Complaints in Mild Traumatic Brain Injury

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Objectives: The extent to which symptomatology following mild traumatic brain injury (mTBI) persists beyond the subacute phase remains a controversial issue. Although the cognitive and emotional effects typically resolve without complications, 10 to 20% of mTBI patients experience symptoms that persist beyond three months post-injury. What gives rise to these persistent symptoms, termed the postconcussive syndrome (PCS), remains a matter of debate. In particular, the evidence regarding the contribution of psychosocial and emotional factors such as pain, depression, and gender has been variable. The degree to which these factors contribute to the expression of PCS symptoms following mTBI is important when considering effective and appropriate treatment interventions for these individuals. The present research set out to investigate the contributions of age, gender, pain, cognitive impairment, and depression to the reporting of neurobehavioural difficulties and PCS symptomatology in the subacute stages and at six months following mTBI.

Method: A sample of 140 patients with mTBI, who presented to the Emergency Department of a lead center for trauma, were followed up to six months post-mTBI and assessed twice during that period of time. The sample was predominantly male, in the third decade of life, with an average intellect. The majority of participants were assigned an initial GCS score of 15 (70.4%) and experienced a PTA of 30 minutes or less (83%).

Pain, depression, and neuropsychological functioning (processing speed, working memory, multi-tasking, and sustained attention in the face of perceptual interference) were formally assessed and used as predictors of postconcussive symptoms (in-house checklist), somatic complaints (Neurobehavioral Functioning Inventory Somatic scale), and cognitive difficulties (Neurobehavioral Functioning Inventory Memory/Attention scale).

Results: All regression models were found to be highly significant ($p < .0005$; Adjusted R² = 0.56 – 0.67). At one month post-mTBI, depression ($\beta = 0.64$; $p < 0.0005$), pain ($\beta = 0.20$; $p < 0.0005$) and working memory performance ($\beta = -0.16$; $p = 0.02$) were significant predictors of the reporting of postconcussive symptoms. In contrast, only depression ($\beta = 0.78$ to 0.80; $p < 0.0005$) contributed significantly to the reporting of cognitive and somatic complaints. At six months post-injury, the reporting of PCS symptoms

and extent of somatic complaints were predicted by both depression ($\beta = 0.59\text{--}0.64$; $p < 0.0005$) and pain ($\beta = 0.32\text{--}0.34$; $p < 0.0005$), while only depression predicted the degree of cognitive complaints. Other aspects of neurocognition, age, and gender did not predict symptom reporting. Further analyses looking at the complaints of those with a pre-existing history of mood disorder versus those without also failed to show a significant contribution of a pre-mTBI history of mood disorder.

Conclusions: The present findings highlighted the important contributions of depression and pain to the expression and maintenance of PCS symptoms in the first six months following mTBI. This information will be used to discuss the development of effective and appropriate treatment interventions for symptomatic mTBI individuals.

0598

Advanced Methods for Non-Invasive Posttraumatic Seizure Monitoring for Head Injury Patients

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Objectives: Posttraumatic epilepsy is a common complication associated with traumatic brain injury (TBI), occurring in up to 15–20% of patients with severe brain trauma. Head trauma also accounts for approximately 5% of chronic epilepsy. Moreover, there is a time lag between trauma and seizure onset that requires constant monitoring. In addition brain injured patients also may display other physiological symptoms along with other electroencephalographic patterns. This type of information is vital in order to obtain a better understanding of posttraumatic mechanisms. There is no currently available method for non-invasive continuous monitoring of electroencephalography (qEEG), oxygen saturation, and heart rate over prolonged periods.

The objective of our research was to develop an embedded monitoring system that is a robust, secure, and non-invasive system which allows for real-time monitoring of physiological signals of the brain for post traumatic head injured individuals.

Method: Two physiological sensors were used to monitor brain activity. Electroencephalography electrodes were used because they provide a good measure of brain activity while being non-invasive.

Oxygen saturation sensors were used to monitor oxygen saturation and heart rate. These sensors were synchronized and processed by a microcontroller. This information was sent via a wireless connection to a computer database.

The main application of this embedded monitoring system was to create a metric to designate whether the physiological signals indicated an abnormal state or not. To test our system, we used an EEG simulator which provides EEG data which includes a baseline signal and a seizure signal. A comparison of the baseline signal and the seizure signal was used to create an overall metric. The theta/alpha ratio of the EEG signal was used to create a metric from the EEG. A theta/alpha ratio that was below 50% of the baseline reading was classified as an abnormal signal. The oxygen saturation data was classified into three categories. Below 70% was abnormal. A reading less than 75% of the baseline heart rate was classified as abnormal.

Results: Test data indicate that there is a decrease in the theta/alpha ratio in the seizure data compared to the baseline data.

Conclusions: These results show that this embedded monitoring system can be used to provide robust, secure, non-invasive, and real-time monitoring. Such systems are ideal for clinical monitoring as well as home monitoring for the identification of personal posttraumatic seizure patterns.

0599

AQP4 expression and diffusion tensor imaging in rat brainstem after diffuse axonal injury: A combined MRI-histological study

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Objectives: The brainstem is an important predilection site for diffusion axonal injury (DAI). Aquaporin 4 (AQP4), a water channel protein located at the blood brain barrier, might facilitate the removal of this excess of water from the parenchyma into the blood. First, we hypothesized AQP4 expression in rats with diffuse axonal injuries of the brainstem. We further hypothesized that movements of water through AQP4 could affect apparent diffusion coefficient (ADC) and the fractional anisotropy (FA) measurements in diffusion tensor imaging after DAI.

Method: Diffusion axonal injury (DAI) was induced in 30 rats by a weight drop trauma model. Five

separate parallel groups of six to eight rats per group were injured and imaged at 3h, 6h, 12h, 24h, 72h post-injury. Rats in DAI group were sacrificed for histology immediately after the scan. A control group of ten rats was imaged and sacrificed for histology but not injured. Each group was studied by conventional MR imaging, diffusion tensor imaging (GE 1.5T scanner) and histologically examination including HE, silver staining, and immunohistochemistry of AQP4. The results of conventional MRI and DTI were compared with the changes of histopathology found.

Results: Brain edema, axon swelling, axon retraction ball were found by histopathological observation. ADC, FA measurements and AQP4 expression change of brainstem regions were detected within 72 hours after DAI at every time point. There was significant difference of ADC, FA measurements, morphological changes of axonal and AQP4 expression in brainstem between DAI group and control subjects.

Conclusions: AQP4 has a relevant relationship with the arisen and development of the brain edema after DAI. Diffusion tensor imaging is helpful for identifying the classification between vasogenic brain edema and cytotoxic brain edema. ADC, FA measurements in brainstem were correlated with AQP4 after DAI.

0600

Differences in employment outcomes 10 years after traumatic brain injury among racial and ethnic minority groups

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Objectives: Racial and ethnic minorities are disproportionately at risk of sustaining TBI. Emerging evidence further indicates that compared to whites, minorities face worse short-term and long-term functional, psychosocial and neurobehavioral outcomes after TBI. Specifically, minorities are more

likely to be unemployed 1 to 5 years post-injury. This area has not been thoroughly examined in the research literature beyond 5 years. Therefore, the aim of this study is to examine differences in employment outcomes 10 years after TBI among racial and ethnic minorities.

Method: Using a retrospective cohort study design, data for 382 participants (194 minorities and 188 whites) with primarily moderate to severe TBI was extracted from sixteen TBI Model System Centers utilizing the TBIMS database. Employment status at 10 years follow-up was categorized as competitively employed versus not competitively employed.

Results: A logistic regression model indicated that the odds of being competitively employment versus not competitively employed at 10 years follow-up were 2.370 times greater for whites as compared to minorities (95% CI = 1.468, 3.831), after adjusting for age at injury, pre-injury employment status, cause of injury, and total LOS. In addition, the odds of competitive employment at 10 years follow-up (versus not being competitively employed) were 2.117 times greater for those employed at injury as compared to those not employed, 2.553 times greater for those with non violent injuries as compared to those with violent injuries, 1.485 times greater for those who were younger (25th percentile = 21 years) versus those who were older (75th percentile = 34 years), and 2.187 times greater for those with shorter total LOS (25th percentile = 28 days) as compared to those with longer total LOS (75th percentile = 71 days).

Conclusions: Compared to whites, minorities with TBI are less likely to be competitively employed at 10 years follow-up. This study adds longer-term employment outcomes for racial and ethnic minorities to TBI research literature. In addition, it supports previous research illustrating that employment is less promising for minorities after TBI both short and long term. Recommendations will assist rehabilitation professionals target the specific needs of minorities with TBI in order to address these employment disparities through culturally-based interventions and service delivery.

0602

Effects of mild hypothermia on the glutamate transporter EAAC1-mRNA expression and injured nervous cell apoptosis after rat focal cerebral ischemia/reperfusion injury

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Objectives: To the effects of mild hypothermia on the glutamate transporter EAAC1-mRNA expression and injured nervous cell apoptosis after rat focal cerebral ischemia/reperfusion injury.

Method: The middle cerebral arteries (MCA) of SD rats were occluded for 30 minutes, and reperfused for 90 minutes. Using DIG-labeled CRNA probe and TUNEL, the positive rate of the glutamate transporter EAAC1-mRNA expression and the apoptotic cell rate were tested in the sham-operated group, the control group and the mild hypothermia group separately.

Results: the positive rate of the EAAC1-mRNA expression and the apoptotic cell rate were obviously lower in the sham-operated group than those in the control group separately ($p < 0.05$, $p < 0.01$). the positive rate of the EAAC1-mRNA expression was significantly higher and the apoptotic cell rate were obviously lower in the mild hypothermia group than those in the control group ($p < 0.05$).

Conclusions: That the mild hypothermia decreases the injured nervous cell apoptosis may be related to the the increased EAAC1-mRNA expression, the induced synthesis of EAAC and the increased uptake of glutamate.

0603

Aquatic Balance and Gait Training in Sequel of Adult Medulloblastoma: a Case Study

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Objectives: Medulloblastoma is a cerebellar tumor that affects children and young adults. It is more common in males and the predominant clinical manifestations are headache and cerebellar syndrome. The cerebellum receives afferent informations from almost all sensorial systems and uses this informations as a regulator of the motor outcome. Patients with ataxia have problems on using mechanisms of feedforward and feedback in order to classify the correct muscle activation for postural stability. To our knowledge there has been no published study investigating the effects on balance of adults with sequel of medulloblastoma after an aquatic intervention. Therefore, the aim of this study was to investigate the use of aquatic balance and gait training to improve balance of an adult with sequel of medulloblastoma.

Method: A 27 years old man with severe upper and lower extremity ataxia, diplopia, bilateral face paralysis as sequel of medulloblastoma affecting

cerebellum vermis and IV ventricle, participated in this prospective case study. It was held in a Rehabilitation Center in Sao Paulo, Brazil: AACD. This individual participated in a 24- week, aquatic physical therapy intervention, focusing on activities that challenged his postural stability. The Berg Balance Scale was used to measure his progress every month. The exercises consisted in cube position (partial body submerged, assuming a seated position, with arms extended), progressing to triangle (stand position with large base of support) and stick (stand position with narrow base of support). In all of them the therapist made turbulence with hands to challenge postural stability. He also had to push and reach a heavy ball in the water surface, and maintain stand position while performed self initiated movements. Gait training was made through holding the safety bar and a stick. To increase the level of difficulty, activities were done in lower water levels, leading to a smaller influence of buoyancy force in patient's body and consequently offering more opportunity of weight bearing.

Results: The Berg Balance Scale results were the following: 23/56 first month; 16/56 second month; 32/56 third month; 32/56 fourth month; 32/56 fifth month.

Conclusions: Results from this case study suggest that aquatic physical therapy intervention may be beneficial to individuals with ataxia. Some water properties influence directly and indirectly on maintaining, recovering and challenging postural stability. Viscosity increases the time to prepare motor outcomes, making easier the balance reactions. The water flux, when turbulent and made behind the the patient walking resists the gait and in front assists the gait. The buoyancy force facilitates movements toward the surface and difficults movements toward the ground. In conclusion we can suggest that aquatic physical therapy is beneficial for patients with ataxia however further investigation using more rigorous methods is needed to confirm this early evidence.

0604

Analysis and Discussion of the Epidemiological Profile of Patients with Stroke Admitted at a Network of Rehabilitation Hospitals in Brazil

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Objectives: Stroke constitutes a group of pathological conditions characterized by sudden, non-convulsive

loss of neurological function due to brain ischemia or intracranial hemorrhage. This paper aims to describe the epidemiological profile of patients with stroke admitted at a Network of Rehabilitation Hospitals in Brazil. Particular attention has been given to the neuropsychological rehabilitative process, as well as primary preventive and/or therapeutic procedures.

Method: A systematic review was conducted of 17,873 patients admitted at a Network of Rehabilitation Hospitals with a diagnosis of stroke with onset of 12 years or earlier. A retrospective analysis of the case series was done in light of major publications.

Results: Between 1995 and 2007, a total of 420,586 patients were admitted for different therapies at the Network. Of these, 4.22% (17,783) were patients with stroke. An assessment of the epidemiological profile of this specific population revealed the following findings: 52% were male; mean age at initial onset was 58.9 years. The most frequent type of stroke was ischemic, accounting for 74.8% of the overall total. Hemiparesis (55.4%) and aphasia (18.8%) were the most common clinical findings. Hypertension, isolated or combined with other risk factors, was present in 83.6% of the patients; smoking, in 42.2%. Patients with cardiomyopathies and arrhythmias accounted for, respectively, 16.46% and 7.25% of the total sample. An analysis of neuropsychological profiles showed that 94% of the patients rehabilitated at the hospital had undergone neuropsychological evaluation.

Conclusions: Stroke remains a common vascular event with high morbidity. Hypertension is the most important modifiable risk factor for stroke. According to the literature, smoking increased the risk of stroke by 2 to 3 times, due to its impact on hemostasis and its accelerative effects on the atherosclerotic process. The percentage of patients diagnosed with depression (7.6%) and cognitive impairment (15.3%) in this sample was below average, when compared to the literature. More concerted efforts should be employed to identify patients with depression and cognitive impairment, especially those rehabilitated in outpatient settings, in order to obtain better rehabilitation outcomes in stroke patients.

0605

TAKLE: A Cognitive Behavior Therapy Based Program on Coping Strategy Use and Emotional Adjustment

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Objectives: To examine impact of a cognitive behavior therapy based program on coping strategy use and emotional adjustment. Nine couples; nine former patients with TBI or stroke, and their spouses were recruited to the program. The two courses ran for 1 week, 5 hours pr day, with a follow-up day of an additional 5 hours. Courses focused on psycho-education and developing adaptive coping skills for the management of emotional and adjustment issues.

Method: The nine couples were tested before and 5 weeks after completion of courses. The measures (Satisfaction With Life Scale, STUM, Symptom Check List-5, CAGE, The Awareness Questionnaire and The Bakas Caregivers Outcome Scale) were sent to the participants by post before the course began and were either filled out at home or upon arrival on day 1 of the course. Measures were filled out a second time 5 weeks after the course was completed on the follow-up day. In addition the participants were all asked to complete an evaluation form. The scores were analysed statistically using SPSS 15.0 (Statistical Package for the Social Sciences).

Results: Following the courses, the majority of participants subjectively reported that they had less anxiety on the SCL-5 scale. The first 15 items of the Bacas Caregivers outcome scale (well-being) also showed a clear tendency of improvement. However, no changes in satisfaction of life, coping, or awareness were observed on the measures used. The participants all subjectively reported having benefited from the course in learning more about brain damage. Participants also reported that the contact with others in the same situation was beneficial to their well-being, and many remain in contact with one another after completion of the courses.

Conclusions: There is a tendency shown to indicate that this kind of course might reduce anxiety and create a support-system between patients and spouses of patients. The participants gave very positive evaluations for the courses. Unfortunately there was too few participants to draw any scientific conclusions.

0606

From Student to Patient to Student to Practitioner

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Objectives: Non medical contributors to recovery and restoration that support or obstruct medical treatment following Traumatic Brain Injury are critical factors in successful rehabilitation programs. Twelve years ago my life was altered irrevocably in a fatal car accident. Severe brain injury has impacted all aspects of my life including a promising elite sporting and academic career. Persisting with my university studies despite fatigue, chronic headaches and challenging attitudes, has enabled me to complete Masters level research, gain employment as a Rehabilitation Counsellor, Project Officer at the University of South Australia and make a difference to many people who have experienced brain injury. My whole value system has changed along with my life ambitions. While my cognitive processes have altered, I faced a progressive journey through rebuilding physical and cognitive function that has been enhanced through experience and resilience complementing medical treatment.

Method: My own personal experiences with traumatic brain injury survival, recovery and rehabilitation.

Results: A coordinated process of support and establishing independence has facilitated success. Employment, university research, mentoring, public speaking, inspirational autobiographies, networking with other survivors and family support have all impacted positively. Even simple interventions have made a practical difference.

Conclusions: Local and international initiatives provide opportunity for a coordinated rehabilitation services including non medical interventions, effective communication and emphasis on individual experiences.

0607

Low frequency rTMS is a safe method for post-stroke patients who had atrial fibrillation: a case report

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Objectives: The aim of this case study is to investigate the safety of low frequency repetitive transcranial magnetic stimulation (rTMS) on a post stroke hemiplegic patient who had permanent non-valvular atrial fibrillation.

Method: The patient was 69 years old male patient who had a right hemiplegia and whose post-stroke duration was 23 months. He had mild to moderate motor disability and mild spasticity at both upper and lower limbs (Brunnstrom 5, Barthel score 75 and Ashworth 1). It was planned to apply 1 Hz rTMS for the 5 consecutive days to him. He was begun to monitorized for the cardiac rhythm a hour before the TMS application and it was continued during the measurement of the MEP latency, amplitude, central motor conduction time (CMCT) and resting motor threshold (rMT) of both affected and unaffected hemispheres and during the following 20 minutes of rTMS application to the unaffected hemisphere. After the rTMS application, the patient was monitorized for the following 24 hours with Holter monitoring.

Results: All of the TMS applications were applied with no complication. Maximally 70% intensity was applied during the measures and rTMS was applied at %90 of the rMT. The patient's measures were as follows; MEP latency 22.20, amplitude 4.40, CMCT 7.8 and rMT 40% at affected hemisphere; and MEP latency 21.80, amplitude 4.90, CMCT 7.7 and rMT 28% at unaffected hemisphere. The TMS and rTMS application caused no difference on the cardiac rhythm.

Conclusions: TMS measurements and low frequency rTMS application had caused no cardiac arrhythmia other than atrial fibrillation. TMS and rTMS application was seem to be safe on post-stroke hemiplegic patients who had permanent non-valvular atrial fibrillation. Nevertheless further researches with more patients are needed to confirm this result.

0608

Long term outcomes after Decompressive Craniectomy

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Objectives: Decompressive Craniectomy is a commonly employed surgical technique that is designed

to reduce intracranial pressure following traumatic head injury, thereby improving survival rates. However, little is known regarding long term functional outcomes. The aim of this study is to determine whether functional outcomes at six months following decompressive craniectomy are representative of outcomes beyond three years, particularly for those patients predicted to have the poorest outcomes.

Method: Between 2004 and 2008, 146 patients underwent decompressive craniectomy for severe head injury in Western Australia. The web-based outcome prediction model developed by the CRASH trial collaborators was applied to the cohort. For those patients for whom there was a greater than 75% predicted risk of unfavorable outcome at six months, standardised assessments of gross functional outcomes, activities of daily living, and carer burden were conducted between 39 and 64 months post craniectomy using the Glasgow Outcome Scale (GOS), Barthel Index, and Zarit Burden Interview.

Results: Of the 146 head injured patients who received craniectomies, 22 had died and 27 were severely disabled (GOS 3 – 4) at six months. So far, one patient has died and six severely disabled patients have survived beyond three years. Five of these surviving patients and/or their carers consented to a home-based assessment. Beyond three years, only one patient was assessed as having a good outcome (GOS 1 – 2). The remaining four patients who required carers stayed within the predicted poor outcome category and consistent with this finding all four patients were assessed as being severely disabled by the Barthel index. Despite caring for a severely disabled brain injured person, only one carer reported severe burden, with the remaining reporting only mild to moderate burden.

Conclusions: Preliminary findings obtained so far suggest that most of those severely head injured patients predicted to be severely disabled at six months, using the web based prediction model developed by the CRASH collaborators, remain so beyond three years post craniectomy. However, one patient predicted to have an unfavorable outcome at six months had improved at 58 months.

Given the significant individual, societal, and financial costs associated with long term care needs for this patient group the results highlight the need and potential value of a prognostic tool to aid the difficult neurosurgical decision making process in the most severely head injured patients.

0609

Quality Of Life In Caregivers Of Patients With Supraspinal Spasticity Receiving Intrathecal Baclofen

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Objectives: Intrathecal baclofen (ITB) infusion has become the treatment of choice in patients with severe spasticity. Increased quality of life (QoL) in patients treated with ITB has previously been demonstrated; however, to date no study has been undertaken concerning QoL of caregivers looking after patients treated with ITB. The aim of this study was to assess QoL in caregivers of patients with supraspinal spasticity who are treated with ITB.

Method: We studied 20 caregivers (14 males, 6 females, mean age 32.5 years) of patients with an implanted SynchroMed pump for ITB treatment. The patients (11 males, 9 females, mean age 20.9 years) suffered spasticity secondary to perinatal damage (n=11), cerebrovascular accident (n=5), traumatic brain injury (n=3), and cerebral hypoxia (n=1). Clinical examination of the patients included Modified Ashworth Scale, Spasm Frequency Scale, Visual Analog Scale for assessing mood, rehabilitative goal attainment, ability to independently change posture, ambulation (independent, with walking aids, with assistance), nursing, type and amount of rehabilitative treatment, and perineal hygiene facilitation). The Caregiver Burden Interview (CBI) was administered to assess QoL of caregivers. All scales were administered one month before and six months after pump implantation. Statistical analysis was carried out by paired t-test.

Results: All caregivers had a significant total score reduction in CBI (p<0.001). The data also showed significant improvement in patients for Modified Ashworth Scale, Spasm Frequency Scale, Visual Analog Scale for assessing mood, rehabilitative goal attainment, ability to independently change posture, ambulation (independent, with walking aids, with assistance), nursing, type and amount of rehabilitative treatment, and perineal hygiene facilitation).

Conclusions: We conclude that ITB treatment improves QoL of caregivers through facilitation of the patients' nursing and rehabilitation.

0611

High-frequency symptoms of communication disorders after brain injury and the difficulty of practicing communication skills to cope with the symptoms: a pilot study for developing a software program which facilitates information provision from the family of the brain injured persons to the caregivers

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Objectives: In Japan, it is not until after discharge from a hospital that the brain injured persons and their families are able to recognize and face specific problems in their daily lives. Here it is important for the family to provide the caregivers with correct information on the symptoms of cognitive disorders and the appropriate ways to cope with them. We have been developing a software program which would facilitate such information provision. The program is designed to take symptoms as input and then output a countermeasure for each symptom. Two questionnaires were conducted concerning communication disorders and communication skills to find which symptoms are more common and which communication skills are harder to practice.

Method: Questionnaire1: Twenty persons participated in the survey. Each has in the family a brain injured person who utilizes welfare services and/or facilities. They were presented with a list of 11 symptoms concerned with communication disorders picked up from 86 symptoms of the cognitive disorders from standard manuals and handbooks. The 11 symptoms included 4 symptoms concerned with language problems, 4 with discourse problems, and 3 with conversational problems. They were asked to check the symptoms which they considered to be causing problems in daily life.

Questionnaire2: Twenty-four persons who had attended a 2-hour course of "How to Communicate with Brain Injured persons"

participated in the survey. They had learned about cognitive disorders, 25 necessary communication skills (Hirozane, 2008), and practiced role-playing among them and practical training with two brain injured persons. They were asked to classify 25 communication skills into three groups; those which are practicable by experience (Group 1), by taking lecture (Group 2), and by taking lecture and practical training (Group 3). The correlation between the classification and the occupations (medical or non-medical) of the participants was examined by the Wilcoxon rank sum test.

Results: Questionnaire 1: More than 70% of the participants checked 2 of the 4 symptoms of language problem, 3 of the 4 symptoms of discourse problems, none of the 3 symptoms of conversational problems.

Questionnaire 2: More than 50% of the participants classified 8 communication skills out of 25 as Group 2 or 3. No correlation between the classification and the occupations of the participants was observed.

Conclusions: The results suggested that the brain injured persons frequently demonstrate symptoms caused by discourse problems as well as language problems. These results were consistent with the previous studies (McDonald, et al., 1990; Hirozane, 2009). Quite a few communication skills require lectures and/or practical training to practice irrespective of one's occupation. Therefore some of the countermeasures output by the program need to be described in detail.

0612

Rehabilitation process of patients with Child Acquired Brain Injury Post Anoxia - Intervention in Occupational Therapy at Associação de Assistência à Criança Deficiente - Sao Paulo/Brazil.

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Objectives: The child acquired brain injury is a serious and recurrent cause of physical, perceptual and cognitive disability according to literature and data of the Clinic of Children's Acquired Brain Injury of the Associação de Assistência a Criança Deficiente (AACD) - Sao Paulo/Brazil. Although there is a prevalence of traumatic brain injury, the anoxia in our services represent 22% of cases treated.

In these cases there are three phases for rehabilitation: Awakening, Adapt and Reorganize. The objective of this study was to analyze the evolution of patients with etiology of anoxia treated at Occupational Therapy by checking the acquisition of individual goals proposed in the scope of occupational performance (areas, components and context). *Method:* Descriptive study of cases reports in a retrospective analysis of electronic medical records of patients of AACD, children with acquired brain injury caused by anoxia and began the occupational therapy process in the period of 2001 to 2007. It was considered patients treated by the same occupational therapist, to ensure the reliability of the findings, because the uniformity of the descriptions in the records.

Results: We identified 7 cases, 5 males and 2 females. During analysis we excluded 1 case. On average, patients had 27 months at the time of injury, the average time until the beginning of occupational therapy was 12 months and remained in service for 33 months, with two of these patients remain in therapy. We analyze the occupational performance, considering components, areas and contexts, regarding the stage of the rehabilitation process that the patient has achieved. The work focused on the family was important to structure the environment, assistive resources, furniture, how to perform the tasks, guidelines regarding the stimulation (sensory, perceptual, cognitive, motor), play, school and social integration, so that it could be implemented for daily activities.

Conclusions: Intervention should be focused on the client and family, to adapt the strategies and approaches, respecting the potential and possibilities of each patient at each stage. While there is a response you should invest in the process, regardless of time post injury and even when there is stability of the functional status, the development and progress of the children should be monitored regularly to manage potential changes and adjust the direction and measures of the actual needs of the patient and family as they present themselves.

0613

Rehabilitation of Executive Functioning with Training in Attention Regulation Applied to Individually Defined Goals: A Pilot Study Bridging Theory, Assessment and Treatment

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Objectives: Some of the most common and disabling consequences of brain injury are deficits in executive control processes. Building on premise that attentional control may serve as a 'gateway' to other components of executive functions we have developed a novel intervention, Goal-based Self-Management (GbSM) training, designed to target deficits in executive control processes with training in attention regulation applied to participant-defined goals. The aims of this pilot study were to assess feasibility and effects of this intervention in participants with chronic brain injury.

Method: Sixteen individuals with chronic (6+ months) ABI and mild-moderate executive dysfunction participated. Eight completed GbSM intervention training during the first 5 weeks, followed by brief control education training (EDU) during the next 5 weeks (GbSM-EDU), and eight completed training in reverse order (EDU-GbSM). Measurements at baseline, weeks 5 and 10 (post-intervention or control) included neuropsychological and functional performance assessments, and self-report.

Results: At week 5, participants who completed GbSM training significantly improved from baseline in neuropsychological domains of attention and executive function, working memory, mental flexibility, sustained attention and inhibition, and had less task failures on functional tasks, while participants who completed EDU training did not show any significant changes. At week 10, participants who crossed over to GbSM training significantly improved in neuropsychological domains of attention and executive function, working memory, mental flexibility, inhibition, and delayed recall. Participants who crossed from GbSM to EDU training maintained their week 5 gains.

Conclusions: The GbSM training protocol involving application of attention regulation strategies to participant-defined goals is theoretically driven, feasible, and practically applicable. Participants found the protocol engaging, improved in cognitive and functional domains targeted by the intervention, incorporated some of the trained strategies to non-trained tasks and situations in their daily life, and continued to use them after cessation of training. The limitations of this pilot study and future directions are discussed.

0614

One-year follow-up of sports related concussion in high school athletes

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Objectives: To investigate the persistence of somatic symptoms and document changes in school performance following a sports related concussion.

Method: Parents of high school athletes from the fall and spring sports seasons were contacted 8–12 months after their last visit to the physician when they were cleared for return to play. Participants received a medical examination, IMPACT testing within 2 days of the initial incident, and serial IMPACT assessments until return to play. Consented parents participated in a telephone interview to answer questions about concussion history, frequency of concussions since return to play, academic performance, time missed from school since the concussion, changes in extracurricular activities or participation in sports, and concerns about their child. During this interview, parents provided consent for completion of checklists mailed to the house on the persistence of somatic symptoms and behavioral changes (BRIEF).

Results: At 12 months, physical symptoms (headache, lightheadedness, nausea, fatigue) dissipated according to the majority of participants (80%). Most of the participants (90%) reported school difficulties immediately following the concussion such as failed tests, time off from school, and difficulty with work completion. School difficulties persisted for 2% at 12 months post, requiring accommodations. Those who reported difficulties had a history of multiple concussions (more than 2) prior to the current incident. For all participants with multiple concussions, this visit was the first time for a medical evaluation regardless of the number of concussion in their history.

Conclusions: Findings support expansion of concussion education to include efforts to prevent multiple concussions that have potential to impact school performance and further follow-up on the functional effects of sports related concussions.

0615

Outcomes Following Admission to UK Paediatric Intensive Care after Traumatic Brain Injury

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Objectives: The UK Paediatric Traumatic Brain Injury (TBI) Study Group promotes multi-centre interdisciplinary research aimed at improving outcomes for children who have suffered TBI. From 2001–2003 a prospective study was carried out across the UK to record comprehensive demographic and clinical data on children admitted with TBI to a paediatric intensive care unit (PICU). A subsequent follow-up study was carried out on a subgroup of children to measure outcomes one year post-TBI.

Method: 20 paediatric intensive care units (PICUs) in England, Wales, Scotland, Northern Ireland and Eire collected anonymised clinical data over a 12 month period for all TBI admissions of children aged < 16 years. Clinical leads at each PICU invited parents of 349 children (by letter) to take part in a follow-up interview 12 months post-TBI. Telephone interviews were carried out by TBI nurses using a structured questionnaire, Kings Outcome Scale for Childhood Head Injury (KOSCHI) and Paediatric Injury Functional Outcome Scale (PIFOS).

Results: Parents of 108 children agreed to participate and 100 with valid phone numbers were interviewed. On the KOSCHI 12 months post-TBI, 9 children had severe disability, 58 moderate disability, 13 good recovery with some minor disability, 20 made a full recovery. 7 had suffered seizures post-TBI. On the PIFOS, less than half had problems with motor skills, one third had difficulties with daily living, 57% had communication difficulties and two thirds experienced physical changes. The majority (88%) had social/emotional and cognitive difficulties. 63% were continuing to be followed up by the hospital, but only 22% were currently receiving rehabilitation. Nearly all school-aged children had returned to school post-injury, half had received some school assistance, yet just under half the parents said their child was now a 'slower-learner'. Only 8 children were still seeing a psychologist or neurologist.

Conclusions: One third of children admitted to PICU for TBI made a good recovery, only 9 children had residual disability requiring specialised rehabilitation. Just over half were 'walking wounded' at 12 months, the majority with invisible cognitive and emotional difficulties. Support for such difficulties is very limited and may impede recovery.

0616

Traumatic Brain Injuries in Preschool Children: High Risk for Consequences and Disparities in Identification.

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Objectives: Children who sustain a brain injury under the age of 5 are particularly vulnerable to the effects of diffuse brain injuries (Eiselle & Aram, 1993, Ewing-Cobbs, & Barnes, 2003; Ewing-Cobbs & Barnes, 2002, Lowenthal, 1998). Contrary to theories on neuroplasticity, a brain injury in preschool creates risks for developmental consequences across the lifespan. Injury effects may not appear until several years later when increased demands for processing and executive skills come into play. Early identification and follow-up for young survivors of brain injury is critical; however, due to lack of a single point of entry to follow-up services and the latent nature of cognitive and behavioral symptoms, disparities in identification exist for this population. The goal of this paper is to describe disparities in identification of this population verified by an injury reporting system in the state of Georgia.

Method: Emergency room visits for traumatic brain injuries in children under age 5 reported to the Georgia Central Registry were compared to children identified in preschool special education program count.

Results: In 2004, the Central Registry captured 7922 visits to the emergency for children between the ages of 0–4 years. Of these children, 7763 were discharged home for care. In the same year, reports from preschool counts of TBI children enrolled in special education in the state indentify 16 children with TBI a number which increased to 17 for 2005. These findings concur with a recent report on under-identification of school-aged children following TBI (Todis, 2007).

Conclusions: Disparities in accurate identification require procedures for capturing children who experience symptoms in services across healthcare, school and community settings.

0617

Cognitive Rehabilitation in Children and Youth: Moving toward Collaborative Partnerships

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Objectives: Cognitive rehabilitation has long been known as an effective intervention practice for remediation of the cognitive and behavioral deficits following brain injuries and strokes (BIAA, 2006; Butler, Fairclogh, Katz, et al. 2008; Cicerone, Dahlberg, Malec, et al., 2005; Laatsch, Harrington, Hotz, et al., 2007). By definition, cognitive rehabilitation is a “systematically applied set of medical and therapeutic services designed to improve cognitive functioning and participating in activities that may be affected by difficulties in one or more cognitive domains” (Katz, Ashley & O’Shanick, 2006). Theoretical models of cognitive rehabilitation propose a systematic, goal directed approach to improved optimal functioning in school, community and home. Different philosophical and service delivery approaches form the concept of cognitive rehabilitation, with some advocating for skill-based intervention while others propose compensatory strategy training. Children are more likely to spend time recovering from a brain injury in the schools, a system that is becoming the long-term rehabilitation program for children and youth. School system models focus on learning needs, and “maintaining” a child in an educational program, mandates that differ significantly from medical models striving for optimal recovery and improved quality of life. Proposals for more “ecologically based” approaches which deliver cognitive rehabilitation in the child’s environment of home, school, and community have the potential to effectively extend intervention beyond the medical model and bridge the gap between both models of service for children (Anderson & Catroppa, 2006; Ylvisaker et al., 2002).

Method: Review of the literature and current clinical practices in cognitive rehabilitation for children.

Results: Several key factors comprise the best practices for cognitive rehabilitation for children and youth. One factor is children are different from adults. A second issue is that parents and caregivers are critical partners for children. A third factor is injury adjustment for both parents and children. A fourth critical factor is communication between medical and educational models of service. A final factor is that principles of learning and development can guide cognitive rehabilitation efforts. Direct instruction and compensatory strategy teaching are methods that hold promise to meet the increasing requirements for independence as the child progresses through school. Researchers report efficacy of these approaches based on child learning principles and use in other populations of children

with disabilities (Glang, Ylvisaker, Stein et al., 2008).

Conclusions: Evolution of new models of care is needed to integrate principles of medically based cognitive rehabilitation into the child's environment of school and community programs as well as provide methods to monitor the child's development through transition to adulthood. Cognitive rehabilitation for children requires partnership with families and schools to monitor injury effects on development in progress and academic achievement outcomes.

0618

ICP versus repeat CT scan in Non Operated Severe Head Injury Patients –A Prospective Multicenter Review

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Objectives: Background: Routine Intracranial Pressure Monitoring (ICP) and/or repeat CT scan for severe head injury is standard practice for head-injured patients in many trauma centers. Utilization of both these methods, especially ICP monitoring has increased over time, yet effects on outcome and the value especially in patients with non operated severe head injury is yet to be determined.

Method: A prospective review was conducted on all non operated severe traumatic head injury patients, admitted to two trauma centers in Malaysia between June 2007 and June 2008. All patients admitted to trauma centre 1 (CT Scan group) underwent routine repeat CT scan 24 to 48 hours after admission with management tailored accordingly. In trauma centre 2 (ICP group), all patients underwent ICP monitoring and management was tailored according to an ICP driven protocol. Variables collected included demographic data, initial head CT results (Marshall grading), ICP on insertion, indication for repeat CT (routine versus neurologic change), number and results of repeat CT scans, and clinical interventions following repeat scans or raise in ICP, duration of ICU stay, duration of ventilation and mortality rates.

Results: Between June 2007 to June 2008 a total of 152 patients were prospectively recruited into this study; 102 in the CT scan group and 50 in the ICP group. The mean age in the CT scan group was 36.9 (14–83) years, where else in the ICP group, the mean age was 37.2 (8–70) years.

In the CT scan group, 23.7% (22 patients) showed progression of injury in the 2nd scan. Only 6% (i.e. 1

patient), had neurosurgical intervention subsequent to the second scan. The type of injury on CT scan was not predictive of progression ($p > 0.05$). 9 patients died prior to the planned 2nd CT scan out of which 5 had progression in the injury on post mortem.

In the ICP group, 44% (22 patients) had sustained raise in ICP ($>25\text{mmHg}$ for more than 20 minutes) and warranted a repeat CT scan. Of these, only 3 (13.6%) showed progression in CT scan findings compared to the first scan. However, due to various other clinical factors 8 (36.3%) out of the 22 patients underwent neurosurgical intervention. There was no mortality prior to rise in ICP and repeat scan.

Comparing the 2 groups, the ICP group showed more neurosurgical intervention ($p < 0.05$) despite less progression on repeat CT scan. Of course, the CT group had 9 mortalities prior to rpt scan.

Mean duration of sedation in the CT scan group was 33 hours (23.3–42.7) while ventilation was 7 days (1.5–15) compared to 57 hours (12–216) ($p < 0.05$) and 6 days (1–35) ($p > 0.05$) in the ICP group. Overall mortality was 44% (43 patients) in the CT scan group while it was 24% (12 patients) in the ICP group ($p < 0.05$).

Conclusions: Routine ICP monitoring in patients with non operated severe traumatic head injury leads to significantly higher neurosurgical intervention, longer duration of sedation and lower mortality as compared to routine repeat CT scan. The duration of ventilation was also noted to be less in the ICP group though not statistically significant.

0619

The Family Week; an Educational and Social Based Program Towards Better Coping and Emotional Adjustment for the Family

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Objectives: Years ago Lezak stated that “Brain injury is a family affair”. The department of Acquired Brain Injuries has over the years developed a wide range of programs to meet this very important challenge. In 2007 it was decided to establish a program with an extensive family focus; the family week. The program is intended for families where mom or dad has had an acquired brain injury, and are living together with children below the age of 18 years. Since 2007 more than 30 families have

attended the program. The objective of this presentation is to present the family week program and the evaluations of the family members who attended the program so far.

Method: The scope of the program is to assist the families to develop adaptive coping skills for the management of emotional and adjustment issues within the families. The program focus on psycho-education, group activities and social arrangements. Parts of the program includes all the family members, some activities/lectures are especially accustomed to the needs of the different age groups (below ten years, eleven – eighteen years, more than eighteen years, the adult group). The program runs from Sunday evening to Friday evening, with an average of 4 hours lectures/psycho-educative activities a day. The following topics is covered; the brain/acquired brain injury and common sequelae, coping and family functioning. The social arrangements includes such activities as barbeque party, beach and water sport activities, visit to amusement park, physical training and more.

All participants evaluated the programs run in 2008 and 2009 by filling out an evaluation form. The evaluation forms were adapted to the age groups (below ten years, eleven – eighteen years, more than eighteen years, adult). Adults with/or without an acquired brain injury evaluated the program separately. All aspects of the programs were evaluated; the psycho-education groups/lectures, the group activities and the social arrangements. The participants were recruited through ads in newspapers, information leaflets in the brain injury department and through the hospital's website.

Results: Seventy four family members have so far attended the programs, 36 females and 38 males. Twenty two were children (below the age of 10), 10 youngsters (11–18) and 42 adults. About half of the former patients had had a stroke, the rest a traumatic brain injury. Sixty six participants rated the overall impression of the program as good, 2 as average and 3 as not that good. "To meet others in a similar situation" and "To do activities with the family" were rated slightly better than the psycho-educative groups by the adults. There were no significant differences between the patient and relative group. Twenty seven of the children/youngsters got new friends during the week, 5 did not.

Conclusions: Brain injury is a family affair. Despite this fact the majority of families experience few or none services on behalf of the specialized health care system in Norway, with a clear family focus. The family week has showed to be a promising approach to help the families to better cope and adapt with the challenges an acquired brain injury often results in for the family.

0620

Understanding the Experiences of Family Caregivers of Individuals with Acquired Brain Injury Following Discharge from Rehabilitation

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Objectives: After the initial medical crisis of a brain injury is over, families are faced with a myriad of behaviors and problems that can be difficult to understand and disruptive to everyday life. The purpose of this study was to offer a deeper understanding of the experiences of family caregivers of individuals who have suffered an ABI once they have discharged from a rehabilitation setting.

The needs of family caregivers of individuals with an ABI are two-fold. First, they need to be well-educated about community and health resources following their family member's discharge from a rehabilitation facility. Second, they need help to understand how to communicate and positively function with the brain-injured individual. Research reveals that neither of these needs is met effectively. One of the main goals of this study was to utilize the Brain Injury Family Guide DVD as a way to understand common behavioral difficulties experienced by family caregivers. A second goal was to identify critical needs of families caring for a loved one with an ABI, in order to improve the awareness of rehabilitation and mental health professionals to this population's needs.

Method: To most effectively understand the experiences and needs of this caregiver population, a phenomenological qualitative approach was utilized via focus group and interview formats. Eleven family caregivers participated in two rounds of individual interviews and one focus group to discuss their difficulties and needs as caregivers. Caregivers' experiences spanned one year to eighteen years post-injury.

Results: Major themes evolved from the data including: Changes in Behavior and Personality of the Individual with ABI including subthemes: verbal and physical aggression, lack of self initiation, impulsivity, lack of cooperation, low frustration tolerance, and poor self-awareness; Barriers to Independence including subthemes: striving to encourage independence, driving, money management, time management, fatigue and sleep disturbances, incontinence, and personal responsibilities and accountabilities; Lifestyle Changes of the Caregiver and the Injured including subthemes: moving, retirement/job

change, financial commitment to caregiving, divorce, intimate relationships, relationship changes within the family, and friendships; Daily Caregiver Stressors including subthemes: no one could have prepared us for this, hopeless healthcare professionals, acceptance, overwhelmed and exhausted, fighting with funding sources, guilt, and respite; and the Positive Focus of Caregiving including subthemes: motivation, spirituality, humor, mental health resources, making a connection with a therapist, and psychoeducational tools.

Conclusions: In conclusion, a greater awareness of the needs and struggles experienced by family caregivers of individuals with ABI following their discharge from rehabilitation will enable rehabilitation and mental health professionals to increase their effectiveness in working with this population and to modify their techniques for a more successful discharge experience. Future research should consider a quantitative approach to examining the emergent themes and their role in current rehabilitation therapies.

0621

A Regional Database of Acquired Brain Injury in Emilia Romagna, Italy - A Report of Four Years of Prospective Data Collection

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Objectives: Severe Acquired Brain Injury (sABI), is a major public health problem. In Emilia-Romagna (4 million inhab. region in Northern Italy) about 80 persons /million/year are expected to undergo a brain injury requiring inpatient comprehensive rehabilitation. A regional network of rehabilitation services for persons with sABI has been established.

A register of persons who sustain sABI has been funded by the Regional Board of Health since may 2004, to collect prospective data about the incidence of sABI and clinical features of persons with sABI admitted in the hospitals of the region, and to facilitate access to rehabilitation services.

This paper describes the information gathered through the register in the first four years of activity (may 2004-may 2008).

Method: Since may, 2004, data concerning the patients admitted in acute care units with sABI and surviving at least 96 hours are collected. Categories

of data include demographic (age, sex, marital status, place of residence, occupational status), clinical/functional (aetiology of ABI, comorbidity, Glasgow Coma Score: GCS, Levels of cognitive Functioning: LCF, Disability Rating Scale: DRS) therapeutic interventions (surgical, rehabilitation) and follow up (disposition at discharge, length of stay: LOS).

Data are also gathered at discharge from the rehabilitation units (Rehabilitation phase database" and after 12 months ("Follow-up database").

This paper describes data extracted from the Acute stage and Rehabilitation databases.

Results: From may 2004 to may 2008, data on 2146 sABI patients admitted in acute care units have been collected.

Most of the patients were male (65%), Italian (91%) and lived at home (83%). 34% were students or full-time employed. The aetiology was: trauma 42% of cases; anoxia 12%, haemorrhage 38%, other causes 8%. The mean age was 46y (sd 21) for traumatic and 62 (sd 16) for nontraumatic cases. Most of the patients had low GCS scores on admission (score 3 to 5: 56%; 6 to 8: 39%). Median LCF on admission and discharge were 2 and 3; median DRS were 9 and 8. The average LOS was 32.1 (sd 20.6) days. Death was reported in 5.5% of cases.

Most of the surviving patients were transferred to rehabilitation units (65% of traumatic and 54% of non traumatic).

675 patients were followed up during the Rehabilitation phase; median LCF and DRS on admission and discharge were 3 - 5, and 7 - 6, respectively. Non traumatic patients showed a worse outcome. Most of the patients (76% of traumatic and 52% of non traumatic) were discharged at home. The average LOS in rehabilitation was 92 (sd 87) days.

Conclusions: The data collected through the regional sABI database confirmed previous epidemiological findings, and represent an useful support in managing and improving health care services.

0622

Alcohol and Drug Use Following Traumatic Brain Injury In Childhood, Adolescence and Early Adulthood

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Objectives: Increased substance and alcohol use/abuse has been reported in adults following even relatively mild traumatic brain injuries (mTBI), and may be associated with subtle deficits in inhibitory control and decision making functions. However, there is little information regarding the incidence of these problems in adults who experienced a TBI during childhood. Previously, we reported that mTBI that occurred during the pre-school period resulted in increased substance use/abuse during adolescence. The objective of this study was to see whether these adverse outcomes were detectable into adulthood (at 25 years of age). We also sought to compare outcomes for those who experienced a TBI event during childhood, adolescence or early adulthood.

Method: We used data from a longitudinal birth cohort of 1265 children. Information about these children, including TBI events, had been collected at birth, 4 months and at yearly intervals until age 16, and again at ages 18, 21 and 25 years. Information about substance dependence was collected from age 14 years. A range of child and family characteristic that have been collected in the context of the study were available to control for other factors that might contribute to increased drug and alcohol dependence. Children were divided into two groups according to their injury severity; Outpatient (consisted of all injuries seen by a general practitioner or at an A&E department and discharged) and Inpatient (all injuries that required a period of hospitalization). The remainder of the cohort formed a reference control group. The majority of injuries experienced were mTBI (over 90%). We examined outcomes for reported alcohol and drug dependence over the age bands 0–5 years, 0–15 years and 0–21 years.

Results: Compared to the reference group, increased rates of alcohol and drug dependence were evident for individuals who had experienced an inpatient TBI. This effect was greatest for the children who had experience an inpatient TBI event during their preschool years. These results remained substantially unchanged when we controlled for sex, early behavior problems and family SES, and also after we controlled for early substance use.

Conclusions: Our results indicate that there is an increased risk of alcohol and drug dependence among young people who have experienced a TBI during their childhood. While it could be argued that young people who experiment with alcohol are more at risk of injury, when we controlled for early substance abuse, evidence of increased risk remained.

0623

Community Capacity Building and Vocational Models of Service Delivery for Individuals with Traumatic Brain Injury in the State of Florida

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Objectives: Traumatic brain injury (TBI) is a unique and complex injury which encompasses a myriad of challenges for the survivor, rehabilitation professional, the family and friends of the survivor, and the community including employers. Individuals who sustain a TBI face many challenges including deficits in their physical, cognitive, and psychosocial functioning. As a result of these deficits, these individuals often have difficulty reintegrating into their community and returning to work after sustaining such an injury. Successful community reintegration and return to work for individuals with TBI is possible with appropriate education, resources, and supports.

Method: Brain Injury Association of Florida (B.I.A.F) partnered with community-based organizations throughout the State of Florida and offered them competitive grants to build capacity to better serve the vocational and community integration needs of individuals with TBI. BIAF facilitated community capacity building efforts in eight regions in the State of Florida during the years 2006–2008. This was achieved through the guidance and implementation of vocational models of service delivery pilot projects. Each of these projects was tailored to the unique vocational needs of individuals with TBI. Curriculums, created by various community-based organizations, have been included and discussed in a “Promising Practices” manual (2009).

Participant demographic information was collected at each organization at the time of participant referral into the program. Program Evaluation Surveys were administered upon entrance and exit of the program (2006–2007 only). Satisfaction surveys were given to the participant upon exit of the program.

Results: During 2006–2007 year-long grant funded pilot projects included the development and implementation of tailored vocational guidance counseling and disability adjustment counseling programs for individuals with TBI. Each of the awarded grantee organizations created a disability adjustment and vocational guidance curricula/manual to facilitate the sustainability of these programs.

During the year of 2007–2008, capacity building pilot projects were implemented throughout eight regions in the State of Florida. These year-long grant funded projects included the development and implementation of tailored supported employment programs for individuals with TBI. Each of the grantee organizations developed methods and a curriculum tailored specifically for supported employment needs of these individuals.

Conclusions: The purpose of the “Promising Practices” manual is to describe and discuss these (a) pilot projects, (b) community capacity building efforts, and (c) programs, products and curriculums that have been developed and implemented regionally throughout the State of Florida during 2006, 2007 and 2008. Our goal is for service providers, educators, researchers and survivors will better understand the needs of persons with TBI in the State of Florida and consider the findings of these pilot projects useful in future endeavors and enhance service provision to individuals with TBI.

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0624

Cognitive and speech/language gains after constraint-induced movement therapy (CIMT) in children with chronic traumatic brain injury (TBI)

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Objectives: Pediatric CIMT is an effective intervention for increasing functional use of the impaired upper extremity (UE) in children with congenital hemiparesis. Key components of CIMT include (1) constraint of the unimpaired UE for up to 3–4 weeks, paired with (2) intensive, repetitive motor practice with the hemiparetic UE, and (3) shaping of more complex motor patterns. Efficacy of CIMT has been attributed to 2 mechanisms: (1) reversal of learned non-use, (2) neuroplastic changes. There have also been anecdotal reports of “collateral” gains following CIMT, both in non-targeted motor skills (e.g. ambulation, speech) and in non-motor, cognitive domains. Successful applications of CIMT

to improve motor skills in children with hemiparesis secondary to TBI have recently been reported in isolated cases. However, there have been no reports of cognitive benefits of CIMT in pediatric TBI. TBI differs from congenital hemiparesis in a number of ways, including (1) neurological disruption in TBI is more diffuse, (2) acquired TBI does not allow the developmental “priming” that may occur in the non-lesioned hemisphere of children with congenital BI, and (3) children with acquired BI have a repertoire of normal motor functions, which may enhance recovery. Thus children with hemiparesis secondary to TBI may or may not demonstrate “collateral” gains following CIMT.

Method: We report results of a case series of 3 children who were greater than 1 yr. post-TBI who were treated with CIMT. In addition to pre- and post-treatment assessment of UE function (reported elsewhere), changes in cognition and in speech articulation were assessed. Three children with motor dysfunction who received equivalent intensity of therapy without constraint were included as controls. All participants were given the Goldman Fristoe Test of Articulation and alternate forms of the Expressive Vocabulary Test, Second Edition (EVT-2) and Test of Nonverbal Intelligence, Second Edition (TONI-2) prior to and immediately following CIMT or equivalent unconstrained intensive therapy.

Results: All 3 children with TBI showed gains in UE function following CIMT (reported elsewhere). In addition, the 3 CIMT participants also showed gains in speech quality, and in verbal cognition as reflected on the EVT-2. Two of the 3 CIMT participants showed improvements in nonverbal reasoning, as reflected on the TONI-2. None of the 3 controls showed improvements in nonverbal nonverbal reasoning, and 2 of the 3 showed no improvements in verbal cognition on post-testing.

Conclusions: CIMT appears to have benefits beyond improved UE function, including cognitive benefits, in children with TBI. Possible mechanisms of efficacy may be increased physiological attention directed to the lesioned hemisphere and decreased inhibitory action of the less injured hemisphere, and thus enhanced neuroplasticity, due to “silencing” of the stronger hemisphere through constraint.

0625

Using the Dizziness Handicap Inventory in Assessment of Patients with Postconcussive Symptoms

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Objectives: Dizziness can occur in as many as two-thirds of patients after brain injury and has been shown to be an independent risk factor for persistent post-concussion symptoms. The Dizziness Handicap Inventory (DHI) is a reliable and validated questionnaire used to measure self-perceived level of handicap associated with dizziness. Although primarily used in patients with vestibular pathology, the DHI has also been used in evaluating subjective dizziness in brain injuries. This study sought to determine if the severity of dizziness in concussion patients is related to age, sex, mechanism of injury, time since injury, past medical or psychiatric history, PTA, LOC, HCT findings, Post-Concussion Scores or computerized neurocognitive testing. In addition, individual questions more commonly answered on the DHI were also evaluated.

Method: Twenty-six patients (19 males, 7 females) between the ages of 12 to 49 (SD 12.24) who sustained a concussion (ranging from 4 days to 4 years prior) and complained of “dizziness” on the Post-Concussion Score Scale were asked to complete the DHI. As part of their routine outpatient clinical visit, patients were also evaluated via computerized neurocognitive testing (ImPACT®). The mechanisms of injury were motor vehicle accident (15%), sports injury (70%) or fall (15%). Post-Traumatic Amnesia and LOC occurred in 73% and 34% of the patients, respectively, and head CT findings were present in 8% of the patients. Fifteen percent of patients had a history of depression and/or anxiety and 19% had a history of headaches and/or migraines.

Results: The severity of DHI score (composite and individual domains) was not found to correlate with sex, mechanism of injury, time since injury, past medical or psychiatric history, PTA, LOC, HCT findings, Post-Concussion Scores or computerized neurocognitive testing. However, the severity of DHI score (composite and individual domains) was found to correlate with age. Older individuals, had a higher DHI composite scores ($p=0.046$) than younger individuals. In addition, patients who reported dizziness were more likely to answer yes to two questions in the DHI: 1) “Do quick movements of your head increase your problems?” ($p=0.095$) and 2) “Because of your problem, is it difficult for you to concentrate?” ($p=0.030$).

Conclusions: Patients who sustain a concussion may complain of dizziness long after their initial injury and the symptoms experienced may be just as debilitating as in the acute period. Given that patients who suffer from dizziness may be at risk of having protracted recoveries, special attention

should be given to this subpopulation. Efforts to treat these patients with vestibular and balance therapies may help improve concentration and diminish the persistence of symptomatology. Treatment of dizziness may also help prevent falls in older patients, a population already at risk.

0626

Experience of participation after brain injury – related to sick leave

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Objectives: In Europe, traumatic brain injury (TBI) is one of the main causes of death and handicap. Several studies have shown problems with return to work (RTW) after a traumatic brain injury and a lower level of activity and participation in society.

In Sweden, social insurance and sickness benefit are central to people’s welfare after all illness. We have not so far found any studies looking at the specific sick-leave pattern prior to a TBI or activity/participation related to sick leave. The aim of this study was to explore the relation between sick leave and participation.

Method: The study was carried out in Sweden and data were collected from three different hospitals in the Sahlgrenska University Hospital complex in Gothenburg. The cohort was made up of all patients (129 in total) aged between 18 and 65 admitted to the emergency room during a two year period (1999–2000) with a traumatic brain injury classified as S06.2 and S06.3 (International Classification of Diseases 10). The patients were asked to reply to a questionnaire concerning participation (IPA) four years after trauma, to explore their participation in society, related to sick leave at the date for trauma and four years after.

Results: Of the cohort, 31% were on sick leave the day for trauma, 63% were not on sick leave. There were no differences in severity of injury between the groups measured with RLS (Reaction Level Scale) or in days at hospital after trauma. Four years after trauma there was a significant difference in participation, measured with the questionnaire IPA, regarding movement, activity in the home, social contacts and work. The group who were on sick leave at the date for trauma experienced a lower level of participation in society four years after trauma than the group not on sick leave the day for trauma.

When analyzing the group not on sick leave the day for trauma considering participation four years after trauma, there was a significant difference in participation if they still were on sick leave or not. The group still on sick leave experienced a significant lower level of participation in activity, leisure time, social contacts, work and helping others than the group not on sick leave. The group on sick leave four years after TBI also had a more difficult brain injury measured with RLS.

Conclusions: We can in our study see that other factor than the pathology and severity of TBI are predictors for less participation in society after a brain injury. This indicate the necessity to consider premorbid and social factors in rehabilitation. As often stated, the importance is not the diagnose, but who has got the diagnosis.

0627

Conversion Disorder after Concussion

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Objectives: It has been shown that conversion disorder is best treated by a dedicated interdisciplinary team with the goal of improving functional independence. We describe a case of a 17 year old football player who developed conversion disorder after sustaining a documented concussion with subsequent post concussive syndrome.

Method: We utilized a retrospective case review, drawing from outpatient clinic notes, outpatient therapy documentation, and inpatient rehabilitation notes and observations. The treatment plan during inpatient rehabilitation was developed by the authors.

Results: Despite the natural history of concussion, the patient was at a dependent level for mobility, activities of daily living and communication for nearly a year. The patient was followed by a psychiatrist during this time who oversaw the comprehensive negative medical work up by multiple specialists. The patient also participated in outpatient physical therapy, vestibular therapy, occupational and speech therapy.

The patient was eventually admitted to an Inpatient Rehabilitation unit, and treated by a team including a psychiatrist, physical therapist, occupational therapist, speech pathologist, rehabilitation psychologist and neuropsychologist. His therapy was a novel regimen, including rewarding positive behavior, goal

setting with expectations of completion of goals, nonmedicalization, community reentry and age appropriate socialization. Using this program, the patient began to improve significantly. By the time of discharge, the patient was completely independent. We describe the details of the patient's presentation and the therapy regimen which resulted in a complete functional recovery.

Conclusions: We developed a novel therapy regimen utilizing a multidisciplinary team in an inpatient rehabilitation setting to restore complete function to a patient with conversion disorder after concussion.

0628

How can we tell who is aware? Who has the "veracity"?

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Objectives: To be able to set realistic goals and make treatment plans the rehabilitation team need knowledge of patient awareness. However, there is no simple way to get this estimation.

One way of doing it is to compare patient ratings with a proxy. The aim of this study was to explore if stroke patient and next-of-kin ratings on the European Brain Injury Questionnaire (EBIQ) are feasible to use in order to estimate the patient awareness of cognitive, social and emotional problems.

Method: In a study of home rehabilitation conducted in 1998–2001, 58 stroke patients were included. From this sample 35 had a next-of-kin that answered the European Brain Injury Questionnaire, EBIQ, which together form the sample of this study. A comparison of the patient and next-of-kin ratings was performed with a paired T-test to explore if there were any differences. With the assumption of the Barrow Neurological Institute Screening for higher cortical functions, BNIS, to be "the veracity", the patient ratings on the EBIQ was compared by a Gamma correlation with the BNIS in order to find out their relation. A lack of relation would indicate a lack of awareness among the patients. In the next step the same thing was done but with the data splitted into two groups according to the rating under the item awareness in the BNIS. A Gamma analysis was also made with the EBIQ version, completed by next-of-kin, and the BNIS in order to examine if there was a better relation than for the patients.

Results: The comparison of patient and next-of-kin ratings significantly differed. The Gamma correlation for patient ratings and BNIS was significant but the variance in EBIQ was only to a little extent explained by BNIS. Only 24% of the cases were ranked the same for the two instruments. When splitted there was a significant correlation between the instruments for the group of unaware. The next-of kin EBIQ did not correlate at all with the BNIS either with the whole group or when splitted into the groups of aware and unaware.

Conclusions: Neither patient or next-of-kin ratings had a strong relation to the BNIS but for the patient ratings there was a significant correlation. When splitted the result showed that more problems at BNIS correlated with more lack of awareness. The conclusion from the study could be that when assessing aspects like perception of cognitive, social and emotional problems it is not feasible to use next-of-kin ratings. It can also be problems when comparing to an objective measure as perceptions are very subjective.

0629

Mortality and Causes of the Moderate and Severe Traumatic Brain Injury: An analysis of 1370 Brazilian Patients

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Objectives: Of all types of injury, those to the brain are among the most likely to result in death or permanent disability. Estimates of traumatic brain injury (TBI) incidence, severity, and cost reflect the enormous losses to individuals, their families, and society from these injuries. In this paper we purpose to study a hospital epidemiological features about severe and moderate traumatic brain injury in a trauma center level I in greater city of South America
Method: Data was collected from the hospital emergency unit, the discharge register during 30 months. We included all patients with moderate and severe TBI admitted to the intensive care unit of our hospital (greater Brazilian hospital). Data including mechanisms of injury, secondary insults, operative and intensive care management, and outcome assessments 6-months post injury were collected.

Results: During the 30 months of this study, 1,370 cases of moderate and severe traumatic brain injury

were reported. A preponderance of injuries occurred among men (78.6%) and among persons aged 15 to 24 years (32.4%). The median age at the time of injury was 26 years (ranged 1 - 97yo). Among all reported cases there were 211 deaths and a lethality rate of 15.4%. Motor vehicles were involved in 703 of the related injuries, accounting for 51.3% of all traumatic brain injuries in the sample. Among transportation-related injuries in occupants of vehicles, 48.6% involved motorcycle riders. In all sample 48.6% of patients underwent to craniotomy and of the patients admitted to the ICU, 78% were mechanically ventilated.

Conclusions: A preponderance of injuries occurred among young men. Strategies to improve outcomes from TBI should be directed at preventive public health strategies, stand out to traffic accident involving motorcycle rider

0630

Neurocognitive Function and the Severity of Head Impacts Sustained in Athletic Competition

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Objectives: Computerized neurocognitive assessment is used by clinicians to assist in the evaluation of concussion injury and, in athletics, is often a significant factor in return-to-play decisions. Helmets instrumented with Head Impact Technology (HIT) actively monitor the frequency, location and severity of head impacts sustained during play, allowing exploration of the complex relationship between impact biomechanics and head injury. The purpose of this study was to correlate neurocognitive performance of concussed and

non-concussed athletes with measures of head impact exposure and severity.

Method: 50 collegiate athletes participating in contact (football, ice hockey) and non-contact sports (golf, cross-country) were separated into three groups: concussed ($n=18$), uninjured contact sports ($n=23$), and non-contact sports ($n=9$). Concussed athletes and their matched teammate controls were evaluated at two time intervals (pre-season and within 72 hours of injury) and again at return to play if greater than 72 hours. Non-contact athletes received a pre-season and repeat assessment matched for test/re-test interval. The computerized Immediate Postconcussion Assessment and Cognitive Testing (ImPACT) evaluation was used to evaluate neurocognitive function. Deviations from baseline performance were compared to ImPACT-defined reliable change indices (RCI) to determine an abnormal change in cognition. Players in contact sports wore helmets instrumented with HIT System technology during all practices and games. The frequency of players with abnormal change scores were compared between groups of athletes and the presence of change was used to calculate receiver operating characteristic (ROC) curves for single-day impact severity measures, including number of impacts sustained, maximum peak linear acceleration, maximum peak angular acceleration, and maximum HITsp, an impact severity measure including impact magnitude measures and weighted by impact location. The area under the ROC curves were compared to 0.5 (equal to guessing) ($\alpha=0.05$).

Results: 72% of concussed athletes had at least one abnormal deficit in any of four cognitive domains (verbal memory, visual memory, visual motor speed, and reaction time) following injury when compared to baseline. 22% of these athletes had abnormal deficits at return to play. In contrast, only 11% of non-contact athletes demonstrated a decline in one or more cognitive domain scores at re-assessment. For both re-test periods, 52% of the contact players not diagnosed with concussion had abnormal cognitive test deficits. ROC curves generated using all test subjects for each biomechanical measure were significantly different than 0.5. Maximum HITsp and maximum linear acceleration were the two metrics most sensitive to abnormal cognitive change (area = 0.652, 0.648 respectively).

Conclusions: Non-concussed athletes in contact sports were more likely to have abnormal neurocognitive scores than athletes in non-contact sports. At return to play, concussed athletes were less likely to have abnormal neurocognitive scores than non-concussed players. In addition, severity of head impact prior to testing is modestly correlated with cognitive declines.

0631

Prognosis in Children with Acute Epidural Hematoma

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Objectives: Traumatic epidural hematoma (EDH) represents a rare head injury complication in infants. Its diagnosis can be quite challenging because its clinical presentation is usually subtle and nonspecific. In our current communication, we present our data regarding the presentation of infants with EDH and management, and their long-term outcome.

Method: In a prospective study, all children (less 16yo) diagnosed with traumatic epidural hematoma on computed tomography scan who were admitted at our Hospital between 2006 and 2008 were included in this study. Neurological status assessed with Glasgow Coma Scale. Age ranged 1 to 16 yo. Medium follow up 6 months.

Results: In this period 49 patients with epidural hematomas were admitted in our hospital. On admission, most of patients 57% had a GCS of 13–15 and 33% patients had a severe traumatic brain Injury (TBI) (Table 1). In patients with mild head trauma, the most common presenting symptom was irritability, which occurred in 19/28 (68%) of our patients (Table 2). Thirty (61%) patients had a skull fracture. There were 26 males and 23 females. In regard to the lateralization of the hematoma in our study, 29/49 (59,1%) were located on the right side, and the remaining 40,9% were located on the left side, while the temporo-parietal area was the most common anatomical location of the hematoma. In total, 23 (47%) patients underwent a neurosurgical operation and 26 underwent to conservative treatment. In the patients with a severe head injury (defined as an admission GCS < 8), eleven patients (61%) have a neurosurgical procedure performed with a standardized procedure. Three of these patients were GCS 3, only one died. In all patients we verified some neurological deficit in nine patients. (Table 4)

The mechanisms of injury in our series were: fall from height in 29 cases (59%), motor vehicle accidents in 16 cases (33%), obstetric maneuver during delivery in 1 case (2%), and domestic accident/aggression in 3 cases (6%). Associated lesion (subdural or contusion hematoma) were

verified in seven patients, five these in surgical group, presenting worse evolution in follow up.

Conclusions: EDH in children represents a life-threatening complication of head injury, which requires early identification and prompt treatment. Patients with associated lesion presenting worse evolution compared with isolated EDH. Falls and traffic accident represents main causes.

0632

Application of Computed Tomography Angiography in Diagnosis of Vascular Lesions Associated with Epidural Hematoma

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Objectives: Traumatic aneurysms of the middle meningeal artery (MMA) are uncommon cause of intracranial hemorrhage. Traumatic aneurysms comprise less than 1% of all intracranial aneurysms. The natural history of traumatic aneurysms is not well known, but progressive growth of traumatic aneurysms has been demonstrated on repeated angiograms. In this our objective is to describe a series of patients with epidural hematoma underwent to angiogram for MMA vascular lesion diagnosis.

Method: Prospective study with 10 patients victims of traumatic brain injury, admitted in our emergency room with mild head trauma with initial tomography with an acute laminar epidural hematoma. All patients underwent to angiogram in first day of trauma. In second day all patients after tomography, the patient was submitted to cerebral angiogram and compared findings.

Results: The main cause of trauma was traffic accident in 6 patients. Nine patients presented hematomas in temporal fossa. All patients has presented Glasgow Outcome Scale score 5 in follow up. Traumatic pseudoaneurysm was identified in 3 angiogram, confirmed in angiogram. All patients with normal angiogram have an angiogram without abnormality.

Conclusions: Because rupture of a pseudoaneurysm of the middle meningeal artery can be lethal, we emphasize early diagnosis and early preventive treatment. We believe that angiogram is useful technique for diagnosis of vascular lesion associated with small epidural hematoma

0633

Experimental Study about correlation PtiO₂ X Intracranial Pressure in Porcine Model

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Objectives: Among the methods, accessible currently in the practical clinic, that make possible the evaluation of the presence of cerebral hypoxia, there is the partial pressure of direct cerebral oxygen (PtiO₂). However a few experimental models have developed for intracranial hypertension and brain hypoxia. The present study intend to measure the PtiO₂ in healthful pigs and to correlate it with other parameters commonly used in patients care.

Method: We develop a model and test partial pressure oxygen in brain tissue in pigs animal model. Intravenous (iv) Sodium Thiopental (10 mg/Kg) is used and the animal can be intubated with a cuffed tube. During all procedure animals will be continuously monitored with a peripheral pulse oximetry (pulse, respiratory rate and oxygen saturation), continuous invasive arterial pressure (femoral artery), EtCO₂, and rectal temperature. A fronto-temporal incision is made in the animal head. It is made a frontal Burr-hole where it was introduced a parenchymal multisensor probe in the white matter of right frontal lobe, over a length of 1,5cm. This device measures the direct tissue oximetry (PtiO₂).

Another Burr-Hole is made in the right temporal bone where it was introduced a 5 ml Foley balloon during the experiment.

Results: Eight domestic pigs weighting between 20–30 Kg will be used in the present study. During normal ventilation, with peripheral O₂ saturation of 100%, average EtCO₂ 36mmHg, a arterial blood sample was collected for gas analyses and comparison with all other parameters. This procedure was repeated during hyperventilation. We analyze the variations in the arterial blood gases and the PtiO₂ and we verified the quantitative response in brain tissue was much more sensitive than femoral artery. Then a 5 ml Foley balloon was introduced in the epidural space through the right Burr-hole. The balloon was filled progressively until 5 ml of 0,9% saline solution, we identified a correlation negative and proportional between PtiO₂ and Intracranial pressure.

Conclusions: In our study could develop a new experimental model in pigs. the parameters of normality are different compared with humans, however the changes under intracranial hypertension seem compatible with patients.

0634

Metabolic and Functional Techniques as Superior Indicators in Neuropsychological Alterations

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Objectives: The conventional structural techniques of neuroimaging are commonly used to determine cerebral lesions after acquired brain injury although several studies have shown that metabolic and functional ones are more sensitive to determine cerebral dysfunctions. The aim of this study was to prove which complementary diagnostic techniques correspond most with the neuropsychological evaluation results and the clinical signs after brain injury due to anoxia.

Method: We compared different structural neuroimaging techniques such as TAC and RMI and others which were metabolic and functional like PET, Background EEG and visual and auditory Evoked Potentials during an oddball paradigm, with the neuropsychological evaluation results on a 40 year old female, who had suffered post-anoxic encephalopathy secondary a thoracic trauma with diaphragmatic break.

Results: TAC did not show lesions suggesting hypoxic encephalopathy. The RMI showed little hyperintensities in frontal and occipital left lobes. A new posterior control IMR was informed as normal. The 18-FDG PET showed evident hypometabolism on wide areas of occipital, temporal and parietal cortex and hypermetabolic reaction in basal nuclei and thalamus. A parametrical analysis of 116 brain areas showed the same alterations and new hypermetabolic areas in both olphatory regions, more in the left side, and hypermetabilism in both hippocampus, parahippocampus and amigdala. The EEG showed a slowing down in parietal areas. The auditory Evoked Potentials were normal but the visual Evoked Potentials revealed a lack of P300 and weak topography of ERPs, demonstrating a general visuo-cognitive processing deterioration.

The neuropsychological study showed a global cerebral affection with severe cognitive alterations such as attention deficit, severe bradypsychia, anterograde and retrograde amnesia, comprehensive and expressive language alteration, anomia, visual agnosia, visoperceptive and visoconstructive deficit, apraxia, dysexecutive syndrome, anosognosia, apathy and lack of initiative and severe affectation on activities of daily living.

Conclusions: This study shows the superiority of metabolic and functional techniques as opposed to the structural conventional ones.

The metabolic and functional techniques correspond more with the neuropsychological results and the clinical signs.

The metabolic and functional techniques are more sensitive than the structural ones and become indispensable to assess cerebral consequences due to acquired brain injury.

0635

Microbleeds as a Marker for Cognitive Impairment Severity in Cerebral Small-Vessel Disease

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Objectives: Cerebral microbleeds (CMB), measured by Gradient Echo (GE) sequence on Magnetic Resonance Imaging (MRI), are associated with intracerebral haemorrhage, hypertension, lacunar stroke and small-vessel disease. CMB are known markers of angiopathy and have generally been considered to be clinically silent. There are however, very few studies which have investigated the prevalence and effects of CMB in cognitive disorder associated to dementia. In this study we attempted to evaluate the relationship between the presence of cerebral microbleeds and cognitive impairment.

Method: We studied 47 patients presenting signs of cognitive deterioration (mean 70, 42 years, 30 male)

and 29 controls (mean 68.79 years, 11 male), in neither of the group samples had anyone suffered a stroke. We analyzed the association of the presence of microbleeds with the presence of any cardiovascular risks factors, APOE genotype and cognitive disorders. To assess the presence of microbleeds we used GE on IRM, measuring their number and location. A neuropsychological battery test and an interview of activities of daily living were used to assess cognitive impairment, the severity of the dementia and the cognitive pattern present.

Results: The results showed a significant relationship between the presence of microbleeds and the presence of cognitive impairment [$\chi^2(1) = 29.06$, $p < 0.01$]. The prevalence of CMB was high, being found in 28 patients (59,6%) and increased with the severity of the cognitive impairment and the level of dementia. There was also a significant association between the cognitive pattern presented and the presence of microbleeds [$\chi(1) = 23,9$, $p < 0.01$].

Conclusions: The results indicate that CMB are one of the important markers of cognitive impairment in cerebral small-vessel disease and are related with the severity of the dementia. However, more prospective research is required in order to confirm these data. The mechanisms underlying the relationship between cognitive disorders and presence of CMB continue to be unclear but this association could have important implications for future diagnosis and treatment.

0636

Follow-up study of patients with an acquired brain injury after early focus on return to work during post-acute rehabilitation

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Objectives: Every year in the Netherlands about 100.000 people acquire a brain injury. This number is expected to rise over the coming years due to the growth of the population and medical and technological developments. Some of these patients get hospitalized and afterwards go to a rehabilitation center in which return to work is an important goal. This is expected to be beneficial to the patient (suggested to increase quality of life, independence, financial situation), to the employer (does not have to pay for a sick employee), and the government (lower social benefits).

Originally rehabilitation will focus in the final stage on return to work. In this research the effectivity on employment will be analyzed in which this view had changed. Now, from the start of the rehabilitation there was a focus on return to work. So, the view changed from a caring one into a work-orientated one.

The objective of this study was to investigate if the positive effect found of the work-orientated view directly after the rehabilitation on employment rates of the patients is sustained over four years. Furthermore, it was studied if factors could indicate if patient would be employed four years after rehabilitation and how quality of life is related to employment. Moreover, it was tried to gain insight in the experiences of the patient of the rehabilitation and the return to work process.

Method: Interviews were held with 5 patients, and 18 patients filled in two questionnaires: questionnaire on work situation, Qolibiri. Interviews were transcribed and analyzed to reveal themes that correspond to the aspects on which the patients reflected. The questionnaire on work situation were analyzed descriptively and four statistical test were performed (Independent Sample T-test, Mann-Whitney U-test, Fisher exact test, Logistic regression analysis). The Qolibiri is described descriptively and the scores on the domains & dimensions of the questionnaire are compared between both groups using a Mann-Whitney U-test. A variable was significant by a $p < 0.05$.

Results: The employment rate of the population directly after rehabilitation was 29% and increased to 53% four years later. The analysis of the transcripts of the interviews revealed ten themes: rehabilitation period, support/guidance, current work situation, period after rehabilitation, colleagues, employer, importance of work, obstacles/fears, health, future perspectives. Two variables showed a significant difference between the employed and unemployed patients: general health ($t(15) = -2.15$, $p = 0.048$), work important (when thought work to be important there was a higher chance to be employed). Furthermore, employment had no influence on the overall perceived QoL of the patients. Only one dimension of the dimensions included to calculate QoL was significant, this was the dimension independence & daily functioning ($U = 10.5$, $z = -2.23$, $r = -0.558$). Employed patients rated themselves to be better on this dimension than unemployed patients.

Conclusions: It can be concluded that the employment rate increased with time by 24%. The information retrieved by the interviews lead to the conclusion that all patients were satisfied with

the rehabilitation, a support system was important after the rehabilitation, work was important mostly for social reasons, most patients were still mentally unstable, and official authorities caused frustration. Furthermore, employed patients rated their general health to be better than unemployed patients. And patients that thought work was important had a higher chance to be employed. Moreover, employed patients did not perceive their QoL to be better than those unemployed, however they did perceive their independence & daily functioning to be better than those unemployed.

0637

Relationship between disability and return to work one year after traumatic brain injury

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Objectives: The aim of this study was to assess the relationship between disability and return to work one year after traumatic brain injury (TBI), using the International Classification of Functioning, Disability and Health (ICF) as a conceptual model for understanding TBI disability.

Method: A prospective study of 93 patients, aged 16–55 years, injured from May 2005 to May 2007 and hospitalized at the Trauma Referral Centre in Eastern Norway with acute TBI (Glasgow Coma Scale 3–12). Based on structural brain damages shown on a computed tomography (CT) scan, TBI severity was defined by modified Marshall classification as less severe (score <3) and more severe (score ≥3). The severity of structural brain damage and overall trauma (Injury Severity Score) were used as indices of body structure impairments. Activity limitations were measured by the motor and cognitive subscales of Functional Independence Measure (FIM). Participation restrictions were assessed via the home competency and social integration subscales of Community Integration Questionnaire (CIQ). The return to work at one-year follow-up, dichotomized into no/yes variables, was chosen as outcome measure. Logistic regression analyses was used to evaluate the impact of disability on the return to work, and the independent variables were entered in four separate blocks based on the ICF conceptual model.

Results: Forty-eight percent of the patients sustained severe TBI with significant intracranial abnormalities, as found on the CT head scans. More than 75% of patients were defined to have major trauma according to the ISS. Roughly one-quarter of the patients reported a disability requiring personal assistance at the one-year follow-up, and 48% were not working. The personal factors (age, gender and pre-injury employment), impairments and activity limitations contributed significantly to the multivariate logistic regression model. The final model predicted correctly 88% of patients who were working at one-year follow-up. The cognitive function, the pre-injury employment status and the severity of structural brain damage was the strongest individual explanatory variables in the model (OR 1.39 $p=0.007$, OR 0.64 $p=0.004$ and OR 0.23 $p=0.04$, respectively).

Conclusions: The ICF worked well as a conceptual model and the results demonstrated that there is a complex relationship between disability and employment status one year after TBI.

0638

Course of Psychiatric Disorders Following Traumatic Brain Injury

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Objectives: Psychiatric disorders are common and often debilitating following traumatic brain injury (TBI). However, few studies examine when individuals with TBI are most likely to develop a psychiatric disorder, and how this timing differs between disorders. In addition, the influence of a pre-injury psychiatric history on this development is unclear. The present study aimed to examine the frequency and association between psychiatric disorders prior to and following TBI, as well as examine the course of psychiatric disorders post-injury.

Method: Participants were 102 adults (75.5% male) with TBI who were mean 34.63 years old at the time of the injury (range 16–73). Psychiatric disorders were assessed using the Structured Clinical Interview for DSM Disorders (SCID), a semi-structured interview administered by a trained clinician to determine DSM-IV Axis I disorders.

Participants were assessed for pre-injury and current disorders soon after their injury, and prospectively re-assessed at three, six and twelve months post-injury.

Results: Over half of the participants (52.9%) met criteria for one or more pre-injury psychiatric disorder; a third substance use disorder, 22.5% mood disorder, and 21.6% anxiety disorder. Adjustment disorders (7.8%), psychotic disorders (3.9%) and eating disorders (2.9%) were also present. In the first year post-injury, 60.8% of participants had one or more psychiatric disorder. The most frequent post-injury disorders were anxiety (44.1%), mood (42.2%) and substance use disorders (11.8%). Post-injury disorders were associated with presence of a pre-injury history ($p < 0.01$), with 74.5% of participants with a pre-injury psychiatric history having a post-injury disorder. However, 45.8% of participants without a pre-injury history developed a novel psychiatric disorder in the first 12 months post-injury. Onset of psychiatric disorders was more common in the first 6 months than in the second 6 month period post-injury ($p < 0.001$). There was a trend towards a significant association between timing of onset of disorders and presence of a pre-injury psychiatric history ($p = 0.065$), with more participants with onset in the first six months having a pre-injury history (70%), compared with those without a pre-injury history (30%). Anxiety disorders followed this course, but novel depressive disorders were as likely to emerge in the first as in the second six month period.

Conclusions: Although there is evidence that many post-injury psychiatric disorders represent the continuation of pre-existing disorders, a significant number of people develop novel psychiatric disorders. This study demonstrates that the timing of onset differs according to pre-injury history and sheds some light onto the time individuals are most at risk for experiencing or developing a psychiatric disorder. In addition, there appear to be different trajectories for different classes of disorders. The lower rates of substance use disorders may be due to doctors' instructions for abstinence in the first year post-injury. Accordingly, participants are prospectively followed-up yearly for five years.

0639

Parallels between the neuropsychological and neuroanatomical correlates of apraxia and aphasia

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Objectives: Apraxia is often found in association with aphasia, and aphasic patients oftentimes show impaired praxis. These clinical observations suggest a common neural mechanisms shared between the brain networks subserving praxis and language. Using neuropsychological and brain imaging data from a large group of chronic stroke patients, we investigated the relationships between the behavioral and neuroanatomical correlates of praxis and language impairments.

Method: The Western Aphasia Battery was administered to 136 left hemisphere stroke patients with aphasia. Brain images (MRI and CT) were acquired from all patients, and their lesions were reconstructed in standard (Montreal Neurological Institute) space by a board certified neurologist. All patients were tested and scanned at least one year post-injury. Behavioral measures of praxis deficits were correlated with aphasia severity, comprehension, repetition and fluency scores from WAB. Praxis impairments were also compared between aphasia subtypes. Voxel-based lesion-symptom mapping (VLSM) was employed to determine the lesions associated with impaired praxis as well as aphasic symptoms. The neural correlates of praxis and language disorders were then compared using these lesion-symptom maps.

Results: Praxis impairments were most strongly correlated with comprehension deficits ($r = 0.74$), as well as aphasia severity ($r = 0.69$), repetition problems ($r = 0.67$) and less strongly with impaired fluency (0.53). The patients with global or Wernicke's aphasia had the lowest praxis performance (mean = 21.2 and 33.4, respectively, out of a maximum possible score of 60). Broca's and conduction aphasics were less impaired (43.1 and 50, respectively). Anomic aphasics and the patients within normal limits on the WAB had the highest praxis performance (57.4 and 58.8). Lesion-symptom maps obtained from the VLSM analysis showed that praxis, comprehension and repetition impairments were associated with common regions in the left inferior parietal cortex (supramarginal and angular gyri), the left lateral temporal cortex (posterior superior temporal and posterior middle temporal gyri), as well as white matter lesions in the left superior and inferior longitudinal fasciculi (SLF, ILF) and the arcuate fasciculus (AF). Superior temporal and SLF/AF lesions were common to both the praxis and fluency lesion-symptom maps.

Conclusions: Our findings are consistent with a common neural substrate for praxis and language, in particular comprehension and repetition. This

shared circuit includes regions in parietal and temporal cortices, as well as the long association tracts that subserve their integration with the frontal lobes.

0640

Capgras Syndrome After Deep Brain Stimulator Placement for Parkinson's Disease: A Case Report.

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Objectives: This patient is a 69 year old male with a past medical history of depression, hyperlipidemia, and advanced medically refractory Parkinson's disease, who underwent bilateral subthalamic bilateral deep brain stimulator (DBS) placement. On post-operative day 4 from DBS placement, he was transferred to acute inpatient neuro-rehabilitation where he presented with episodic agitation, poor safety awareness, paranoia and was noted to express paranoid delusions.

Neuropsychological evaluation revealed Capgras syndrome, centered mostly around the patient's wife who visited daily.

Capgras syndrome is the delusional belief that a person significant to the patient such as a spouse, friend or family member, is an imposter or an identical appearing double. It has been hypothesized that the syndrome is a result of a disconnection between the recognition of a face and the emotional reaction to it. This patient, when interviewed, in fact stated that he knew it was not his wife because he would feel something when he saw her, and he felt nothing when this "imposter" would visit.

Method: n/a

Results: For control of agitation and delusions, risperidone therapy was initiated. Dosage was titrated up to 4mg/day until the delusions were dampened. On post-operative day 18, he was discharged home with his wife from acute inpatient neuro-rehabilitation with resolved agitation but continued, albeit dampened delusions. In the outpatient setting, risperidone was subsequently tapered off with complete resolution of delusions over 2 months.

Conclusions: Deep brain stimulator placement has been associated with transient post operative neuro-cognitive changes. To our knowledge there have been no specific reports of Capgras syndrome.

0641

Considering the Validity of Two Existing Prediction Models to Predict the Outcome of Patients after Severe TBI in the ITCP Database of the International Neurotrauma Research Organization.

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Objectives: The International Neurotrauma Research Organization collected data on treatment and outcome of 1172 patients after severe traumatic brain injury (TBI) in Austria, Slovakia, Bosnia, Macedonia and Croatia. The data was collected beginning 2001 through 2005. Patients were included if they had 'severe TBI' according to the criteria defined by the US National Traumatic Coma Database⁹ such as a Glasgow Coma Scale (GCS) score of 8 or less following resuscitation or a GCS score deteriorating to 8 or less within 48 h of injury. Only patients who survived at least until admission to the intensive care unit (ICU) were enrolled into this study. Trauma and Injury Severity Score (TRISS) has been used for predicting the outcome of patients. Because of the limitations of this score to predict outcome of brain injured patients we were looking for a suitable existing prediction model which could be used instead.

Method: From the existing prediction models we have chosen two (based on comparing the used prediction variables in the models with the variables available in our database) which fulfilled our requirement. We applied the technique of external validation to determine whether they are useful in predicting the outcome of our patients. Both models used patient's parameters at their admission to the hospital to predict their outcome. The first model used patient's age, motoric response score and pupillary reactivity (model 1). The second was more complex and used age, pupillary reactivity, motoric response score, presence of hypoxia, presence of hypotension, Marshall's CT classification and presence of traumatic subarachnoid hemorrhage (model 2). Both models were constructed using a population similar to our database. We considered the C statistics (ROC characteristic) and the Brier score to analyze the ability of the models to adequately predict outcomes of the patients from our database.

Results: When used for prediction of favorable outcome in patients from our database - model 1

showed a C statistics value of 0.79 which means a good discriminative ability (the C statistics can range from 0 to 1; 1 meaning a perfect fit). The Brier score was 0.18 (in an optimal case the Brier score is 0, a score of 0.25 means that the model is non-informative). Model 2 showed in predicting favorable outcome a C statistics of 0.8 and a Brier score of 0.24.

Conclusions: Both validated models when compared to TRISS are more valid to be used for outcome prediction in patients after traumatic brain injuries similar to patients in our database. The main reason for this is that TRISS is a methodology not specific for traumatic brain injuries. Model 1 appears to be suitable to be used as a prediction model in our further research. The limitation of model 2 is a relative complex set of variables needed for the prediction and a relative high Brier score as shown in our analysis. Therefore, if a prediction model considering a more complex set of predictors will be needed, a new model specifically drawn from the existing ITCP database might be appropriate.

0642

Epidemiological study of post operator patients with cerebral palsy treated at the aquatic physiotherapy sector of AACD - Sao Paulo, Brazil

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Objectives: This study was carried out in order to trace the epidemiological profile of those patients diagnosed with cerebral palsy, which underwent orthopedic surgery of lower limbs and lately treated at the aquatic physiotherapy sector at AACD - Sao Paulo, Brazil. AACD is a Brazilian private entity, with no funds collection, born in 1950 to treat those people with physical diseases, and which is nowadays the most complete center of neurologic rehabilitation in the country.

Method: Three hundred and sixteen medical records of surgery outpatients between January to December 2008 were analyzed. Only 62 of them, who were undergoing aquatic physiotherapy, had their data computed. From this initial sample nine of them were excluded, resulting in 53 individuals.

A retrospective study of those medical records was conducted, analyzing: gender, age, topographic

diagnosis, motor level (Gross Motor Function Classification System - GMFCS) and surgery type.

Results: From the data collected, 60% were male. The mean age was around thirteen years old. The most prevalent topographic diagnosis was the diparetic spastic with a greater GMFCS level III incidence, despite of the occurrence of all scale levels. The concomitant performance of soft tissue and bone parts surgery prevailed, totaling 58.49%.

Conclusions: That current study traced the epidemiological profile of those patients diagnosed with cerebral palsy, which underwent orthopedic surgery of lower limbs and lately treated at aquatic physiotherapy. As a result, the most of them turned as: male gender, aging around 13 years old, who prevalent with a diparetic spastic, with level III of GMFCS.

0643

Head vibration damping reflects intracranial pressure

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Objectives: Traumatic Brain Injury (TBI) is a major source of morbidity and mortality. Intracranial pressure (ICP) is only accurately measured by placing one or more pressure sensors within the skull. Treatments to reduce elevated ICP are difficult if the exact nature of the pressure variation over time is unknown. A non-invasive approach is needed for better medical care. The skull and brain can be modeled as a coupled acoustic system characterized by a set of complex resonances and antiresonances induced by broad band sound. Increases in ICP caused by TBI are due to increases in fluid volume within the cranium (mostly within the parenchyma). If the skull and brain are stimulated near its resonant frequencies the amplitude recorded with an accelerometer will reflect damping at resonance and harmonics produced by increases in pressure.

The objective of this study was to evaluate the value of broad band frequency analysis in assessing the effects of increased ICP. Prior work had focused only some narrow bands in a limited range of interest.

Method: Traumatic Brain Injury (TBI) is a major source of morbidity and mortality. Intracranial

pressure (ICP) is only accurately measured by placing one or more pressure sensors within the skull. Treatments to reduce elevated ICP are difficult if the exact nature of the pressure variation over time is unknown. A non-invasive approach is needed for better medical care. The skull and brain can be modeled as a coupled acoustic system characterized by a set of complex resonances and antiresonances induced by broad band sound. Increases in ICP caused by TBI are due to increases in fluid volume within the cranium (mostly within the parenchyma). If the skull and brain are stimulated near its resonant frequencies the amplitude recorded with an accelerometer will reflect damping at resonance and harmonics produced by increases in pressure.

The objective of this study was to evaluate the value of broad band frequency analysis in assessing the effects of increased ICP. Prior work had focused only some narrow bands in a limited range of interest.

Results: Forehead stimulation with broad band acoustic energy revealed a pattern of decreased acoustic transmission (damping) with increasing ICP. The five patients had ICP pressures of: 7, 11, 15, 18 and 20 mmHg respectively. Differences in the vibratory response were obtained by calculating the difference in the acoustic recording, that is, the intensity difference, at individual frequencies, across the broad frequency band of 5–50 kHz. All possible combinations data across the frequency range recorded was assessed (11–7, 20–7 mmHg etc.) The geometries of the skull/brain likely varied by individual and were not controlled. All acoustic differences-summed across the entire range- were statistically significant at the $p > 0.0001$ level. Not all subjects exhibited the same frequency distribution, but all revealed frequency differences in multiple frequency regions likely reflecting individualized complex resonances and antiresonances. The acoustic features of ICP pressure changes were stable, allowing confidence that the patient difference approach used was not only reliable but valid.

Conclusions: Attenuation of frequencies between 5–50 kHz reflects changes in ICP (after IC reserve space has been saturated) that are:

- reliable, based on attenuation,
- proportional/incremental, with
- first order acceleration calibration (m/s²)
- stimulation and recording suitable for clinical use;

Algorithms need to be developed for real time ICP equivalents display.

Broadband frequency analysis is superior to narrow band analysis is reliability and validity as indicated in this very small sample.

0644

Functional visual restrictions manifested as tunnel-like patterns with peripheral shrinkage in patients with acquired military TBI.

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Objectives: A qualitative analysis describing the assessment of peripheral vision shrinkage in a specific tunnel-like pattern, in Iraq and Afghanistan war veterans with mild to moderate brain injury who have been evaluated by the Polytrauma Clinic at the Caribbean Healthcare System. Visual patterns were correlated with: subjective patient symptoms, mechanics of injury, functional outcomes, imaging and neurophysiologic measures.

Method: Initial optometry evaluation was performed through Humphrey's and Goldman testing. Evaluations were administered according to clinical indication and participation restrictions for each subject. Positive identification of tunnel-like shrinkage of peripheral vision with lack of structural lesions were referred for further physiologic and functional assessments, including: visual evoked potentials (VEP), electroretinography (ERG), neuro-optometry examination. Subject's functional visual deficits were assessed through Occupational Therapy and neuropsychological testing. Mechanics of injury and ongoing symptoms have been monitored through clinical evaluation and imaging studies.

Results: Identified subjects had clinical findings of mild to moderate brain injuries, most of them after blast exposure. They presented subjective complaints of: disorientation within familiar environments, spatial disorganization, sensation of imbalance and dizziness, reading problems, photophobia and headaches. Subjects demonstrated functional deficits in visual perceptual, visual motor tasks and sensory integration. Neuropsychological deficits involved depth/distance perception, visual perception, visual tracking, visual compensation, and shift setting for pattern information. Neurologic examinations often failed to reveal focal deficits, while neuroimaging findings revealed a tendency for

hypoperfusion/hypometabolism at specific areas (often parieto-occipital) that correlate with observed findings.

Conclusions: This tunnel-like visual shrinkage appears to be difficult to identify on routine testing, and required high level of suspicion based on patient's symptoms and functional deficits. In our clinical experience, blast-related brain injury veterans presented visual processing deficits that were not compensated, as well as perceptual deficits, correlating with higher cortical functions essential for perception and orientation in space. This has an impact on functional outcomes, particularly in balance, and organization abilities. Potential treatment interventions that seemed effective in this population have been: binasal occluders, prisms (based in vs. based out).

0645

Finite Element Analysis of the Effectiveness of Combat Helmets in Mitigating Blast Induced Traumatic Brain Injury

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Objectives: Blast induced traumatic brain injury (TBI) has emerged as a significant injury among military personnel in the ongoing conflicts. Combat helmets are designed primarily to protect against ballistic and blunt impact. The effects of the primary blast wave on brain injury resulting from IDEs have not been addressed in past helmet designs. Primary blast overpressure transmitted through the helmet and its subsequent effect on the brain has never been measured and demonstrated. Our preliminary study using finite element (FE) modeling indicated that mechanisms involved in primary blast TBI may be due to the coupling of stress waves and stress differential in various brain structures. Our hypothesis is that multi-layered materials of the advanced combat helmet (ACH) may serve as decouplers capable of reducing the stress waves transmitted to the head during blast, thereby reducing injury. To test the hypothesis, FE analyses of human head and helmet model subjected to various blast loadings were performed to characterize the resulting biomechanical responses of the brain to blast threats and the effects of helmet in mitigating blast injury.

Method: A hybrid Lagrangian-Eulerian model coupled with Lagrangian technique was used to

simulate the explosion, wave propagation and blast coupling with the helmet-head FE model. The FE head model consisted of various anatomical structures. The helmet model shell and padding consisted of material properties, weight and geometry based on the ACH. Five levels of overpressure (0.48–1.4 MPa) with pulse duration between 0.5 and 3 ms on Bowen's iso-damage (10% lethality) curve were selected to simulate blast threats. Both standing in open field and against wall blast conditions were investigated.

Results: For all five cases the helmeted-head received pressure waves 15–56% lower than that in the head without helmet. The peak pressure in the brain without helmet was around 3.2–5.6 MPa and was reduced by 46–65% for helmeted cases. With helmet, the strain rate in the brain tissue ranged from 13 to 21 s⁻¹, which was reduced by 9–32% as compared to non-helmeted cases. With helmet, head acceleration was mitigated by 34–57%. This reduction with helmet was largely attributed to a reduced momentum transfer and increased mass inertia. The padding compression ranged from 37 to 45%, suggesting a limiting effect of energy transfer offered by the helmet.

Conclusions: The effect of the combat helmet design on blast protection was significant. Current ACH helmet design significantly reduced brain pressure and strain rate, suggesting effectiveness of the helmet liner in mitigating blast damage. The helmet showed a high level of protection against head acceleration from blast impact. This study supports the notion that protective effectiveness of helmets against blunt impact may and provide protection against blast impact.

0646

Development of a Physical Therapy Clinical Practice Guideline for Patients with Brain Injury

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Objectives: To date, there is no guideline to standardize the practice of physical therapy in patients with various forms of brain injuries at rehabilitation phase. We intend to develop an evidence-based clinical practice guideline for physical therapists (CPG-PT).

Method: The CPG would provide physical therapists with a reliable and standardized reference for clinical decision-making and drawing strategies relevant to the care of patients with brain injury. The CPG-PT will contribute to the optimization the rehabilitation process, delivery of effective treatment and improvement of the outcomes. We conducted an extensive literature search and review, followed by a systematic analysis of the data from established sources Ovid, Medline, Hooked on Evidence (from American Physical Therapy Association), and PEDRO. We also considered relevant ideas implemented by established clinical practice guidelines developed by major medical organizations (e.g., Congress of Neurological Surgeons) in formulating the final version of the CPG-PT. The strength of evidence of the selected literature was determined by established criteria developed by Oxford Centre for Evidence-based Medicine (2009; <http://www.CEBM.net>).

Results: The CPG-PT is served as a reliable tool for physical therapists in clinical and academic settings to develop strategies for treatment of patients with brain injury. The CPG-PT is also served as a quick reference for the clinicians involved in clinical practice and those engaged in clinical outcomes research in patients with brain injuries.

Conclusions: The CPG-PT is a reliable tool for physical therapists to develop strategies for treatment of patients with brain injury in clinical and academic approaches.

0647

Plasticity-Based Swallow Training for Patients with Acquired Brain Injury and Dysphagia

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Objectives: Dysphagia is a common disorder following traumatic brain injury. Ludlow (2008) at the National Institute of Health examined the benefits of intensive training in the treatment of four dysphagia patients post brain injury and reported promising outcomes. Integrating neuroplasticity principles in dysphagia rehabilitation has been recognized as a crucial component for successful outcomes (Robbins 2008). The present study examines the feasibility and benefits of plasticity-based swallow training technology in promoting rehabilitation and swallowing recovery for individuals with acquired brain injury.

Method: The intensive swallow training method combined motor training, sensory stimulation, and feedback. Cervical accelerometry instrumentation was used to integrate and simultaneously deliver these three therapeutic techniques. The device includes a piezoelectric acceleration sensor (placed on the patient's skin above the larynx) that records swallow (hyolaryngeal) movements, the swallow signal is digitized and analyzed, providing swallow imaging and quantifiable measurements of swallow physiology. The device learns and adjusts its feedback to the patient's performance, guiding patients in a broad range of task specific physical exercises to promote motor relearning and enhance the recovery of proper swallow biomechanics. The participants in this pilot study were two individuals with acquired brain injury ages 50 and 83 both of whom suffered from functionally significant neurogenic dysphagia Patient 1: 83 years old male, resident in long term care facility with a history of brain surgery, radiation therapy and Parkinson's disease. Patient 2: 50 year old female, outpatient with a history of traumatic brain injury with cognitive deficit, gait and ADL impairments and left spastic hemiparesis. Participants were instructed to perform 30 to 43 repetitive swallow exercises during 45–53 minutes respectively for patient 1 and 2.

Results: Both patients demonstrated the ability to participate in intensive repetitive task specific swallow exercise training, performing 30 to 43 swallow exercises respectively for patient 1 and 2. Patients' swallow biomechanics were improved by training with laryngeal movement onset, duration, larynx range of motion, or overall hyolaryngeal pattern of movement nearer the normal range. Both patients were successful in modifying endogenous secretion management behavior, reducing the number of throat clearing or coughing episodes and increasing the volitional dry swallowing rate from 2 to 4 and from 2 to 8 swallows per 5 minutes, respectively for patients 1 and 2.

Conclusions: We found that intensive swallow training provided with cervical accelerometry enhances swallowing rehabilitation for persons with acquired brain injury. We theorize that these improvement occur through promotion of plasticity and motor re-education of normal swallow biomechanics. Based on our experience, this non-invasive method is practical for use with patients in long term care (LTC) and outpatient rehabilitation settings. The established safety and non-invasive nature of the general treatment technique which has been previously demonstrated in other studies, combined with the positive initial reports of these two cases suggests that the use of swallow training using accelerometry technology is a promising treatment modality for patients with acquired brain injury and

swallowing impairments. More research is forthcoming and will shed more light on the mechanisms underlying improvement, the clinical benefits of treatment and the most cost effective protocols.

0648

A retrospective analysis of performance on the Personality Assessment Inventory in persons with Mild Traumatic Brain Injury and post-traumatic pain

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Objectives: Detailed assessment of psychoemotional status using well validated, standardized assessment tools with internal validity measures is often critical to fully understanding clinical presentations in persons with claimed mild traumatic brain injury (MTBI). Individuals with MTBI who have concurrent pain issues often present with more complex assessment and treatment challenges, as well as, poorer long term outcomes compared to persons with MTBI without pain complaints. There is often a complex interaction between pain, depression, anxiety, and life adjustment in persons post-MTBI that must be appreciated in the context of both assessment and treatment. The current study, retrospectively, evaluated performance patterns on the Personality Assessment Inventory (PAI), a standardized self-report psychoemotional assessment battery, in persons diagnosed with MTBI who also had post-concussive/traumatic pain complaints. This is the first study to investigate PAI profiles in persons with post-concussive disorders due to MTBI.

Method: Thirty-eight adults diagnosed with claimed MTBI (22 males, 18 females, $M = 40.6$; $SD = 12.4$; $R = 18-62$; time post injury, $M = 3.6$ year; $SD = 1.77$) were referred over a multiyear period to a tertiary care center specializing in neuromedical and neurorehabilitation assessment and management of acquired brain injury. Data was analyzed anonymously and retrospectively by an independent reviewer. Individuals were referred for treatment due to persistent post-concussive symptoms and were administered the PAI as one of several psychoemotional screens used in this particular clinic setting. All 38 patients had concurrent post-concussive or post-traumatic pain complaints with headache being the most common.

Results: Two individuals originally included in this sample were eliminated from further data analysis

because of unacceptable elevations on one or more of the internal PAI validity scales. Analysis of the PAI was conducted through linear regression analysis. Of the sample studied, 76% scored above the cut-off T-score of 70 on scale 4 (DEP/depression); whereas, 74% scored above the cut-off T-score of 70 on scale (SOM/somatic concern). Elevations in t-scores on scale 1 (SOM) ($M = 78.8$, $SD = 10.1$) and scale 4 (DEP) ($M = 79.4$, $SD = 11.6$) were found to be the most significant across our sample ($t = 1.2$; $r = .821$, $p < .001$). Interestingly, no significant patterns of elevation were noted on scales associated with anxiety (i.e. ARD/anxiety related disorders) in this group of patients. Furthermore, the two primary score elevations were also significantly inter-correlated by select subscales including (scale 4/SOM-C [conversion] = .742, $p < .001$; scale 1/DEP-P [physiologic] = .723, $p < .001$; and scale 1/DEP-A [affective] = .711, $p < .001$). These subscales correlations suggest risk factors for a possible interaction between a depressive disorder and conversational (pseudo-neurological) symptomology. Trend differences were also found between genders on both the primary and secondary scales with higher rates of depression noted in females who also tended to elevate the affective depression subscale (DEP-A). Conversely, males were more likely to elevate the somatization scale (SOM-S).

Conclusions: Assessment using comprehensive, standardized psychoemotional batteries such as the PAI can yield important information in patients presenting with post-concussive complaints and post-injury pain issues. Our findings support the need for more thorough assessment of the psychoemotional status of these persons particularly as it relates to risk factors for depressive and/or somatic focus related complaints, the latter potentially including somatization tendencies. Further research, ideally of a prospective nature, evaluating the utility of the PAI in persons with MTBI, with and without pain issues, is clearly warranted based on our results.

0649

Diffusion tensor imaging vs conventional MRI for single case diagnosis of traumatic brain injury in spinal cord injury patients

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Objectives: Concomitant traumatic brain injury with spinal cord injury (SCI) is common because of shared primary causes of injury: motor vehicle accidents and falls. These injuries are associated with acceleration, deceleration and rotational forces that are exerted to the brain resulting in mild TBI (mTBI) due to diffuse axonal injury. However, mTBI is often overlooked, not only due to the focus of medical attention on SCI and associated medical emergencies, but also because neuroimaging findings are frequently normal. Diffusion tensor imaging (DTI) has been shown to be more sensitive for subtle microscopic axonal injury compared with conventional MRI in group studies, but has been little studied in individual cases. To our knowledge, this is the first study to examine individual cases in SCI patients to detect TBI. In the present study, we examined the sensitivity of DTI in individual patients with SCI, but normal findings on conventional MRI of the brain.

Method: DTI-derived fractional anisotropy (FA) was examined in fifteen SCI patients (aged 35.7 ± 11) with normal findings on conventional MRI. Individual FA values in 12 regions of interest for each patient were compared with the normative data from 11 healthy individuals (aged 34.6 ± 10). FA values 2.0 SDs below the control average were classified as abnormal.

Results: Three of 15 had abnormal FA in at least one ROI: One had FA values 2.5 SDs below the control mean in the cingulum; another, 2.0 SDs below in the genu of the corpus callosum; and the third, 2.0 SDs below normal in the body of the corpus callosum and the anterior commissure. In addition, there were two further noteworthy cases in which FA values in 11 of 12 ROIs were all clustered below the control mean.

Conclusions: Our preliminary data suggest that DTI can detect abnormalities in the brain that are not detectable using conventional MRI in SCI patients. Thus, DTI data may be useful to plan and manage treatment and rehabilitation for suspected dual diagnosis patients. However, further research with larger samples is still needed to demonstrate the sensitivity and specificity of DTI for mTBI in SCI patients.

0650

A second wave of damage to the brain after moderate to severe traumatic brain injury: a diffusion tensor imaging study of the fornix from 5 to 24 months post-injury

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Objectives: Recent evidence suggests that traumatic brain injury (TBI) patients show sub-acute atrophy in the hippocampus from five months to 24 months post injury (Ng et al., 2008). This may be a contributing factor to observable memory deficits seen in patients post injury. The fornix, which serves as the major output of the hippocampus, may also be vulnerable to sub-acute damage in TBI. However, no study to date has examined the stability of the fornix post-injury, the relationship between sub-acute hippocampal atrophy and loss of fornix integrity or the relationship between loss of fornix integrity and memory changes. These questions were addressed in the current study.

Method: 25 patients with moderate to severe TBI, recruited from Toronto Rehab, acquired MRI scans at two time points with the first being at approximately five months post injury, and the second scan either a) within the first year of injury (mean: 5 ± 2.6 months, $N=19$) or, b) at 24 months post injury (mean: 26.1 ± 7.5 months, $N=6$). All scans underwent manual (DISPLAY) volumetric analysis for the hippocampi and automated region of interest DTI analysis for the fornix. The DTI analysis entailed the automated calculation of fractional anisotropy (FA), a measure of the degree of water diffusion along white matter fiber tracts. Neuropsychological measures, conducted at the time of MRI acquisition, included Rey's Auditory Verbal Learning Test (RAVLT) and Ray Visual Design Learning Test (RVDLT) and Wechsler Memory Scale III – Logical Memory.

Results: Using paired t-tests, significant differences in FA were found from 5 to 24 months post-injury (after controlling for multiple comparisons) in the column and body of the fornix ($p < 0.05$), the right crux of the fornix ($p < 0.05$) and the left crux of the fornix ($p = 0.01$). There were no significant differences from 5 to 12 months post-injury. Using Pearson rank correlations, there was a trend towards significance after controlling for multiple comparisons in change from 5 to 24 months-post injury in the left crux of fornix with the left hippocampus ($p = 0.034$).

(Preliminary) Significant positive Pearson correlations were also observed between percent change in right crux of fornix and logical memory from five to 12 months ($p = 0.008$) and percent change in right

hippocampal body and RAVLT long delay scores from five to 12 months ($p = 0.043$).

Conclusions: This study provides evidence of loss of integrity in the fornix during the sub-acute phases of recovery from moderate to severe TBI. It also demonstrates relationships between the fornix and hippocampal atrophy. Lastly, loss of fornix integrity was associated with poorer memory recovery. The fornix is the hippocampus's main connection with the remainder of the limbic system and continued damage to this structure post-injury may aggravate the hippocampal related memory impairments observed in TBI patients.

0651

A retrospective comparative analysis of performance on Green's Word Memory Test among persons with Mild Traumatic Brain Injury with and without a legal claim.

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Objectives: The issue of organicity assessment with regards to claimed cognitive impairment has received significant attention in recent years, particularly as related to symptom validity testing. In the forensic arena, there is a clear role for such testing as an indicator of effort and response bias, although such procedures are also important in general clinical practice but often not utilized. One of the most common impairments assessed by symptom validity testing is that of claimed cognitive impairment. Prior studies have shown a higher rate of failure of certain cognitive effort measures in persons presenting after mild traumatic brain injury (MTBI). The current study sought to replicate prior studies examining performance patterns on one specific cognitive symptom validity test known as Green's Word Memory Test (WMT) in individuals who had sustained MTBI and compare performance between those with clearly identifiable external incentives and those without such incentives.

Method: Records from seventy-eight adults diagnosed with MTBI (per 1993 ACRM criteria) referred to a tertiary care center specializing in neuromedical and neurorehabilitative assessment and management of acquired brain injury were anonymously and retrospectively reviewed with regard to their performance on the computer based version of the Green's WMT. Fifty-three individuals

were identified as having a legal claim (personal injury litigation, SSDI or worker's compensation claim). In contrast, twenty-five adults were identified as clinical patients without an active legal claim of any kind as regarded their claimed disability.

Results: Individuals who were identified as having a legal claim performed significantly worse ($n > 10\%$) on the WMT primary scales (IR: $M = 79.1$, $SD = 18.0$; DR: $M = 77.6$, $SD = 19.0$; CNS: $M = 75.0$, $SD = 16.5$) than individuals in the clinical group who were not involved in a legal claim (IR: $M = 92.6$, $SD = 10.5$; DR: $M = 90.7$, $SD = 12.3$; CNS: $M = 88.7$, $SD = 10.8$.) Likewise, a parallel performance level was noted on the secondary scales for the individuals who were not involved in active litigation and/or receiving ongoing compensation ($n > 10\%$) (MC: $M = 59.2$, $SD = 25.2$; PA: $M = 56.7$, $SD = 24.9$; FR: $M = 38.8$, $SD = 2.1$; LDFR: $M = 42.6$, $SD = 21.0$.) Additionally, there were significant differences found between gender, age, and education across clinicolegal/legal versus clinical samples, which will be amplified on in this presentation. Consistent with the previous literature, our findings showed a higher rate of failure on the WMT primary, as well as, secondary measures in persons after MTBI with ongoing clinicolegal and/or legal issues versus persons without such ongoing issues. Performance below threshold criteria on such measures should serve as a basis for practitioners to further assess effort and response bias, in general, across clinical and historical signposts.

Conclusions: The results of the current study support the findings of prior literature examining the performance of persons with MTBI and secondary gain issues on the WMT. In our study, the results suggest that secondary gain incentives play a large part in predicting performance on the WMT. Further studies, ideally of a prospective nature, assessing what factors may additionally influence effort and/or create cognitive response bias (both positive and negative) after acquired brain injury are clearly indicated.

0652

Inter-joint Coordination of the Lower Extremities during Gait following mTBI

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Objectives: The rate of sustaining subsequent concussions (mTBI) is reported to be significantly higher even months after the initial concussion. Multiple concussions occurring with unresolved primary symptoms can lead to permanent brain damage or increased probability of fatality. Cognitive deficits and motor dysfunction have been reported in individuals with mTBI. We hypothesized that these deficits would further alter the coordination between joints of the lower limb that is required to produce a smooth and stable movement.

Method: Fifteen young adults, sustained a Grade II concussion within 48 hours, and 15 control subjects were included in the study. Subjects were asked to walk at a self-selected pace along an 8-m walkway with undivided attention (single-task) or while performing a concurrent cognitive task (dual-task). Whole body motion data were measured using an eight-camera motion analysis system with a sampling rate of 60 Hz. Sagittal plane hip, knee and ankle joint angles and angular velocities were used to obtain the phase plot and calculate the phase angle (PA) of each joint. Continuous relative phase (CRP), representing the coordination between two adjacent joints, were then calculated by subtracting the PAs of the distal joint from that of the proximal. Deviation phase (DP), representing the variability of the inter-joint coordination, was calculated as the standard deviation of each point on the ensemble CRP curve and then the standard deviations for the stance and swing phase were averaged. The percentage of correctness in answering to the concurrent cognitive task during dual-task walking was recorded.

Results: There is no significant group difference in the percentages of correctness in answering to the cognitive task during dual-task walking. For both single- and dual-task walking conditions, coefficients of multiple correlation (CMC) of the hip PA was greater than 0.85 while CMC of the ankle PA was about 0.65. It indicates that in contrast to the ankle motion, the hip motion was similar between groups during both conditions. The CMC of the hip-knee and knee-ankle CRP curves were greater than 0.8, indicating inter-joint coordination patterns were similar between groups. For both conditions, the swing hip-knee DP of the concussion group was greater than those of the control group, suggesting the greater variety of the swing hip-knee inter-joint coordination was used in the concussion group.

Conclusions: During dual-task condition (walking while simultaneously completing simple mental task), subjects following concussion can maintain their cognitive performance similar to the normal control. Subjects following concussion changed their single-joint movement pattern but did not change

their inter-joint coordination pattern. However, the variety of the hip-knee inter-joint coordination of the swing limb in subjects following concussion increased.

0653

Hyperbaric Oxygen Therapy Treatment of Chronic Mild-Moderate Blast-Induced Traumatic Brain Injury/Post Concussion Syndrome with Post Traumatic Stress Disorder: Pilot Trial

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Objectives: Mild-moderate blast-induced traumatic brain injury (TBI) and post-traumatic stress disorder (PTSD) affect 11–28% and 13–17%, respectively, of U.S. combat troops returning from Iraq and Afghanistan. Protracted treatment for PTSD exists, but there is no effective treatment for the post-concussion syndrome (PCS) of mild-moderate TBI nor the combined diagnoses of PCS and PTSD. Based on previous case experience with PCS and an animal model we investigated the effect of hyperbaric oxygen therapy (HBOT 1.5) on symptoms, cognition, and SPECT brain blood flow in military veterans with blast-induced TBI/PCS with/without PTSD.

Method: Fifteen symptomatic U.S. military veterans with blast-induced PCS(2) or PCS/PTSD(13), diagnosed by military and/or civilian neuropsychologists and neurologists, who were average: 29.7y (21–45), 2.6y (1.24–4.75) post injury, 1 minute (13 subjects; 2 subjects 4.5 & 9h) loss of consciousness, with 3 blast TBI's (1–8) completed the study. All subjects completed cognitive testing, symptom and quality of life questionnaires, and affective measures pre and immediately post a course of forty bid, 5d/week, 1.5ATA/60 minute hyperbaric oxygen therapy treatments (HBOT). Subjects underwent SPECT brain blood flow imaging (Picker Prism 3000, 25mCi Ethyl Cysteinate Dimer) pre and post a single HBOT and post 40 HBOT's. SPECT was analyzed with Osirix software; relative standard deviation of the mean on a histogram analysis of counts in left centrum semiovale region of interest was taken pre/post Rx. Paired Student t test and

Wilcoxon Signed-Ranks test (non-normally distributed data) were used for all cognitive/questionnaires. *Results:* All subjects reported symptomatic improvement in the 35 day study period. Pre, post, difference, confidence interval, and p values for cognitive tests and questionnaires were: FSIQ: 95.8+/-8.4; 110.6+/-10.3, 14.8+/-7.4, 10.7-18.9, <0.001; Wechsler Memory Scale (WMS) IV delayed memory: 97.7+/-13.3, 106.9+/-15.4, 9.2+/-14.3, 1.3-17.1, =0.026; WMS Working Memory: 97.0+/-13.6, 106.9+/-13.1, 9.9+/-10.3, 4.1-15.6, =0.003(np); Stroop Color/Word: 84.3+/-12.2, 95.3+/-12.8, 11.1+/-9.2, 6.0-16.2, <0.001; TOVA variability: 64.4+/-28.7, 75.3+/-24.6, 10.9+/-20.2, -0.2-22.1, =0.045(np); Rivermead Post Concussion Symptom Questionnaire: 39.7+/-6.0, 24.1+/-12.6, -15.6+/-12.8, -22.7-(-8.5), =0.002(np); PTSD Checklist Military: 67.4+/-10.5, 47.1+/-16.0, -20.3+/-18.2, -30.4-(-10.2), <0.001; Modified Perceived Quality of Life: 81+/-37, 114+/-36, 33+/-36, 13-53, =0.003; Personal Health Questionnaire 9-Depression Index: 16.6+/-4.9, 8.2+/-4.7, -8.4+/-7.4, -12.5-(-4.3), <0.001; GAD-7 Anxiety Rating: 12.7+/-5.8, 7.9+/-5.3, -4.8+/-5.8, -8.0-(-1.6), =0.007; Percent Back to Normal: [Cognitive: 49.6+/-17.6, 67.0+/-19.4, 17.4+/-17, 7.5-27.2, =0.002], [Physical: 46.8+/-23.0, 66.3+/-18.6, 19.5+/-16, 10.3-28.7, <0.001], [Emotional: 32.5+/-20.6, 61.3+/-19.8, 28.8+/-20.9, 16.7-40.9, <0.001]. SPECT analysis on the first 5 subjects showed a reduction in the standard deviation of the mean on counts in the left centrum which corresponded to a pattern shift from heterogeneity (abnormal) to homogeneity (more normal).

Conclusions: A thirty day course of forty 1.5 ATA HBOT's demonstrated significant symptomatic, cognitive, and affective improvements in 15 U.S. military veterans with chronic blast-induced post-concussion syndrome and post-traumatic stress disorder. These findings were reinforced by quantitative and qualitative SPECT improvements.

0654

Quantitative Assessment of Glucose Metabolism in 83 Brain Structures of Eighteen MVA Patients

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Objectives: Quantitation of injury is essential to objective assessment of brain trauma therapies.

Positron Emission Tomography with F18 deoxyglucose is inherently quantitative. Neuroanatomical software and gender as well as age based comparison groups allows multicenter comparability of injury scores.

Method: Positron Emission Tomography allows quantification of local glucose metabolism. MIM VISTA software allows quantification of brain glucose metabolism as compared to age matched controls. Patterns of injury as well as quantification of injury severity may allow objective assessment of response over time.

Results: Cerebellar injuries were documented in 12 of 18 MVA patients, 67%. Precentral and post-central injuries were present in 11 of 18, 61%. Occipital injuries were present in 8, 44%. Occipital injuries showed a mean SD of 2.4, more severe than the 2.0 score for cerebellum, precentral, and post-central injuries.

Pontine Tegmentum injuries occurred in 5, 28% with a mean SD of 8.6. Cerebellar peduncle lesions commonly accompanied Tegmentum lesions. Inferior peduncle injury occurred in 5 with a mean SD of 6.4. Superior occurred in 3 (17%) with a mean SD of 7.7. Mid cerebellar peduncle injury occurred in 3 with a mean SD of 5.7.

Caudate 6 (33% mean SD 3.7); midbrain 4 (22% mean SD 3.8); and brainstem 4 (22% mean SD 3.3). Precuneus and pons injuries each occurred in 5 patients (28%) with mean SD of 2.6 in both injuries.

Conclusions: Quantitation of neurotrauma is practical and important. Cerebellar trauma is underappreciated. Severe lesions of the pontine tegmentum, cerebellar peduncles, and brainstem were seen in 5 if 18 patients.

0656

Traumatic Brain Injury and olfactory deficits: the tale of two smell tests!

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Objectives: Olfactory functions are not systematically evaluated following traumatic brain injury (TBI). This study aimed at comparing two smell tests that are used in a clinical setting.

Method: The University of Pennsylvania Smell Identification Test (UPSIT) and the Alberta Smell Test were compared in terms of assessment time, cost, and diagnosis. Parameters associated with olfactory loss such as injury severity, type of cerebral lesion and depressive data, were considered. Forty-nine TBI patients admitted to an outpatient rehabilitation program took part in this experiment.

Results: The scores of the two smell tests were significantly correlated. Both tests indicated that patients with frontal lesion performed significantly worse than patients with other types of lesion. Mood and injury severity were not associated with olfactory impairment when age was taken into account. 40–44% of the patients showing olfactory impairments were not aware of their deficit.

Conclusions: Since a significant proportion of the patients showing olfactory impairments were not aware of their deficit, we recommend that clinicians systematically evaluate olfactory functions using the Alberta Smell test. To refine their diagnosis, the UPSIT can also be used.

0657

Long-term mortality following rehabilitation after severe traumatic brain injury (TBI)

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Objectives: Background and Purpose: The Glasgow Coma Score (GCS) is a widely used measure of neurological deficits after traumatic brain injury. However, the long-term prognostic significance of

GCS measured on admission to a rehabilitation facility is not well known.

Method: Materials and Methods: We studied 313 patients who had a severe traumatic brain injury who were consecutively admitted to a department of intensive, multidisciplinary rehabilitation. The patients were referred from intensive care units from a well-defined uptake area in the eastern part of Denmark. The patients were admitted as soon as assisted ventilation was no longer required to maintain sufficient respiration. All rehabilitation and treatment was free and the patients were not discharged before the rehabilitation team decided that further in-hospital rehabilitation was no longer necessary. Patients were stratified into patients with very severe TBI (GCS \leq 8) and severe TBI (GCS $>$ 8) and followed for seven years after the injury. Multivariate adjusted Cox Regression analyses were applied.

Results: 76 (24.3%) of the patients had very severe TBI. There were no gender specific differences between patients with very severe and severe TBI. There was a trend towards patients with very severe TBI being younger (39.2 ys. (SD 18.2)) compared to patients with severe TBI (43.5 ys. (SD 18.4)), $p=0.06$. The time from injury to admission for rehabilitation was the same for patients with very severe TBI as compared to patients with severe TBI, 21.3 days (SD 16.7) versus 18.0 days (SD 18.3), $p=0.26$. At seven years after onset of TBI there was a trend towards a higher crude mortality rate for patients with very severe TBI (19 per 100 cases) compared to patients with severe TBI (13 per 100 cases), $p=0.08$. After adjustment for age and gender we calculated that a decrease of 1 point on the GCS was associated with increased risk of long-term mortality after TBI (RR 1.22 95% CI 1.10 to 1.35).

Conclusions: The present findings suggest that GCS on admission for rehabilitation should be taken into account in studies investigating the long-term mortality after severe TBI. A decrease of 1 point on the GCS appears to indicate a 10% increase in long-term mortality risk after rehabilitation for severe TBI.