

ABSTRACT BOOK

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Importance of Multidisciplinary Approach to Mild Traumatic Brain Injury with Post-Concussive Syndrome

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Case Presentation: A 45-year-old African male presented to our Physical Medicine and Rehabilitation (PM&R) clinic on January 20, 2017 for electro-diagnostic study to rule out cervical radiculopathy. He complained of neck pain radiating to left arm, jaw pain, headache, and dizziness with certain movements, confusion, along with physical and mental fatigue. Physical exam showed impairment in attention, executive function, and recent memory/recall. On further questioning patient reported that while he was at work he was hit by a heavy machinery on the posterior aspect of the head causing brief loss of consciousness on October 2016. His head CT and cervical spine MRI that was done prior to our clinic visit did not show any acute pathology. Prior to our clinic visit he had tried multiple medications for headache and pain with poor control. Electro-diagnostic study was normal. He was provided referral to physical therapy, speech therapy and neuropsychology.

On his follow-up visit a week later accompanied by a family member who reported that patient sleeps most of the time, misplaces things and has not been himself since the incident. We felt comfortable diagnosing him with mild TBI with post-concussive syndrome. Patient and family member provided extensive education on natural history and symptoms of TBI. Since then he has been compliant with treatment plan. After multiple visits with physical and speech therapist, neuropsychologist, trials of multiple analgesic medications, trigger point injections his headache and jaw pain improved significantly, neck pain became less intense and more localized to the left lateral aspect of the neck, dizziness was gradually improving but continued to have persistent cognitive deficits. He was able to mitigate this somewhat by keeping memory logs containing clinic appointments and medication schedule with the assistance of his relatives. After starting neurostimulants improvement has been noted in overall cognition as well.

Discussion: This is a classic case of mild TBI subsequently developing post concussive syndrome. This patient was referred to us for neck pain and prior to our clinic visit a diagnosis of mild TBI was overlooked. Certain percentage of patients with mild TBI do not recover completely. Various studies have showed that early access to multidisciplinary (MD) rehabilitation improves functional activity of patients hence timely referral is important in the management. Early intervention will help decrease the severity of complication suffered by patients with mild TBI. MD rehabilitation team involves a physician providing direct care as well as coordinating care through referrals to various disciplines and integrating treatment plans.

Conclusion: Clinicians should be educated on accurately diagnosing mild TBI. Once such diagnosis is made timely referral to a multidisciplinary team can improve patient outcome.

Emotionally Empathic Responses Improves Emotion Recognition Accuracy to Film Clips after Brain Injury

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Objective: Emotion recognition is often impaired after a traumatic brain injury (TBI). Currently, little is known about the mechanisms underlying this deficit. One theory behind affect recognition is that it is easier to identify others' emotions if you have firsthand experience with those emotions. This suggests that the occurrence of a shared emotional response to others' feelings could facilitate affect identification. Thus, the study objective is to compare, in participants with a TBI and Healthy controls (HCs), emotional responses to affective film clips that were congruent with the emotions portrayed by the characters (i.e., felt the same emotion as the character) and examine associations of emotional congruence with affect recognition accuracy and empathy.

Design: Cross sectional study using a quasi-experimental design.

Setting: Multi-site study conducted at a post-acute rehabilitation facility in the U.S. and a University in Ontario.

Participants: A convenience sample of 60 adults with moderate to severe TBI and 60 HCs, frequency matched for age and gender.

Main Outcome Measures: Affective Film Clips were used to examine participants' emotional responses to the clip and their accuracy at identifying characters' emotions. Personal emotional responses that were the same as the character's affect in the clip were considered congruent. Empathy was measured with the empathic concern sub-construct of the Interpersonal Reactivity Index.

Results: Participants with TBI had fewer emotionally congruent responses than HC's (62% vs. 73%; $p < .001$) and this was associated with reduced emotion recognition accuracy ($p < .001$). When participants' personal emotional responses were congruent with the character, recognition for that character's emotion was correct 81% of the time, compared to 52% of the time when personal emotional responses were incongruent. Participants with TBI who had low empathy had significantly fewer emotional responses that were congruent with the characters' emotions ($p = .001$).

Conclusions: It has been theorized that recognition of others' emotions is aided by replicating and experiencing those same emotions in oneself. This is the first study to empirically demonstrate a disruption of this mechanism in participants with TBI and its association with reduced emotion recognition and empathy. These findings yield important assessment and treatment implications.

Intimate Partner Violence Related Traumatic Brain Injury: The Development of a Tool to Identify Risk

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Introduction: In recent years, media stories related to the immediate and long-term consequences of traumatic brain (TBI) have increased, prompting much dialogue about the accurate detection and potential effects of injury to the brain. Although most of this press coverage has focused on TBI among athletes and soldiers, an emerging body of research suggests that another group of individuals should be recognized: Survivors of intimate partner violence (IPV). These individuals are at a high risk for sustaining TBI. While the true prevalence of IPV-related TBI is unknown, studies suggest that it ranges from 30 to 74% (Kwako et al., 2011) in this population. However, most scholars and practitioners working on the issues associated with IPV have not examined the prevalence of TBI in these survivors. Neither have they considered the effects of the symptoms associated with TBI on the survivor's ability to make sound decisions, particularly decisions regarding personal safety and their ability to navigate legal and medical systems following the event. In fact, community stakeholders working with this population are often unaware of the risk for TBI and therefore do not recognize the often-subtle cognitive signs and symptoms. As a consequence, at-risk survivors are not always referred to the appropriate medical personnel to get the assistance needed. The goals of this study were to increase awareness of IPV related TBI in a mid-sized city in the southeastern region of the United States and to work with the community in developing a screening tool to identify survivors at risk.

Methods: This research project has four phases and uses a mixed method design. During Phases I-III training and education was provided to community stakeholders, needs and concerns of the community stakeholders were assessed and various versions of an IPV related TBI screening tool were presented. Community stakeholders provided feedback about the form and its utility throughout the process using surveys and focus group discussions.

Results: Community stakeholders from a wide variety of disciplines and agencies participated in the community stakeholders' meetings in a midsize city in the southeast region of the United States. Based on survey results and focus group feedback a screening tool was finalized and will be presented. In Phase IV this screening tool will be piloted by four organizations within the community.

Discussion: IPV is a pattern of physical and/or sexual violence in the context of coercive control by a domestic partner or ex-partner (Humphreys & Campbell, 2004). One of the many serious, yet underrepresented consequence of IPV is TBI (Banks, 2002). Having a community friendly screening tool available will serve to assist stakeholders in the identification of those survivors at risk for TBI so that they may seek appropriate services.

Assessing the Relationship between Neck Strength and Concussion Risk in University Athletes

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Introduction: Concussion is a significant public health concern affecting upwards of 3.8 million people in the United States each year (Langlois, 2006). An estimated 10,000 National Collegiate Athletic Association athletes experience a concussion annually (Kerr et al., 2015), with female athletes having a higher rate of concussion in sex-comparable sports (Covassin et al., 2016). Past research suggests that overall neck strength and neck muscle symmetry play a role in decreasing head acceleration during impact, potentially reducing the impact and damage to brain tissues (Broglio et al., 2012; Dezman et al., 2013; Viano et al., 2007). Decreased neck strength and girth is one hypothesis of why women show a higher rate of concussion relative to males. This hypothesis is supported by past work showing female athletes' neck strength and circumference to be lower than males (Eckner et al., 2014; Hildenbrand, & Vasavada, 2013; Eckner et al., 2014). These findings may importantly contribute to evidence that female athletes have higher head acceleration relative to males (Teirney et al., 2008; Mansell et al., 2005).

Objective: The goal of our work was to assess differences in neck strength and muscle symmetry in athletes during their preseason assessments, and determine whether differences in overall strength and symmetry are related to sex and concussion risk.

Methods: Male and female university athletes competing in contact (e.g., soccer) and non-contact (e.g., tennis, running) sports completed cervical spine strength assessments during their preseason physicals. Isometric cervical spine strength was collected using handheld dynamometry in standardized testing positions, averaging three trials of the following motions: flexion, extension, right and left rotation, and flexion in rotation. Differences in neck strength and symmetry were compared in male and female athletes, as well as differences in neck strength and symmetry based on concussion history.

Results: Isometric neck strength was greater across all motions assessed in males (N=29) relative to females (N=22; $p < .001$). When assessing muscle symmetry, males showed significantly greater strength in the left sternocleidomastoid (SCM) relative to right SCM ($p < .05$); no differences were noted in females. Eleven athletes reported a history of concussion (6 females). There were no differences in strength dependent on concussion history. However, athletes with a history of concussion showed significant asymmetry in the left and right SCM, with left SCM being significantly stronger than right SCM ($p < .05$).

Discussion: Our research replicates past work showing differences in neck strength between males and females, but also indicates that concussion risk may be related to asymmetry in muscle strength, particularly in the SCM. As such, our work suggests that imbalances in neck strength may be one factor associated with concussion risk, but future work in larger samples of athletes with concussion is needed.

Infusing Post-Secondary Education Transition Strategies for Individuals with an Acquired Brain Injury

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Post-secondary education can be difficult for individuals with acquired brain injuries. This article provides instructional strategies to meet the individual needs of persons with ABI that often struggle daily with following directions, organization, memory and attention/concentration. Although not all acquired brain injuries are the same; each one instructional strategy may not work for all. If post-secondary education transition strategies are infused into students' daily routine or practices their opportunity of success is greater.

Keywords: Post-Secondary Transition, Acquired Brain Injury, Classroom Strategies

Importance of Managing the Neuropsychiatric Aspects of Brain Injury in the Acute Inpatient Rehabilitation Institute Setting

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Introduction: 29-year-old male in high-speed motor vehicle crash in early April 2016 with Glasgow Coma Scale 3 at scene. Patient suffered depressed skull and basilar skull fractures, subarachnoid hemorrhage, bifrontal intraparenchymal hemorrhage, right internal carotid artery injury with middle cerebral artery territory stroke, left eye proptosis, left upper extremity avulsion requiring above elbow amputation, multiple rib fractures and left acetabular fracture-dislocation. At time of crash, patient had history of occasional alcohol and marijuana use, and was a daily smoker. Once stabilized, patient was transferred to St. Luke's Acute Inpatient Rehabilitation Institute 6 weeks later. Over the 4 weeks, despite intensive care involving physical medicine and rehabilitation physicians, physical, occupational, speech and recreational therapies, neuropsychologist, chaplain, nursing care, and constant 1:1 sitter, disruptive behaviors continued, and primary team requested Neuropsychiatric evaluation and medication fine-tuning.

Evaluation and Intervention: At time of Neuropsychiatric evaluation, patient would constantly wheel himself in hallways, mumble repetitively, get agitated if anyone came into physical contact, get anxious with toileting, and occasionally get combative. Patient had been or was currently on Quetiapine, Olanzapine, Lorazepam, Buspirone, Propranolol, Amantadine, Melatonin, and Oxycodone. Over the next 4 days, aforementioned medications were tweaked, and patient started on Fluoxetine and subsequently Venlafaxine.

Results: By day 5, patient had reduced repetitive behaviors, started following staff direction, allowing staff to come into physical contact, and had taken his first bites and sips. Patient continued to progressively improve and was discharged to an adult family home [AFH] 5 weeks later. When patient and family were contacted in November 2017, patient was noted to be doing well in AFH, and was interacting well with family members, community and therapies.

Conclusion: Neuropsychiatric management is an important component of brain injury rehabilitation, and patients benefit when neuropsychiatric care is instituted sooner rather than later.

Creating Awareness of Catatonia Responsive to Ativan in the Rehab Population: A Case Report

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Setting: Tertiary care rehabilitation hospital

Case Description: 36-year-old female, with a hypoxic ischemic brain injury following cardiac arrest during an ankle surgery. Patient had ROSC within 30 minutes. Brain CT and MRI revealed infarctions in the supratentorial and bilateral caudate. On admission to inpatient rehabilitation, patient was in a minimally conscious state, demonstrating sporadic automatic movements but unable to communicate or demonstrate functional object use. Patient's passive motor exam was within normal range of motion for the spine and lower limbs. In-addition to being minimally conscious the patient was noted to have frequent grimacing, posturing of extremities, and excessive drooling. EEG and imaging ruled out seizures and acute brain injury. The team, based on clinical presentation, considered the diagnosis of catatonia. The Bush-Francis Catatonia Rating Scale (BFCRS) score, a 23-item rating scale standardized for evaluation of catatonia, was 22 including features of stupor, mutism, poor eye contact with decreased blinking, posturing of < 1 min in duration, moderate rigidity, severe motoric negativism, waxy flexibility, withdrawal, gegenhalten, grasp reflex, and autonomic abnormality. Patient was trialed on 1mg IV Lorazepam.

Assessment/Results: Patient had significant clinical improvement especially thirty minutes after receiving lorazepam. Improved arousal, attention, command following, and initiation of purposeful movements was noted. During periods of lorazepam wash-out, the patient demonstrated return of prior catatonic features. Lorazepam was up-titrated and ultimately dosed at 2.5mg every 6 hours. With lorazepam treatment, her Modified BFCRS score decreased to 3. Patient was discharged to post-acute rehabilitation. Although requiring significant assistance with ADL's she had improved cognitively and was now responding to yes/no questions with her head.

Discussion: Catatonia is characterized by the coexistence of psychiatric and motor symptoms. Pathobiology of catatonia is poorly understood but it can be fatal without effective treatment. The treatment of catatonia should target the underlying condition in addition to pharmacological therapy. Although numerous pharmacological treatments have been proposed benzodiazepines, however, remain the mainstay.

Conclusion: It is important for physicians treating patients with acquired brain injuries and resultant neurobehavioral disturbances to be mindful of the possibility of catatonia as a confounding factor during cognitive assessments as catatonia can mimic brain injury. In rare cases catatonia may be the primary diagnosis rather than brain injury, whose mainstay is benzodiazepines which are usually avoided in brain injury.

Preinjury Employment Status as A Risk Factor for Symptomatology and Disability in Mild Traumatic Brain Injury: A TRACK-TBI Analysis

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Background: Mild traumatic brain injury (MTBI) is a leading cause of morbidity and healthcare cost with an estimated annual incidence of 4 million cases in the U.S. Approximately 5-30% of MTBI patients continue to suffer neurologic, cognitive, psychiatric, and/or postconcussional symptoms one year after injury. Preinjury employment status may contribute to disparity, injury risk and recovery patterns.

Methods: MTBI patients from the prospective multicenter Transforming Research and Clinical Knowledge in Traumatic Brain Injury Pilot (TRACK-TBI Pilot) study with emergency department (ED) Glasgow Coma Scale (GCS) 13-15 and complete six-month functional, neuropsychiatric, postconcussional, post-traumatic stress disorder (PTSD), satisfaction with life (SWL), and cognitive (executive function, verbal memory, nonverbal processing speed) outcome measures were extracted. Preinjury employment was coded as employed/unemployed. Presence/absence of prior medical comorbidities, injury factors, and intracranial pathology on initial brain computed tomography (CT) scan were considered. Multivariable regression was performed for employment and each outcome, correcting for GCS, CT, psychiatric disorders, headache/migraine, loss-of-consciousness, amnesia, polytrauma, age, race and education. Mean increase/decrease (B) and 95% confidence intervals (CI) are reported. Statistical significance was assessed at $p < 0.05$.

Results: Overall 162 MTBI patients were aged 39.8 ± 15.4 years, 73.5%-male, 74.7%-Caucasian, and 24.6%-baseline unemployed. Unemployed patients demonstrated increased psychiatric comorbidities (45.0%-vs.-23.8%; $p=0.010$), illicit drug use (52.5%-vs.-21.3%; $p < 0.001$), smoking (62.5%-vs.-27.0%; $p < 0.001$), and prior TBI (78.4%-vs.-55.0%; $p=0.012$), and lower education (15.0%-vs.-45.1% college degree; $p=0.003$). Age, systemic comorbidities, ED disposition, CT-positivity (30.9%), and polytrauma (11.7%) did not differ by preinjury employment.

On multivariable analysis for six-month outcomes, unemployment associated with decreased functional outcome (Glasgow Outcome Scale-Extended: $B=-0.50$, 95% CI [-0.88, -0.11]; $p=0.004$), increased psychiatric disturbance (Brief Symptom Inventory-18: $B=6.22$, 95% CI [2.33, 10.10]; $p=0.002$), postconcussional symptoms (Rivermead Postconcussion Symptoms Questionnaire-13 Item): $B=4.91$, 95% CI [0.38, 9.44]; $p=0.034$), and PTSD symptoms (PTSD Checklist-Civilian Version: $B=5.99$, 95% CI [0.76, 11.22]; $p=0.025$). No differences were observed for cognitive measures or SWL by employment status.

Conclusions: Pre-injury unemployment is associated with psychosocial comorbidity, prior concussions, and decreased education in MTBI patients. Unemployed MTBI patients are at risk for poorer six-month functional recovery and increased psychiatric, postconcussional, and PTSD symptoms on outcome. Heightened surveillance, resource allocation, and return precautions should be implemented to mitigate and/or prevent the further decline of these at-risk patients.

Relationship Between Spatial Neglect and Inpatient Rehab Safety Concerns in Patients with Ischemic Stroke

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Aims: Assess incidence, risk factors and circumstances related to falls in patients with stroke and spatial neglect within inpatient rehab facilities (IRF) setting.

Assess the incidence and reporting of other injuries (orthopedic injury, twisting injury or abrasion) during acute rehab hospitalization in patients with neglect.

Design: The charts of ischemic stroke patients were retrospectively reviewed at two sites within one IRF system. Through review of nursing notes, the number of falls or other in-hospital injuries were recorded. Patients with spatial neglect were identified using the Catherine Bergego Scale (CBS) through the Kessler Foundation Neglect Assessment Process (KF-NAP™).

Results: There were a total of 484 patients admitted with the diagnosis of ischemic stroke. The CBS score was not available in 194 patients or not correctly documented in 139 patients. Of the remaining 151 patients, they were further reviewed to determine if this admission was for first stroke (no prior history of stroke) and CBS performed within 7 days of admission. 97 patients met the designated criteria and were included in the analysis. 32 (33.0%) had no neglect, and 65 (67%) had spatial neglect (CBS via KF-NAP > 0). Among the patients without neglect (n=32), two people (6.25%) fell. Among the patients with left neglect (n=48), 8.3% of them had at least one fall and among those with right neglect (n=17), 35.3% had at least one fall. There was a greater number of other in-hospital injuries in those with spatial neglect although there was no significant statistical difference than in those without.

Conclusions: In the study, the presence of spatial neglect increased the risk fall and interestingly; the presence of right neglect had the greatest risk. This suggests that patients with spatial neglect may be at greater risk for adverse effects in the IRF setting and therefore spatial neglect should be identified early.

Pathophysiology of Concussive Head Injury is Exacerbated High Altitude. Neuroprotective Effects of TiO₂ Nanodelivery of Cerebrolysin

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Military personnel are highly vulnerable to concussive head injury (CHI) during combat operation either at ground level or at high altitude mountains. High altitude induced brain edema development and alterations in cognitive dysfunctions are well known. However, effects of head injury at high altitude as compared to sea level are still not known. In this investigation we examined CHI at laboratory-simulated condition of high altitude and compared the results on identical head injury at normal laboratory conditions.

Rats were exposed to simulated high altitude (HA) equivalent of 5000 m in an Altitude chamber (Hypobaric chamber) 11.2 % O₂ at 0.53 Atm for 6 h daily for 1 week. The temperature of the hypobaric chamber was maintained at 21±1 °C. The humidity (45 to 50%) and airflow was maintained at 4 liters per hour. Control rats kept at room temperature at standard laboratory conditions. Control or HA rats were provided food and water ad libitum before experiment.

CHI was inflicted in control and HA rats under Equithesin anesthesia (3 ml/kg, i.p.) by dropping an Iron tapered cylinder (114.6 g) through a guide tube from 20 cm height over the exposed right parietal skull inducing an impact of 0.224 N over the skull surface without making any fracture. The method simulates counter coup injury and results in profound cellular damage in the left uninjured hemisphere as compared to the injured side 12 to 24 h after the primary insult. In these rats blood-brain barrier (BBB) breakdown to Evans blue albumin and radioiodine was examined together with edema formation using brain water content. Nissl stain on paraffin sections was used to evaluate neuronal injuries. Our results showed that CHI in HA rats resulted in 250 % exacerbation of BBB breakdown, 3-to 4- fold higher brain edema development and 2- to 2.5 fold greater neuronal injuries in the cerebral cortex, hippocampus and cerebellum as compared to rats kept at room temperature.

Co-administration of Cerebrolysin 2.5 or 5 ml/kg, i.v. with mesenchymal stem cells (MSCs, 1 million) 4 to 6 h after trauma was able to induce profound neuroprotection in CHI rats at room temperature. However, this dose was only slightly effective in reducing brain pathology following CHI in HA rats. On the other hand when TiO₂ nanowired cerebrolysin (2.5 ml) was co-administered with 10⁶ MSCs 4 or 6 h after trauma significant reduction in the BBB breakdown, edema formation and neuronal injuries were seen in HA rats. Taken together our observations are the first to point out that CHI in HA results in exacerbation of brain pathology and under such situations nanodelivery of suitable drugs are needed to achieve better neuroprotection, not reported earlier.

Functional Outcomes and Discharge Destinations for Pediatric Brain Injury Patients after Inpatient Rehabilitation

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A retrospective cohort study was conducted at an Inpatient Rehabilitation Hospital involving the medical charts of 106 pediatric brain injury patients admitted over 5-year period. Variables collected for analysis included total Functional Independence Measure (FIM) score at admission, length of stay, scores on FIM subscales, and discharge disposition. It was found that children and adolescents made functional gains across all FIM subscales, regardless of level of consciousness on admission. Patients without disorders of consciousness on admission were discharged back to the community at a 95% rate, while patients with impaired consciousness returned to the community roughly 55% of the time. Among pediatric patients with disordered consciousness, those returning to the community made significantly greater functional gains than those with institutional discharges. Even children with severe brain injuries can make functional gains while admitted to inpatient rehabilitation. Rates of home discharge are associated with functional gains during hospitalization.

Effect of BMX Riding on Head Impact Kinematics and Concussion Assessment Scores

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Context: Bicycle Motocross (i.e., BMX) riding is a popular sport enjoyed by individuals across their lifespan. BMX has evolved from motocross racing competitions to include activities such as ‘dirt jumping.’ Dirt jumping is an extreme sport where riders traverse ‘jump lines’ (i.e., man-made ramps) that can project them up to 20 feet in the air. Additionally, riders typically wear less protective equipment compared to BMX racers (e.g., half shell helmets vs. full-face helmets with whiplash restraint). The repetitive nature of acceleration/deceleration during dirt jumping combined with the risk of crashes puts participants at particular risk of enduring multiple subconcussive and concussive events. Currently, there is a paucity of research examining head kinematics during dirt jumping and its effect on common concussion assessments.

Objective: To examine the effects of dirt jumping on head kinematics and concussion assessment scores.

Design: Pre-test post-test design. **Setting:** BMX track. **Participants:** Twenty-one riders (age = 33±8.2 years) completed 23 riding trials where common concussion assessments were completed pre and post riding. Head movement was measured during 16 riding trials. All volunteers participated after signing an IRB-approved consent form. **Interventions:** The independent variable was assessment time (pre vs. post riding). Head kinematics were measured during jumps and impacts using a mouthpiece accelerometer (i1 Biometrics™, Inc., Kirkland, WA, USA; 5g threshold) during a 60 to 90 minute riding trial. Data were analyzed with descriptive statistics, Pearson correlations, and paired samples t-test using IBM SPSS Statistics Version 23 (p<.05).

Main Outcome Measures: The dependent variables were number of impacts, peak g, sum of linear and angular accelerations and concussion assessment and change scores (signs and symptoms [s/s] number and severity, vestibular ocular motor screening [VOMS] symptom provocation, and near point of convergence [NPC]).

Results: The average, standard deviation, and range of number of recorded impacts, peak linear acceleration (g), total linear and angular accelerations were 9.75±17.3 impacts, 1 to 71 impacts; 30.4±21.2g, 6.00 to 81.0g; 205±402g, 6 to 1,640g; and 19,400±36,700.4 rad/s², 725 to 150,000rad/s², respectively. There were strong positive statistically significant relationships (p < .05) between all kinematic variables and post-test symptom severity (r=0.574 to 0.618), post-test VOMS score (r=0.539 to 0.825), and change in VOMS score (r=0.550 to 0.862). There was also a statistically significant difference over time for NPC only, t(22)= -2.75; p=0.012. Specifically, post-test NPC score (9.90±5.63cm) was significantly greater than pre-test score (7.43±3.78cm).

Conclusions: This is the first study to our knowledge to assess head impact kinematics and concussion assessment scores during dirt jumping. These findings suggest that riders sustain multiple subconcussive impacts during riding and these impacts are related to changes in vestibular and/or ocular-motor function. Further research is required to elucidate the functional significance of these changes.

Recognition of Faciobrachial Dystonic Seizures Prior To Its Progression to Limbic Encephalitis in A 67-Year-Old Patient: A Case Report

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Setting: Inpatient Rehabilitation

Case Description: Here we illustrate the case of a 67-year-old male with a history of seizures presenting with brief involuntary twitching of his right arm and face occurring about 8 times over the course of a day going on for several months. These movements were new and refractory to anti-epileptics. Neurological work-up included an EEG and MRI. A Leucine-rich Glioma Inactivated 1 (LGI1) protein antibody test was ordered to rule out FacioBrachial Dystonic Seizures (FBDS). At presentation the patient exhibited functional and cognitive decline and admitted to the Inpatient Rehabilitation unit

Assessment/Results: EEG showed generalized slowing indicative of mild encephalopathy. Brain MRI had no acute findings including that for encephalitis. Patient continued to have dystonic seizures while in therapy impeding his rehabilitation. A positive LGI1 antibody result confirmed the diagnosis of FBDS associated with VGKC/LGI1 complex autoimmunity. The patient was transferred to the Neurology service for treatment with IVIG and oral steroids with resolution of his abnormal movements.

Discussion: Faciobrachial dystonia is a unique type of seizure that is closely associated with voltage-gated potassium channel (VGKC) related autoimmunity. VGKCs are the potassium channels that adjust the neuronal excitability of the central and peripheral nervous systems. Antibodies are not directed at VGKC but to closely associated proteins particularly the leucine-rich glioma inactivated 1 (LGI1) protein. Patients with FBDS present with brief ipsilateral face and upper limb twitching secondary to increased excitability of peripheral nerves. These distinctive dystonic movements precede cognitive impairment associated with limbic encephalitis. FBDS is refractory to treatment with anti-epileptics but has shown a favorable response to immunotherapy. Early recognition and treatment with immunotherapy can prevent progression to limbic encephalitis and possibly death.

Conclusion: LGI1 LE is an autoimmune encephalitis with clinical features of memory loss, cognitive decline, faciobrachial dystonic seizures and hyponatremia. Brain MRI may show manifestations of autoimmune disease mainly involving the mediotemporal lobe and hippocampus. After patients with LGI1 LE receive gamma globulin and steroid treatments their clinical prognosis is good. With this case we hope to create awareness of faciobrachial dystonic seizures as a prodrome to limbic encephalitis and the need for vigilance among rehab physicians for expedited treatment.

Minimizing the Barriers for Children and Adolescents with Traumatic Brain Injury: Implications for Families and Schools

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Traumatic brain injury (TBI) is the leading cause of death and disability for children and teens (Thurman, 2014) and is often classified as a “low incidence” disability; it is not as low as previously thought (Chesire, Canto, & Buckley, 2011). Many students who sustain a TBI are identified by the medical community but each year many more experience a TBI that are not examined by medical personnel such as in the emergency department in a hospital or community urgent care facility. This has direct implications for students who sustain a mild traumatic brain injury (mTBI) or concussion. Research has provided valuable insight into the residual effects of a TBI which can include cognitive, motor, communication, physical, and social-emotional challenges. These effects can be long-term or temporary, and some have a direct effect on the academic performance and behavior of a student with a TBI. Educational professionals (i.e., teachers, school psychologists, school counselors) and families may notice a change in externalizing behaviors as well as internalizing behaviors in which a student may have obsessions or compulsions, be anxious or depressed, and feel a sense of alienation (Noggle & Pierson, 2010). Many factors impact the overall mental health of a student with a TBI and the response and intervention provided. Such factors include the age at which the injury occurred, the number of previous TBIs, area(s) of brain affected, course of recovery, home environment, family resources, and parental coping skills. Identifying the mental health concerns as a residual effect of a TBI can shed light on the matter thus reducing stigma usually associated with social-emotional matters. The goal in addressing the mental health of children and adolescents who have sustained a TBI, especially for educational and related professionals is to enhance the academic success and overall well-being of this unique population.

Mental Health Concerns Following Traumatic Brain Injury in Children and Adolescents

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Traumatic brain injury (TBI) is the leading cause of death and disability for children and teens (Thurman, 2014) and is often classified as a “low incidence” disability; it is not as low as previously thought (Chesire, Canto, & Buckley, 2011). Many students who sustain a TBI are identified by the medical community but each year many more experience a TBI that are not examined by medical personnel such as in the emergency department in a hospital or community urgent care facility. This has direct implications for students who sustain a mild traumatic brain injury (mTBI) or concussion. Research has provided valuable insight into the residual effects of a TBI which can include cognitive, motor, communication, physical, and social-emotional challenges. These effects can be long-term or temporary, and some have a direct effect on the academic performance and behavior of a student with a TBI. Educational professionals (i.e., teachers, school psychologists, school counselors) and families may notice a change in externalizing behaviors as well as internalizing behaviors in which a student may have obsessions or compulsions, be anxious or depressed, and feel a sense of alienation (Noggle & Pierson, 2010). Many factors impact the overall mental health of a student with a TBI and the response and intervention provided. Such factors include the age at which the injury occurred, the number of previous TBIs, area(s) of brain affected, course of recovery, home environment, family resources, and parental coping skills. Identifying the mental health concerns as a residual effect of a TBI can shed light on the matter thus reducing stigma usually associated with social-emotional matters. The goal in addressing the mental health of children and adolescents who have sustained a TBI, especially for educational and related professionals is to enhance the academic success and overall well-being of this unique population.

Prevalence of Traumatic Brain Injury in Adult Female Victims of Domestic Violence

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Domestic violence often includes physical blows to the body, the use of weapons, and strangulation. As a result, traumatic brain injury (TBI) can be a result of domestic violence. However, survivors of domestic violence may not be aware that they have experienced a TBI. Individuals who have experienced TBI may present with a variety of symptoms, such as impaired memory and attention, emotional instability, and sensitivity to certain visual or auditory stimuli. This study was done to determine whether 1) whether survivors of domestic violence have sustained a TBI, and 2) whether TBI in survivors of domestic violence is correlated with post-traumatic stress disorder (PTSD). To answer these questions, a battery of cognitive, mood, and personality measures were administered to six participants who had experienced domestic violence. All participants screened positively for a TBI based on the HELPS brain injury screening tool, which includes questions about blows to the head, loss of consciousness or confusion, and other problems in daily life. Participants must have displayed all of the aforementioned symptoms (including at least 2 new daily problems) in order to screen positively for a TBI. The most commonly reported problems in everyday life were anxiety, headaches, and dizziness. The results of the study indicate that domestic violence often results in TBI, and that victims of TBI experience difficulties related to the TBI in daily life. These results are part of an on-going study on domestic violence and brain injury, which will screen a total of 30 adult female domestic violence victims in the 2017-2018 academic year.

Examining the Use of an Intensive Physical Exertion Test as a Final Return to Play Measure in Concussed Athletes

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Objectives: This study aimed to examine the utility of the Chicago Blackhawks physical exertion test (BHT) and modified BHT (mBHT) as a final return to play (RTP) clearance test in youth and young adult athletes, and to determine the relationship between participant and test variables on RTP within asymptomatic athletes diagnosed with concussion.

Methods: As part of usual patient care, concussed athletes underwent the BHT, or mBHT, at partnered Complete Concussion Management Inc. (CCMI) clinics once they were asymptomatic and had completed all standard return to learn and RTP stages. The BHT/mBHT was utilized as the final step of RTP-clearance decision making. Prospective data was collected electronically by trained CCMI clinicians utilizing the Complete Concussion Management database. A de-identified chart review was conducted to examine data collected between January 2016 and February 2017. Participant and test variables were analyzed to determine relationships with pass/fail rate of the BHT/mBHT.

Results: A total of 759 athletes performed the BHT/mBHT in the study period. Although all asymptomatic prior to test initiation, 14.6% of concussed athletes had an exacerbation of symptoms during the BHT/mBHT while attempting to achieve RTP clearance. Statistically significant relationships were found between failure of the BHT/mBHT and symptom severity score on initial presentation, and self-reported history of pre-morbid anxiety. When taken together, sex, age, and pre-morbid anxiety significantly predicted length of time between injury and RTP clearance.

Conclusion: The BHT/mBHT may identify individuals who are not ready to RTP, despite a resolution of self-reported symptoms and a completion of standard return to learn and play protocols. These results illustrate that RTP clearance decisions based on self-reported asymptomatic status at rest are inadequate. Instead, monitored, intensive, sport-specific, physical exertion testing should be utilized to inform clinical RTP decisions.

Repeated TiO₂-Nanowired Delivery of Cerebrolysin Reduces Pathophysiology of Blast Brain Injury

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Blast brain injury (bBT) is a serious problem in military personnel during combat or peacekeeping operations. The primary and secondary pressure waves created by the blast induces intense brain damage depending on the magnitude and severity and the distance between blast and the victim. Few reports using compressed-air or gas induced blast in the shock tube in the magnitude of 150 to 250 kPa showed unilateral brain damage e.g., neuronal loss, activation of astrocytes and distortion of axonal and synaptic connections after 2 to 12 h bBT. However, studies on drugs modifying bBT induced brain pathology are still lacking.

Previously we have shown that cerebrolysin- a multimodal drug when given alone or using TiO₂ nanowired delivery induces marked neuroprotection following brain injury caused by trauma, hyperthermia or concussion. Thus, we examined effects of cerebrolysin following bBT in a rat model.

Equithesin anesthetized Male Wistar rats (age 25 to 30 weeks) were placed in a compressed air driven blast shock tube with head facing. The torso was wrapped to protect from the blast waves. Rats were exposed to blast waves of either 150±5 kPa or 250±8 kPa (measured using a pressure transducer fixed into the shock tube) and allowed to survive 8 or 24 h. Brain edema, blood-brain barrier (BBB) breakdown and cellular injuries were examined using standard protocol.

Our results showed breakdown of the BBB to Evans blue albumin and radioiodine ([¹³¹I]-I) in the cerebral cortex, hippocampus and cerebellum by 4 to 8-fold from the normal control rats depending on the magnitude of the blast waves. The contralateral side also showed 2 to 4 folds higher BBB leakage after 150 or 250 kPa shock waves, respectively. The brain water content elevated by 6 to 10 fold on the right hemisphere, whereas 4 to 6-fold increase in water content was seen on the left side. Nissl staining showed pronounced neuronal loss, damage and cell death in the above brain areas that was most prominent on the right side.

Cerebrolysin (2.5 or 5 ml/kg, i.v.) administered 2 and 4 h after bBT (250 kPa) significantly reduced brain pathology following 8 h. However, multiple injections of high doses of cerebrolysin (5 ml/kg, 2,4,6,8 and 10 h after injury) are needed to induce neuroprotection 12 h after bBT. TiO₂ nanowired delivery of cerebrolysin (2, 4 and 8 h after bBT) significantly reduced brain pathology at 12 h. These results show that cerebrolysin if given in multiple doses is able to thwart bBT induced brain pathology and TiO₂-nanowired cerebrolysin has superior neuroprotective effects.

Nanodelivery of Cerebrolysin with 5-HT₆ Receptor Antagonist Induces Superior Neuroprotective Effects Following Concussive Head Injury Induced Exacerbation of Brain Pathology in Sleep Deprivation

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Sleep deprivation (SD) in military leads to often decline in cognitive and higher mental functions. Since military personnel are vulnerable to concussive head injury (CHI), it appears that SD may worsen brain pathology in CHI. Previously, we showed that 48 or 72 h SD alters serotonin (5-hydroxytryptamine, 5-HT) metabolism and induces brain pathology that is significantly reduced by 5-HT₃ receptor antagonist ondansetron. Recent reports suggest that treatment with 5-HT₆ receptor antagonists has also beneficial effects in attenuating behavioral and cognitive functions in brain injury.

We found that Cerebrolysin, a balanced composition of several neurotrophic factors and active peptide fragments when delivered through TiO₂-nanowired-technology results in superior neuroprotective effects on brain pathology in CHI. Thus, we examined whether CHI brain pathology that is aggravated in SD could be reduced by nanodelivery of 5-HT₆ receptor antagonist SB-399885 together with Cerebrolysin probably having a synergistic enhanced therapeutic effects.

Male Wistar rats (age 20 to 25 weeks) were subjected to 72 h SD using an inverted flowerpot model placed in a pool of water maintained at 1 cm below the surface so that animals are deprived of restful sleep. After 72 h of CHI in these animals were inflicted by dropping a weight of 114.6 g from a 20 cm height guide tube inducing and impact injury of 0.224 N on the right skull.

Our observation shows that CHI in SD rats resulted in marked exacerbation of brain pathology (2 to 3 fold higher) after 4 weeks of survival. In the brain, neuronal damages in cortex, hippocampus and cerebellum, blood-brain barrier (BBB) breakdown and edema formation was also aggravated by 2-3 fold in SD rats after CHI. These SD rats after CHI also showed much worse behavioral performances on Rota-Rod treadmill, inclined plane angle test, and water maze apparatus.

TiO₂-nanowired delivery of 5-HT₆ receptor antagonist SB-399885 (3 mg/kg) together with Cerebrolysin (2.5 ml/kg) intravenously once daily for 2 weeks starting from 1 week after CHI in SD rats induced marked neuroprotection as compared to these drugs either given alone or without nanotechnology under identical conditions. Interestingly, nanowired delivery of drugs in combination also improved behavioral function remarkably in SD rats after CHI. These observations are the first to show that a combination of 5-HT₆ receptor antagonist with Cerebrolysin using nanodelivery has superior neuroprotective effects in CHI induced brain pathology in SD, not reported earlier.

Blueprint for Recovery from Brain Injury: A Decade's Journey

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A case specific study of an 18yo woman w extensive global injury over a ten-year time span

Keeping a continuum of care from ICU to community.. don't get lost in the cracks

Protocols for care

Plasticity of the brain

Rewiring of the brain through unconventional methods

Use of bispectral monitors

Circadian Rhythms

Neurobiofeedback an integral part of recovery -brain maps show the difference

Provisional Versus First Adulthood and Gender-Mediated Differences in Six-Month Neuropsychiatric and Post-Traumatic Stress Outcomes Following Mild Traumatic Brain Injury: A TRACK-TBI Analysis

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Background: Mild traumatic brain injury (MTBI) causes significant morbidity, and up to 30% of MTBI patients suffer persistent functional, neurocognitive and neuropsychiatric symptoms beyond six-months. Age-stratification and gender differences as risk factors for impaired outcomes in young-adults remain in need of improved characterization.

Methods: MTBI patients 18-39 years-of-age with emergency department (ED) arrival Glasgow Coma Scale (GCS) 13-15 and complete six-month outcomes were extracted from the prospective Transforming Research and Clinical Knowledge in Traumatic Brain Injury Pilot study. Patients were grouped by provisional-adult (PA, 18-29 years) and first-adult (FA, 30-39 years), and by male/female gender as variables of interest. Race, psychiatric history, assault mechanism, loss-of-consciousness, GCS, acute intracranial pathology on computed tomography (CT), and polytrauma were considered for multivariable regression. The interaction factor age-group*gender was analyzed in multivariable outcome models, and if not statistically significant, was removed from the regression. Mean-differences (B) and 95% CIs are reported, with significance assessed at $p < 0.05$.

Results: One-hundred MTBI patients were included (PA: 70.0%, FA: 30.0%; male-71.0%, female-29.0%). Gender did not differ by age-group. Mean education years were 14.3 ± 2.5 (female: 15.1 ± 2.8 , male: 13.9 ± 2.3 , $p = 0.029$). 23.0% were CT-positive (female-10.3%, male-28.2%, $p = 0.068$). Other demographic/clinical variables did not differ by age-group or gender.

On multivariable analysis for six-month outcomes, compared to FA, PA exhibited decreased nonverbal processing speed (Wechsler Adult Intelligence Scale-Processing Speed Index; $B = -5.8$, 95% CI [-11.1, -0.5], $p = 0.032$), marginally decreased psychiatric disturbance (Brief Symptom Inventory-18: $B = -4.4$ [-8.8, 0.0], $p = 0.052$) and marginally increased life satisfaction (Satisfaction with Life Scale: $B = 3.0$ [0.0, 6.0], $p = 0.052$). Male associated with increased functional outcome (Glasgow Outcome Scale-Extended: $B = 0.6$ [0.1, 1.0], $p = 0.013$). No differences were observed for executive function or verbal memory by age-group or gender.

The interaction factor age-group*gender associated with post-traumatic stress disorder (PTSD Checklist-Civilian (PCLC); $p = 0.022$) and postconcussional symptoms (PCS; Rivermead Questionnaire-13 (RPQ-13); $p = 0.044$). On the PCLC, compared to female-FA, female-PA scored 19.6-points lower [-30.6, -8.5], male-FA 15.5-points lower [-26.5, -4.4], and male-PA 19.7-points lower [-30.1, -9.3]. RPQ-13 showed that compared to female-FA, female-PA $B = -12.9$ [-22.1, -3.7], male-PA $B = -12.8$ [-21.4, -4.2], and male-FA $B = -11.1$ [-20.3, -1.9]. Accordingly, age-group ($p < 0.001$; $p = 0.007$) and gender ($p = 0.021$; $p = 0.049$) remained independent predictors of PTSD and PCS, respectively.

Conclusions: Within a cohort of young-adults suffering MTBI, PA and FA may constitute groups with different risks for impairment on specific outcome measures, particularly those in the neuropsychiatric

domain. Gender appears to interact with age-group for PTSD and PCS. These results may be attributable to brain cortical maturation, social modifiers during recovery, differential responses to trauma, and/or response bias during self-report outcomes. Prevention, resource allocation and rehabilitation/counseling strategies in young-adults at risk for and/or suffering from MTBI should be designed with consideration for age- and gender-groups, which warrant further study in larger, more diverse samples.

Inpatient Length of Stay Moderates the Relationship Between Race and Functional Outcomes in Pediatric Brain Injury

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Racial disparities in recovery following trauma have been well-documented in adult populations. Far fewer studies have examined the potential influence of race/ethnicity on outcomes of children and adolescents recovering from a brain injury. Research aimed at identifying factors that affect outcomes is vital towards improving medical practice. This study examined the role of race/ethnicity on improvements in functional independence during short-term recovery from a pediatric brain injury. Data from a comprehensive trauma database was assembled at an independent pediatric rehabilitation hospital. Participants were 147 pediatric, first time admissions for a brain injury. The Functional Independence Measure for Children (WeeFIM) was used to assess functional independence, and children were identified as either Caucasian (n = 80) or Non-Caucasian minorities (n = 67). Disparities were found between racial groups when patients' inpatient length of stay exceeded 29 days, with Caucasian patients showing significantly greater improvements in functioning than their Non-Caucasian peers. No significant differences were found between groups among patients with a length of stay 29 days or fewer.

Views About the Neurohabilitation Process in Greece

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Introduction: Beliefs about neurohabilitation may influence whether minors and adults with a nervous system injury will use effectively the existing resources in hospitals and clinics in order to recover as soon as possible. The aim of this study is to explore what different groups of Greeks believe about the hypothetical need for neurohabilitation services to their children or other adult family members.

Methods: One hundred seventy-five participants from Northern Greece (147 women; 29 student nurses, 34 professional nurses, 52 psychology students, 22 professional psychologists, and 38 students of non-relevant sciences; Mage = 27.72, SDage = 9.61; and for the 55 professionals Myears of professional working experience = 11.76, SDyears of professional working experience = 6.50), replied to a questionnaire related to their knowledge and attitudes towards neurohabilitation. The inclusion criteria were: 1) being a professional or student in a medical-related field (psychology and/or nursing) or a university student of non-relevant sciences, 2) the good knowledge of the Greek language, and 3) an age over 18 years. Due to the inexistence of similar questionnaires on use in Greece, we devised a new questionnaire, which consisted of open questions to explore deviant responses and questions in the form of a 5-point Likert scale, with statements ranging from 'strongly agree' to 'strongly disagree'.

Results: Over half of the participants (79 %) of respondents agreed that people with a nervous system injury must have access to neurohabilitation in order to facilitate recovery, only a minority (26%) expressed uncertainty about whether neurohabilitation is harmful both for minors and adults, and 69% believed that family members do not have the skills without professional guidance after their exit from the hospital to help a child/adult with any type of nervous system injury to overcome difficulties.

Conclusions: Misconceptions about neurohabilitation as a process should be further examined in different cultural contexts. Taking into account that neurorehabilitation works with the skills and attitudes of the disabled person and their family and friends, attitudes should be further examined as they may interfere with family support.

A Case of Bilateral Combined Cranial Nerve III and IV Palsies After Stroke

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Ocular movement abnormality is a common symptom affecting over half of all stroke patients. However, only a small percentage of these are from bilateral damage to the ocular cranial nerves, leading to a scarcity of available data on the prognosis, recovery time, and best course of treatment. Therefore, we report a case of bilateral cranial nerve (CN) III and IV palsy, and discuss prognosis and difficulties in management.

A 43-year-old female presented to emergency department unresponsive. Computerized tomography (CT) head revealed bilateral infarcts of cerebellar peduncles, midbrain, pons, thalamus, occipital lobe, and left medial temporal and posterior parietal lobe. CT angiography revealed occlusion of basilar artery, with filling defects in branches all the way to posterior cerebral arteries bilaterally. Patient was revascularized, stabilized, and subsequently admitted to inpatient rehabilitation unit. Her initial examination showed mild quadriparesis, impaired arousal and cognition, bilateral ptosis, fixed, dilated and nonreactive pupils, and extraocular movements intact only in abduction on both eyes.

CN III, IV, and VI are responsible for ocular and eyelid movements, and can be damaged directly at their nuclei or anywhere along their tracts to target muscles. Our patient's symptoms included pupil nonreactivity in addition to ocular and eyelid movement dysfunction, suggesting that her lesions were directly at the CN III and IV nuclei. Recovery from ocular CN palsies typically take from several weeks to 6 months, with atraumatic causes carrying a more favorable prognosis. However, previous studies typically compared cases of isolated tract evulsions from trauma against non-stroke causes of CN palsies (diabetes, hypertension, aneurysm). Persistence of bilateral CN III palsy past 6 months has been observed in a case with midbrain infarction. Prognosis tends to be poor when there is concurrent broad involvement of other regions. Our patient's ocular symptoms persist 2 months after stroke, along with multiple other issues from her extensive brainstem lesions, hinting at a more unfavorable prognosis.

Treatment is aimed at controlling symptoms of diplopia and strabismus, and involves prisms, eyepatches, compensatory head posture, use of visual scanning strategies, botox injections in antagonistic eye muscles, or surgical interventions to correct misalignment if problems persist for more than 6 months. These techniques are harder to optimize in our patient and less effective due to bilateral combined CN III and IV palsy. For patients with severe ptosis, strategic measures to hold the eyelids up can be used until nerve function improves. If symptoms persist past 6 months, minimally invasive frontalis suspension surgery, to allow the frontalis to assist with eyelid opening, or resection of muller's muscle, to increase levator tone, can be done. Considering her presentation and data that's available, we suspect that our patient will require surgery in the future.

Screening for Brain Injury: Can We Decrease Disability by Getting More People to Brain Injury Services and Supports?

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The literature is beginning to abound with examples of people who have brain injury, but who do not know that they have a brain injury. How does this occur, one might ask? Certainly, public awareness about brain injury has increased, due to publicity about brain injury in athletes as a result of sports injuries (collisions with other players/goal-post/ground, and now Chronic Traumatic Encephalopathy), as well as brain injury in soldiers involved in war-related injuries (gunshot wounds/blast-related injuries/motor vehicle crashes). What is being found is that multiple, mild brain injuries have a cumulative effect, and yet each one, on its own, may not result in a diagnosis of brain injury. Without a diagnosis of brain injury, it is unlikely that one will be treated for brain injury. If there are residual cognitive or physical sequelae of mild brain injury, but no brain injury diagnosis, then the root cause of these problems is either overlooked or attributed to psychological problems, and consequently people do not get the benefit of brain injury treatment and supports that are available and validated as efficacious.

A growing list of "at-risk" populations are coming to the attention of brain injury professionals. In addition to athletes and military personnel, people who are homeless, victims of domestic violence, and people in juvenile justice or adult corrections may in fact have a lifetime history of brain injury, but not be aware of it, and may never have received treatment for it. In addition, there may be an over-representation of a lifetime history of brain injury among people presenting for vocational rehabilitation services, mental health services, drug and alcohol services, and psychiatric hospitalizations. The issue for these populations is that brain injury, left untreated, can result in any number of mood, behavior, substance use disorders, that then become the focus of treatment. Without an understanding of the root cause of the person's difficulties, and how they developed into mood, behavior, or substance use disorders, the traditional treatments for those disorders are likely to be less effective. The reason has to do with cognitive impairments that can undermine new learning and applying that learning, which is essential for change when dealing with mood, behavior, and substance-use disorders.

This paper will highlight recent research done in several "at-risk" populations, including corrections and juvenile justice, to get at the prevalence of previously undiagnosed brain injury. In a backward chaining fashion, we will make the public policy argument for annual screening for brain injury in children, much as is currently done for developmental disorders, or visual/auditory impairments, so that we can more easily identify who could benefit from brain injury interventions and supports, and break the cycle of mild brain injury masquerading as other disorders.

Dark Cloud of Concussion: An Emerging Grounded Theory of Adolescent Athlete Health Decision-Making Post Sport-Related Concussion

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Concussion comprises a substantial number of traumatic brain injuries each year among high school athletes. Adolescents are more vulnerable to concussion consequences due to disturbances of physiologic processes during brain maturation. Reports suggest up to 50% of adolescents do not seek healthcare post-concussion. Failure to report results in treatment delays and premature return to activities, potentiating risk for prolonged symptoms or subsequent injury.

The purpose of this study was to explore influential factors and pivotal decision points within the process of health decision-making (DM) of adolescent athletes post-sport related concussion (SRC).

Methods: Twelve predominantly white adolescent athletes post-SRC were recruited to participate in semi-structured interviews. Grounded theory methods were used to examine salient concepts within the athletes' DM process. Theoretical sampling was conducted to further develop each concept or dimension until saturation occurred. Data were coded and analyzed utilizing dimensional analysis to explore interrelationships of emerging concepts and dimensions. Member checks were performed to verify findings that emerged during analysis. This process involved a review of each theory iteration to ascertain the alignment with their experiences and perceptions, with revisions based on member feedback. A peer debriefing process was also used to ensure trustworthiness of findings.

Findings: SRC DM occurred within the context of sport culture, which encourages pushing through pain. The central perspective, dark cloud, reflects literal and symbolic facets of SRC before and after the point of impact. Participants distinguished between hurt or injured, influencing symptom reporting. Timing of symptom onset differed, with four levels of functional impairment described. Participants "Made Sense" of symptoms through "Crucial Conversations" with a "Trusted Person" to "Weigh Options" about concussion reporting. Participants who immediately returned to play and those with slow symptom onset both described prolonged cognitive and physical impairment, depression, and anxiety. Individual, social, community, and policy factors influenced adolescent athletes' SRC DM.

Discussion: Symptom reporting and connection with healthcare providers were influenced by a "Dark Cloud" of concussion, with decisions occurring within the context of sport culture. The Dark Cloud encompassed cognitive impairment, lack of knowledge, dark mood, isolation, and exclusion. Ecological factors influenced adolescent athletes' health decisions post-SRC. Sport culture values tough athletes able to push through pain and injury among males and females, however females received less external support despite prolonged, serious symptoms.

Practice implications suggest opportunities for anticipatory guidance during pre-sport participation exams, decision support for cognitively impaired athletes, revised concussion education strategies, advocacy for female sport resources, and enhanced models of concussion care. Findings warrant further investigation in a larger, more ethnically diverse population.

Comparison of F-18 FDG PET Glucose Scans in Murderers with Brain Injury Vs Civil Brain Injury Patients Vs Normal Controls

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Background: We retroactively analyzed clinically acquired local cerebral uptake of glucose using positron emission tomography (PET) of individuals convicted of murder with brain injury (M-BI) compared to civil patients with brain injury (C-BI) and a group of normal controls (NC) with IRB approval for retrospective anonymized data. We hypothesize that M-BI will show decreased frontal cortex and temporal cortex metabolism compared to C-BI or NC.

Methods: 17 M-BI, 20 C-BI, and 20 NC had F-18 FDG PET brain scans during vigilance task. These scans were compared using statistical parametric mapping ($p < .001$ height, $n = 30$ voxels extent) with age and gender covariate adjustments.

Results: M-BI showed decreased relative activity in the orbitofrontal cortex, bilateral insular cortex, more extensive left DLPFC, cingulate compared to NC. M-BI exhibited an apparent relative increase in glucose metabolism in the cerebellum bilaterally and white matter regions compared to NC. C-BI had reduced metabolism in the left parietal and temporal cortex, and bilateral occipital lobes compared to NC and increased right sided temporal activity compared to M-BI. The ratio of the neocortex to the cerebellum was lower in the group of M-BI compared to C-BI and NC.

Conclusion: M-BI show an abnormally low neocortical to cerebellar ratio compared to either C-BI or NC and asymmetrically lower left sided metabolic decreases compared to NC, whereas C-BI show asymmetrically greater right sided temporal metabolic increases compared to NC.

Brain Injury in Juvenile Justice: Results and Implications of a Demonstration Project in PA

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Research from across the United States indicates that brain injury is over-represented in both adults and youth who are involved in the criminal justice system. Often undiagnosed in these populations, brain injury affects risk for justice involvement, responsivity to corrections treatment, and success in school and work. This session will review the literature about the prevalence and effect of brain injury in the juvenile justice system and summarize results of an ongoing demonstration project in Pennsylvania which seeks to identify these youths and intervene to positively impact their lives and potential success in the community. Project elements include screening for lifelong history of brain injury, neurocognitive assessment, and connections to resources using a process called NeuroResource Facilitation. Data from the project and examples of how key elements have been applied in 3 settings: youth detention, a placement facility for adjudicated youth, and a county court system, will be provided. Preliminary results indicate that more than half of youth screened indicate a history of possible brain injury, with more than half of those youth who were assessed demonstrating neurocognitive impairment upon testing. Impairments were most commonly in the areas of memory and executive functioning. Implications for pediatric rehabilitation practitioners, juvenile justice professionals, and public policy will also be discussed.

Proposal of A Nihilism Guard for Patients with Severe Traumatic Brain Injury

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Many regard a vegetative outcome as a fate worse than death. In an effort to avoid poor outcomes of this nature physicians sometimes recommend withholding aggressive care in severe traumatic brain injury (TBI) patients. Such recommendations are, however, based upon limited data obtained early after presentation. Marked variation in aggressiveness in the care of severe TBI patients exists due to physician differences in perceived prognoses, knowledge of medical literature, training and personal views on what constitutes an acceptable outcome. Multiple studies have demonstrated inherent clinical pessimism in physicians, suggesting an overestimation of poor outcomes. An inappropriately pessimistic view of a patient's outcome and the belief that a patient would not benefit from aggressive care is termed therapeutic nihilism. This outlook can see patients subjected to less aggressive care and ultimately the self-fulfilling prophecy of an unfavorable outcome.

In an international study we administered to neurosurgeons and general surgeons, respondents indicated that aggressive care should generally be pursued in patients aged less than 76 years or those with >15% chance of survival or good outcome as predicted by the IMPACT prognostic calculator. The IMPACT (International Mission for Prognosis and Analysis of Clinical Trials in TBI) prognostic calculator is extensively externally validated and accurately predicts outcomes for TBI patients in >80% of cases which offers the opportunity to decrease variability in physician aggressiveness. Indeed, increasingly accurate prognostic models offer the opportunity to define therapeutic nihilism more objectively and to seek a consensus definition.

Here we propose a nihilism guard which could be used in clinical practice. We propose using threshold values from advanced clinical prediction models and consensus opinion to develop a guard which would reduce the risk of patients being deprived of a reasonable chance of an acceptable outcome. A guard could be integrated into modern electronic medical record software and could mandate a second physician opinion prior to proceeding to withdrawal of care in a patient calculated to have an acceptable outcome. Opposition to such a guard may include the perception of undermining physician autonomy, potential increased costs to the healthcare system, a chance of prolonged patient suffering as well as the risk of an outcome unacceptable to the patient. Despite potential opposition, implementation of a nihilism guard would protect patients from physicians with overly nihilistic views regarding probable outcome and the ability to benefit from aggressive care.

Subacute Systemic Inflammation Associated with Depression At 12 Months Post Traumatic Brain Injury

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Objective: To investigate the influence of systemic inflammation on depression after moderate-to-severe traumatic brain injury (TBI).

Design: Prospective cohort study.

Setting: University-affiliated level 1 trauma center.

Participants: Adults with moderate to severe traumatic brain injury (N=112).

Interventions: Sub-acute serum samples were collected monthly for 3-months post TBI for inflammatory cytokine biomarker analysis.

Main Outcome Measures: Patient Health Questionnaire-9 (PHQ-9), a validated and reliable screening tool for major depressive disorder, was administered to participants at 12-months post-injury. In accordance with DSM-IV diagnostic criteria for major depressive disorder (MDD), participants were characterized as having PTSD if they reported at least five symptoms, including at least one of the cardinal symptoms (depressed mood or anhedonia).

Individual inflammatory biomarkers and ratios, significantly associated with PTSD at 12-months post-injury in bivariate analyses ($P < 0.05$) were used as component variables to build an inflammatory load score (ILS), which was calculated by summing quartile ranks. Multivariable logistic regression was used to evaluate ILS as a predictor of PTSD at 12-months, after controlling for age, education, and Glasgow Coma Scale score (GCS).

Results: Higher levels of the following subacute serum inflammatory markers were used to formulate an ILS were associated with 12-month PHQ-9 scores: ITAC, MIP1b, soluble TNF-alpha 1 receptor, IL-21, Fractalkine, GMCSF, IL-8, IL-1b, IL-10, and IL-7. For each unit increase in ILS, there was a 17% increase in the odds of 12-month PTSD, after adjustment for age, sex, and GCS (95% confidence interval: 1.073-1.285). This ILS model is a relatively strong model in predicting PTSD at 12-months (c-coefficient=0.796).

Conclusions: Subacute serum ILS is a promising clinical tool for identifying individuals at risk for PTSD. Psychiatric research identifies an association between depressed people with high systemic inflammation whose depression is refractory to antidepressant treatment. In a TBI population with high inflammation and high risk for depression, future research should identify the best treatment regimen that addresses underlying pathology. Continued research in personal biology, screening, pathology, prevention, and treatment in mood disorders after TBI is warranted.

Rhythmic Auditory Stimulation and Gait Training in Traumatic Brain Injury: A Feasibility Study

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Purpose/Hypothesis: To investigate the feasibility of using Rhythmic Auditory Stimulation (RAS) for gait training with individuals who have chronic traumatic brain injury (TBI).

Subjects: 9 community dwelling individuals 1-20 years post TBI, aged 18-65, Glasgow Coma Score <13, Functional Gait Assessment (FGA) score <22, no formal physical therapy in the last 30 days. Participants were able to ambulate at least 30 minutes with assistive devices, braces and rest breaks as needed, had a deviation in spatiotemporal aspects of gait, and were hemiparetic and/or ataxic.

Materials/Methods: This was a cohort pilot study. Following informed consent, participants completed assessment at baseline, pre-test 2 weeks after the baseline, post-test immediately following the 2-week intervention, and follow up 1 week after the final intervention.

Outcomes Included: 10 meter walk test, GAITRite gait analysis, manual muscle testing, the Modified Ashworth Scale, the Functional Gait Assessment (FGA), and the Physical Activity Enjoyment Scale (PACES). Participants completed 9-10 treatment sessions in a 2-week period. The daily treatment protocol included: a 2-minute warm-up walk; listening to a musical stimulus matched to cadence (beats/minute) for 5 minutes; walking with the musical stimulus (RAS) at their baseline cadence for 13 minutes; and walking with RAS at 5% higher cadence for 10 minutes. RAS was delivered in the form of preferred music with a rhythmic click. Music was chosen and altered by a board-certified music therapist. Participants walked with a physical therapist. The distance walked and the time walked by each participant was tracked daily. A Diary of Adverse Events was completed daily during intervention to determine safety.

Results: RAS is a safe and feasible intervention for individuals with a TBI that yields improvements in gait. There were no adverse events reported during the treatment, and overall participants reported enjoying the intervention (mean PACES score 63.6). Participants showed significant improvements in their gait speed (mean improvement of 0.12 m/s, $p = 0.0275$), distance walked during the intervention (mean improvement of 1412 feet, $p = 0.0014$), cadence during the intervention (mean increase of 10.4 steps/minute, $p = 0.0040$), and FGA score (mean improvement of 2.7 points, $p = 0.0027$). In addition, all participants had FGA scores less than 22, indicating an increased risk of falls, prior to the interventions. At post-treatment testing, 5 of the participants (56%) had scores of 22 or higher.

Conclusions: RAS is a feasible, safe, and enjoyable treatment for this population. The addition of RAS appears to be a useful therapeutic intervention to assist individuals with gait abnormalities following TBI, but more research is needed in this population.

The Use of The Balance Evaluation Systems Test for Individuals with Chronic Traumatic Brain Injury

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Purpose/Hypothesis: To evaluate the use of the Balance Evaluation Systems Test (BESTest) in a cohort of individuals with chronic Traumatic Brain Injury (TBI), including a comparison of a clinician's judgement of the most impaired balance system in contrast to the lowest subscale score designated by the BESTest and associations between the BESTest, Community Balance and Mobility Scale (CB&M), and the Activities-Specific Balance Confidence Scale (ABC).

Subjects: Participants included 59 individuals with a TBI who were taking part in a larger randomized controlled trial to improve balance. All information used in the current analysis was collected at baseline at Craig Hospital.

Materials/Methods: Individuals who were at least 1 year post-TBI, 3 months post-completion of skilled PT treatment, and ambulated independently within the home (with assistive devices and/or orthotics as needed) were eligible. Trained clinicians administered the BESTest and then provided their clinical judgement of the most impaired subscale based solely on observation during the test. The CB&M and the ABC were also administered.

Results: Thirty-eight males and 21 females with a mean age of 48 years old completed testing. Clinical judgment of the most impaired subscale matched the lowest subscale score on testing 58.1% of the time ($\kappa = 0.45$, 95% confidence interval = 0.28, 0.63). Those identified as most impaired on the sensory orientation subscale trended towards lower scores on the CB&M, although this was not statistically significant ($p = 0.18$). Mean scores on the BESTest were significantly associated with stratification of CB&M scores ($p < 0.0001$), with higher BESTest scores associated with higher category of CB&M. There was a significant weak to moderate positive correlation between the ABC and BESTest ($r=0.471$, $p=0.0002$) and between the ABC and CB&M ($r=0.407$, $p=0.0015$).

Conclusions: This research provides initial data to support the use of the BESTest to measure balance impairment in individuals with chronic TBI. Further investigation is warranted to validate this measure in chronic TBI. Clinical judgment of the most impaired balance subscale on the BESTest matched the actual outcome just over 50% of the time. The ABC demonstrated a significant positive relationship to the CB&M and the BESTest. However, given that the correlation was weak to moderate between the self-report measure and the clinical measures, there's likely important information gained from the clinical measures that would be missed by only using a self-report measure.

Improving Post-Injury Outcomes: Challenges and Changes in A Culturally Diverse Program for Young Adults

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Young adults who have had a moderate or severe traumatic brain injury (TBI) typically experience difficulty in transition to adulthood. This is based partially on age of injury as well as interruptions in completion of developmental milestones. Also, in a comprehensive review of post-injury outcomes, Gary et.al. (2009) found that minorities were at a disproportionate risk for poorer outcomes. The current study looks at how attitudes regarding race and ethnicity may affect satisfaction with life and community integration in a comprehensive program for young adult participants. The program is based on ability and designed to teach participants how to become productive employees through sheltered work, community based enclaves and/or competitive employment. One hour of group therapy follows the reduced work day. Independence is reinforced through communication, staff mentoring, group discussion and peer support. Assistance with educational options is offered including: high school completion or equivalency, or post-secondary options. A measure of effects of race and diversity was developed and used in a study in 2009. This measure is repeated in the current study.

Objectives: Measure effects of race and ethnicity at the workshop.

Participants: Nineteen members of the Young Adult Program (YAP) including females and males; Caucasians (n=6) and African Americans (n=11). One female identified ethnicity as Hispanic; one male identified ethnicity as Arabic.

Design: Surveys are being completed. Statistics will be run to determine relationships between age, education, and years post injury and racial harmony.

Setting: Vocational day program for young adults with TBI.

Measure: 18 item questionnaire of attitudes toward race and ethnicity.

Results: The results will be determined. A factor analysis will be run. Means by scale across race and independent sample t-tests will be run. Linear regression will be completed to determine if there are significant predictors for the factors.

Implications: Vocational rehabilitation of a diverse population of young adults may be done successfully. Issues of race and ethnicity are discussed in group therapy to improve relationships between the participants and improve outcomes for the participants regardless of race, gender or ethnicity.

Keywords: Vocational Rehabilitation, Young Adult, TBI, Race, Ethnicity

Saliva microRNA Levels Are Associated with Longitudinal Measures of Balance and Cognition Following Traumatic Brain Injury

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There is emerging evidence that microRNA profiles in saliva may provide insight into the severity and duration of brain injury symptoms. Previously we have shown that salivary microRNA profiles overlap with microRNA profiles in cerebrospinal fluid after a traumatic brain injury. Furthermore, these profiles demonstrate utility in identifying brain injury status and predicting which patients will experience prolonged symptoms. Such information could be valuable for clinicians seeking to provide anticipatory guidance for patients and families, or to create individualized patient management plans. Further development of this tool will require a better understanding of how brain injury-related microRNAs change over time, and how microRNA levels relate to functional symptom measures. We posited that a subset of salivary microRNAs previously identified as diagnostic and prognostic markers of traumatic brain injury would show longitudinal trends in expression after an injury and correlate with measures of balance and cognition.

Salivary microRNA was collected from 50 children (ages 7-21) presenting to a tertiary care center with a physician-diagnosed mild traumatic brain injury at acute (0-3 days after injury), sub-acute (7-17 days after injury), and chronic (≥ 28 days after injury) time-points. Injury mechanism and demographic features were recorded. Subjective symptoms were assessed with SCAT-5 survey, and functional symptoms of balance and cognition (e.g. processing speed, divided attention performance) were measured with the ClearEdge[®] Concussion Toolkit. Saliva microRNA levels were quantified with high throughput RNA sequencing. Spearman's rank correlations were used to identify potential relationships between microRNA levels and four continuous variables: 1) days since injury; 2) ClearEdge balance score; 3) ClearEdge cognitive score; and 4) participant age.

Initial analyses (n=35) have identified six microRNAs whose levels are associated ($R \geq 0.40$; $p < 0.05$) with number of days post-injury. Three of these microRNAs (50%) were identified as potential biomarkers in our previous studies (miR-574-5p, let-7b-5p, let-7f-5p). One of these microRNAs (let-7f) is negatively associated with participant age ($R = -0.48$; $p = 0.009$), and may represent a unique biomarker for pediatric brain injury. There were seven salivary microRNAs associated with ClearEdge cognitive score, and two of these (miR-30e-5p, $R = -0.48$, $p = 0.015$; miR-320c, $R = -0.43$, $p = 0.034$) were identified in previous studies. Three previously identified microRNAs were also associated with ClearEdge balance score (miR-182-5p, miR-744-5p, miR-769-5p).

Longitudinal interrogation of salivary microRNA biomarkers alongside measures of balance and cognition demonstrates that microRNAs show expression trends over time and are associated with objective symptoms following brain injury. A subset of microRNAs is correlated with patient age and may represent unique signatures for pediatric brain injury. Validation of these findings in a larger cohort is ongoing, and will be required to substantiate the diagnostic/prognostic utility of salivary microRNA as a non-invasive, objective measure of brain injury.

The Necessity of Building a Robust Database: A Key to Successful Outcomes for Children and Adults

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The Brain Injury Alliance of Washington (BIAWA) began as a small organization and has continuously been growing to meet the needs of those affected by brain injury throughout Washington. BIAWA is able to provide consistent telephone and in-person support to connect survivors and family members to the services and activities necessary to achieve the highest quality of life attainable. As BIAWA has developed models through program planning BIAWA has also had to create structure for providing resources to the community in the most efficient and data driven manner. BIAWA's positive growth has given the organization the opportunity to expand its information and referral system to a database structure using Salesforce.

Services and providers that adult and pediatric brain injury communities utilize are wide spread, from healthcare providers to recreational activities to several varieties of attorneys. BIAWA recognized the inability to meet such expansive requests for information and referral with the initial resource system in place. In 2009 BIAWA incorporated the Salesforce database and developed a more efficient system to collect and distribute resources. The database model allows BIAWA to provide more accurate and comprehensive information in a bilateral manner to brain injury survivors and providers.

In this presentation, BIAWA will give an overview of organizational growth and expansion through collaboration with external programs and services. It will go into depth about the necessity of a robust, usable, and accessible database in order to serve the brain injury community. BIAWA will also elaborate on reducing cost barriers in order to take information and referral services to the next level of support. Improving outcomes for children and adults begins with establishing a stable foundation for connecting the community with accurate information and referral services.

Persistent Neurological Deficits After Cerebral Fat Embolism Despite Negative Neuro Imaging: A Case Report

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Disclosure: None

Setting: Tertiary care rehabilitation hospital

Case Description: 25-year-old female sustained polytrauma in a motor vehicle collision. Glasgow Coma Scale was 15 with no loss of consciousness. Physical exam revealed no neurological deficits and computerized tomography (CT) head was without abnormalities. She was diagnosed with right femoral shaft and left olecranon fractures and underwent intramedullary nailing of the right femur and open reduction and internal fixation of left olecranon. Post-operatively she developed seizure like activity and became somnolent.

Assessment/Results: Magnetic resonance imaging (MRI) brain revealed numerous punctate foci of restricted diffusion and T2 signal abnormality throughout the white and gray matter, suggestive of cerebral fat embolism (CFE). She was transferred to a long term acute care hospital (LTACH) where she demonstrated frequent episodes of confusion, agitation, and restless behavior. Repeat brain MRI two weeks later at the LTACH did not show any abnormalities. She was transferred to acute inpatient rehabilitation, approximately 1-month post-injury. She continued to have neurological deficits, both cognitive and physical. However, admission CT head revealed no abnormalities. During her stay in rehabilitation, the patient improved physically and cognitively. At the time of discharge, the patient was at a supervision level for basic ADLS and mobility; neuropsychological testing showed mild global impairment of cognition.

Discussion: Although the patient had characteristic clinical and imaging findings of CFE in the acute care setting, subsequent neuro-imaging was negative, despite persistent neurologic deficits on admission to inpatient rehabilitation. No other explanation was found for her deficits and the pattern was consistent with previous reports of sequelae of CFE.

Conclusion: Clinicians should consider the possibility of CFE in patients with a history of unexplained persistent neurological impairment after an orthopedic injury even in the absence of subacute or late findings on brain imaging.

Pediatric Firearm-Related Traumatic Brain Injury in United States Trauma Centers

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Objective: Pediatric firearm-related deaths are a national public health concern in the United States and a leading cause of deaths in the American youth. In particular, outcomes following gunshot wounds to the head (GSWH) remain in need of systematic characterization. Here we analyze pediatric GSWH from a population-based sample to identify predictors of prolonged hospitalization, morbidity and mortality.

Methods: Pediatric GSWH patients were extracted from the National Sample Program of the National Trauma Data Bank, years 2003-2012. Predictors included injury intent, firearm choice, injury site, age, Charlson Comorbidity Index (CCI), sex, race, health insurance, geographic region, trauma center level, isolated TBI, emergency department (ED) hypotension, Glasgow Coma Scale (GCS), and Injury Severity Score (ISS). Multivariable regression was performed for outcome measures including hospital length of stay (HLOS), ICU LOS, complications, mortality, and discharge disposition. Statistical significance was assessed at $\alpha < 0.001$ to correct for multiple comparisons.

Results: A weighted sample of 2,847 pediatric GSWH were included. Age was 14.8 ± 3.3 years and 59.0% were severe TBI (GCS 3-8). Assault intent (63.0%), handgun weapon (45.6%), and residential area (40.6%) were of highest incidence. Mean HLOS was 11.6 ± 14.4 days and ICU LOS was 9.3 ± 10.3 days for survivors at discharge. Blood pressure (BP), GCS, and ISS were significant predictors across all outcome measures. Overall mortality was 45.1%; by intent, suicides associated with worse outcomes and the highest mortality (71.5%); by firearm type, shotgun mortality was the highest (56.5%). Versus handgun, hunting rifle resulted in greater odds of complications but lower odds of death; shotgun resulted in better odds of discharge to home for survivable injuries. When compared to injury at a residential area, injury on the street/ highway resulted in greater odds of death and injury at a recreational/sport site resulted in longer ICU LOS. Outcomes varied with insurance, including the private/commercially insured having lower odds of mortality versus the other insurances. Compared to the Midwest, the South had higher odds of complications and lower odds of discharge to home, the Northeast had higher odds of mortality and lower odds of discharge to home, and the West experienced shorter ICU LOS and lower odds of complications. Age was associated with the likelihood of being discharged to home; CCI and race associated with odds of mortality. Compared to level I trauma center, level II trauma center had lower odds of discharge to home.

Conclusions: Hypotension, injury severity, injury intent, and firearm type are important prognostic variables in pediatric firearm-related TBI. Demographics, level of trauma center and geographic region also associated with outcomes. Improved understanding of pediatric GSWH is critical to promoting increased awareness of firearm injuries as a public health concern, and reducing its debilitating injury burden to patients, families, and healthcare systems.

Emergent Neurosurgical Management of a Rapidly Deteriorating Patient with Acute Intracranial Hemorrhage and Alcohol-Related

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Alcohol intoxication is a common risk factor of traumatic brain injury (TBI). A feared sequela of TBI is the development of coagulopathy resulting in worsened intracranial bleeding. Whether alcohol potentiates or antagonizes hemostasis in the setting of head trauma remains unclear. Patients with chronic alcohol use may suffer a spectrum of bleeding diatheses from hepatic dysfunction not well studied in the context of TBI and not effectively diagnosed using conventional markers. Acute intoxication also appears to affect clot formation and fibrinolysis, therefore screening methods using newer tests warrant further investigation as part of the diagnostic arsenal for patients with coagulopathy.

Herein we report the case of a 52-year old man with a history of alcoholic liver disease (ALD) who was found alert and responsive after sustaining an unwitnessed fall. Aside from bleeding due to a scalp laceration, numerous hematomas were present throughout the body suggestive of a chronic antihemostatic state. His initial ED Glasgow Coma Scale (GCS) score of 12 declined to 4 during the brief span of 25 minutes because of space occupying subdural and subarachnoid hemorrhages. Emergent decompressive craniectomy was performed in an effort to mitigate neurologic decompensation, following which the patient was admitted to the neurological intensive care unit (ICU) under TBI protocol to allow for aggressive critical care management.

While elevated blood alcohol level (BAL) is independently associated with decreased consciousness, GCS in the intoxicated trauma patient should always be interpreted at face value during initial assessment as to judiciously intervene to minimize secondary injury following head trauma. Our experience dictates the important and timely consideration of the possibility of rapid deterioration from coagulopathic intracranial bleeding in the initial assessment of intoxicated patients presenting with head trauma of unknown severity.

Cocaine Induced Toxic Leukoencephalopathy Resulting in Severe Persistent Cognitive Deficits: A Case Report

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Introduction: Drugs of abuse remain a common cause of altered mental status requiring emergency medical care. Toxic Leukoencephalopathy (TLE), a disorder of brain white matter caused by exposure to leukotoxic agents has become more evident to clinicians over time given easily identifiable neuro-radiologic components. Many clinical symptoms can accompany the diagnosis of TLE but most often include cognitive dysfunction. TLE has been reported often with opioid abuse but is increasingly being seen with other drugs of abuse since contamination is common. TLE should be considered when evaluating patients with presumed toxic exposure.

Case Report: A 55 yo male with unknown PMH presented to the emergency department after being found unresponsive by a friend after they had snorted cocaine earlier in the night. When EMS first arrived, he had pinpoint pupils as well as bradypnea and was given intranasal naloxone for presumed opioid intoxication. Following naloxone, his respiratory rate improved but not his mental status. On arrival to ED oxygen saturation was 88% on 5L nasal cannula, normal HR, BP and was normoglycemic. He also had spontaneous movement in all 4 extremities but was unresponsive to pain. Initial CT head and laboratory testing was unremarkable. CXR was concerning for aspiration pneumonia and he was intubated for airway protection. It was decided by the primary team to transition to a naloxone drip and monitor in the ICU. He was quickly transitioned to general medical floors given that his overall arousal improved within the following day. After extubation he displayed severe cognitive deficits most specifically in temporal orientation and memory. He would at times have intelligible speech and severe confusion to surroundings and tasks that were intermittent but persistent. An MRI was obtained and showed areas of hyper intensity within the bilateral cerebellar hemispheres, bilateral globus pallidi, caudate nuclei and lentiform nuclei, likely secondary to recreational drug toxicity.

His respiratory status improved with antibiotics and further laboratory work up was overall unremarkable, although a detailed opioid screening tool had not returned by discharge. He was eventually discharged home with supervision given his ongoing cognitive deficits.

Discussion: This patient's cognitive deficits were felt to be due to toxic leukoencephalopathy after reviewing the MRI. The MRI findings are characteristic of previously described cases involving inhaled opioids, most specifically heroin which is known as "chasing the dragon syndrome." In this case, the patient did not report opioid use but given response to naloxone he likely consumed cocaine that was combined with a synthetic opioid which would not present on an initial drug screen. In general, treatment is not standardized and initially involves reduction of toxin exposure and supportive care. Occasionally specific treatments have been indicated such as cholinergic agonists or stimulants for cognitive dysfunction.

Undiagnosed Hearing Loss Resulting in The Underestimation of Consciousness in A Severe Brain Injured Patient: A Case Report

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Setting: Tertiary care rehabilitation hospital

Case Description: A 35-year-old male with history of right sensorineural complete hearing loss suffered a severe traumatic brain injury from a fall and was admitted to a Disorders of Consciousness (DoC) program 10 days after his injury. Computerized Tomography head demonstrated multifocal acute subarachnoid hemorrhages, intraventricular hemorrhage, and intraparenchymal hemorrhages in the midbrain and pons.

Assessment: Scores on the initial Coma Recovery Scale- Revised (CRS-R) performed 12 days after injury were consistent with the patient being in a vegetative state. Repeat CRS-R six days later (day 18) suggested he had progressed to a minimally conscious state (MCS), based on visual tracking. CRS-R performed 30 days after his injury suggested he had emerged from a MCS, based on functional object use. However, 45 days post-injury, as patient continued to improve, severe hearing loss was suspected. Full audiological evaluation revealed bilateral deafness. Although patient had a history of right sided complete hearing loss, the left sided hearing loss was new and determined to be central in origin. A retrospective review revealed that, outside of the CRS-R, patient was actually noted to demonstrate functional object use (manipulating a phone)—indicating emergence from the MCS —14 days post-injury, a full two weeks before the CRS-R was able to detect emergence.

Discussion: The majority of the subscales in the CRS-R are verbally mediated and therefore require intact hearing to perform the behaviors asked for. If patients have hearing impairments, their inability to perform the actions may be misinterpreted as evidence of impaired consciousness, thereby mischaracterizing their true level of consciousness.

Conclusion: Unrecognized hearing impairments can result in the underestimation of the level of consciousness in the DoC population. Clinicians should keep the possibility of occult hearing loss in mind, especially if there is a dissociation between qualitative clinical observations and findings on the CRS-R.

Dance and Movement-Based (DMB) Therapy in TBI Rehabilitation Using Laban Movement Analysis (LMA)

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Dance and Movement-based (DMB) Therapy has been an emerging bodily-kinesthetic treatment modality in TBI rehabilitation as a means by which to integrate the mind, body, and spirit (physical, cognitive, and psycho-social dimensions) within one approach. Studies in neurophysiology have revealed that bodily-kinesthetic experiences produce learning that establishes exceptionally strong neural pathways in the brain and that when individuals participate in this type of learning, the two hemispheres of the brain are simultaneously engaged and produce long term memory. The neurophysiological literature supports the argument that the mind and body are inter-connected and communicate together to form a unified integrative self and that movement increases bodily-kinesthetic, proprioceptive, tactile, and vestibular reception. These fundamental sensory-motor functions are critical to the physical, cognitive, and psycho-social restructuring and integration when a TBI occurs, as they are all inter-related.

LMA is a systematic method for observing, describing, and analyzing qualitative and quantitative changes in human movement by providing a comprehensive vocabulary and analytic framework through four basic components - Body, Effort, Shape, and Space (BESS). LMA is a means of perceiving and a language for documenting movement applicable to any body movement research. Symbols have been developed to correspond with the terminology.

Post TBI, an individual's sense of self is often altered requiring an integrative mind-body approach to aid in (re)discovering a sense of self and connection with the environment. The therapeutic DMB intervention employs and promotes a creative and expressive technique to assist individuals with learning their capabilities and limitations. Its process encourages individual movement experiences from a functional and expressive perspective. Conventional therapies are functional and body oriented in nature. Creative and expressive movement activities support the ability to discover what one can do with an awareness of how one feels about the experiences. As a result, therapeutic DMB intervention imparts an integrative mind-body methodology to learning about one's Inner and Outer self and one's ability to cope with and connect to one's environment.

Movement practitioners in the healthcare field often find themselves identifying with one end of the Function-Expression polarity. Conventional physical therapy, for example, helps strengthen and stretch specific muscle groups. From this perspective, the goal is to improve strength and flexibility. One's personal experience is not a component of the intervention. DMB therapy provides the balance between function and expression as a component of participation.

The use of LMA provides an observational and analytic tool to clearly illuminate the intricate and subtle aspects of movement at a micro and macro level. A holistic understanding of each individual's challenges and attributes emerge, which in turn provides practical treatment strategies for the individual.

This paper explores the implications of a therapeutic DMB intervention in TBI rehabilitation using Laban Movement Analysis (LMA) techniques.

Earlier Time to Aerobic Exercise Associated with Faster Recovery Following Acute Sport Concussion

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Importance: Despite the growing evidence supporting aerobic activity post-concussion, the optimal time point to initiate aerobic exercise following an acute concussion has yet to be determined.

Objective: To determine whether earlier time to initiation of aerobic exercise following acute concussion is associated with time to full return to sport and school or work.

Design, Setting, and Participants: A retrospective survival analysis of acute (<14 days) physician diagnosed concussion presenting to an academic sports medicine clinic between October 2016 to October 2017.

Exposure: Time (days) to initiation of aerobic exercise post-concussion.

Main Outcomes: Time (days) to full return to (1) sport and (2) school or work.

Results: A total of 204 acute concussions (median [IQR] age, 17.0 (15.0-20.0) years; 115 (56.4% males) were included in this study. Multivariate Cox regression models identified that earlier time to aerobic exercise was associated with faster return to sport and school or work adjusting for other covariates (e.g., initial symptom burden). Exposure to aerobic exercise within 24 hours of injury was associated with the fastest return to school and school or work. For each successive day in delay to initiation of aerobic exercise, individuals had a less favourable recovery trajectory. Initiating aerobic exercise at 3 and 9 days following injury was associated with a respective 26.2% (HR, 0.74; 95% CI, 0.49-1.11) and 73.6% (HR, 0.26; 95% CI, 0.07-0.96; $p < 0.001$) reduced probability of faster full return to sport; and a 51.3% (HR, 0.50; 95% CI, 0.31-0.78,) and 92.2% (HR, 0.08; 95% CI, 0.02-0.34; $p < 0.001$) reduced probability of faster full return to school/work.

Conclusion and Relevance: Earlier initiation of aerobic exercise was associated with faster full return to sport and school or work. This study supports the growing body of literature supporting an active rehabilitative approach to the management of concussion; however, provides greater insight into the benefits of aerobic exercise within the first week of the injury.

The Association Between University Sport Participation and Well-Being of Former Athletes in Mid-Adulthood: A Focus on Prior Concussions and Sport Type Played

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Rationale: Sport-related concussions (SRC) have been associated with an increased risk of long-term cognitive, neurobehavioural, and psychiatric issues. Similar findings have also been reported among former collision sport participants. However, research to date has primarily examined former professional male athletes. It is unclear if these findings are generalizable to all athletic populations.

Objective: To examine the association between sport participation and long-term well-being in a group of middle-aged male and female former university athletes across all types of sports, with specific focus on prior concussions and type of sports played.

Design, Setting, and Participants: Retrospective cross-sectional cohort study. 384 university graduates (age range: 30-45 years old) were recruited, stratified by: (1) Former university athletes (n = 343) and (2) university non-athlete graduates (n = 41).

Measures: Beck Anxiety Inventory (BAI), Center for Epidemiological Studies Depression Scale (CES-D), Short-Form 36 Health Survey (SF-36), Satisfaction with Life Scale (SWLS), Perceived Deficits Questionnaire (PDQ), and Alzheimer Disease-8 (AD-8) questionnaire.

Results: Former athletes were found to report fewer depressive symptoms, a greater mental health status, higher life satisfaction, and a greater physical health status compared to non-athletes. Specific to concussion, athletes with a history of concussion reported more symptoms of anxiety than athletes without a history of concussion. After controlling for history of concussion, gender, and age, no association was identified between sport type and well-being.

Conclusion and Relevance: Results from this study suggest former athletes in mid-adulthood generally report greater status of well-being compared to non-athletes. Furthermore, compared to previous research examining former professional athletes, prior concussions and participation in collision sports at the university level do not result in profound negative health outcomes in mid-adulthood.

Substandard Impact Performance of Common Bicycle Helmets

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Bicycling generates more emergency department treatments for traumatic brain injuries in children and adolescents than all other sport/recreational activities (Gilchrist, 2011). Bicycle helmets sold in the US must be certified to the Consumer Product Safety Commission (CPSC, 1998) standard requiring peak headform accelerations of <300g for impacts above a prescribed “test line”. The test line is used to define the region of the helmet that is subject to testing. This region includes the cephalad portion of the helmet, but typically does not include the helmet’s lower edge and thus does not cover the location of many real-world impacts we see in our forensic work. The CPSC standard is self-certifying, which means manufacturers test and certify their own helmets. As a result, compliance data are not publicly available.

Our goal was to investigate the impact performance of CPSC-certified bicycle helmets at impact locations below, on and above the test line to determine how impact performance declines below the test line. We tested 12 popular helmet models including kids helmets (MEC Dash, Stoneridge Dora), traditional vented helmets (Bell Adrenaline, Giro Revel, Smith Overtake, POC Octal Raceday, Fox Flux) and hard-shell BMX style helmets (Bell HUB, Bern Macon EPS, Schwinn Pharos, Bell Trans, Nutcase Street Gen 3). Impact locations were chosen based on each helmet’s geometry and were located on and in increments of about ± 1.5 cm from the test line on the front, side and rear of the helmets. Ten to 28 impacts were conducted per model with each helmet subjected to 1 to 3 impacts. Peak headform linear acceleration was measured.

Across all 181 impacts, the helmets generally had higher accelerations for impacts near the lower edge compared to more cephalad regions. At and above the test line, half of the helmet models (Bell Adrenaline, Smith Overtake, Fox Flux, Bern Macon EPS, Schwinn Pharos, Bell Trans) exceeded 300g (range 306 to 916g) for between 1 and 15 impacts per model. All but one model (Nutcase Street Gen 3) exceeded 300g in at least one impact at any location. Most helmets exceeded 300g because of inadequate energy absorbing liners, inadequate retention systems, or features (e.g., rivets) that directly contacted and dented the headform.

We found that half of the helmets failed to meet the CPSC standard at or above the test line. While more tests are needed across a wider range of helmets, our data suggest that many popular bicycle helmets do not meet the standard and therefore may be exposing bicyclists to an increased risk of head and brain injuries.

CPSC 1998. Safety Standard for Bicycle Helmets; Final Rule, 16 CFR Part 1203. Bethesda, MD.

Gilchrist J. Centers for Disease Control and Prevention, MMWR. 2011;60:1337-1342.

Speech Cognitive Therapy and Cognitive Symptom Improvement in Patients with Traumatic Brain Injury as A Result of Domestic Violence

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Domestic violence is a public health crisis which affects both women and men at alarming rates. Injuries to the head, neck and face are among the most common types inflicted by abusers, which leads to often repetitive traumatic brain injury (TBI) over many years. As a result, victims often suffer chronic cognitive symptoms which significantly impact their work, family and social responsibilities. We conducted a retrospective chart review to assess the impact of speech cognitive therapy for patients who suffered TBI as a result of domestic violence, to determine if cognitive symptoms can be improved with therapy. A total of 14 patients who received speech cognitive therapy were age matched to patients for whom therapy was recommended, but not completed, to assess symptom improvement using a symptom severity scale. Patients were seen in follow up in a neurology clinic and severity scales were collected from visit notes. Data was analyzed graphically via scatter plot, and both trend lines and Pearson correlation coefficient were calculated. Overall, five of eight cognitive symptoms assessed showed greater improvement in the treatment group, and average cognitive symptoms were more improved with therapy than without. Although this is a small sample size, these results indicate speech cognitive therapy can be helpful in cognitive recovery for this population.

Interprofessional Pediatric Treatment Model Plays Critical Role in Recovery Process: Case Study of 8-Year-Old Child with Catastrophic Brain Injury from Gunshot

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Too often a child with traumatic brain injury is discharged to home once a hospital deems him medically stable even if that child is still incontinent, wheelchair-bound, on a G-tube, hearing and vision impaired, and has severe language deficits. This is understandable from the hospital's perspective of medical cost. It is understandable also that parents would want nothing more than to tuck their child in his own bed again every night. For the child who goes directly from the hospital to home, however, there is no way to measure the functional gains missed by skipping the step of post-acute inpatient rehabilitation where an interprofessional pediatric team guides the intervention: one cannot quantify what one doesn't have.

Children with traumatic brain injury who are discharged straight to home can present a burden of dependence on caregivers already buckling under tremendous financial and emotional strain. The less able a child is to participate in life independently, the greater the burden on communities, families, and health care providers alike. The scope of dependence in childhood post injury can have an inverse relationship to the scope of independence in adulthood: the less dependent a child becomes, the better the prognosis for independence in adulthood.

This presentation will report on a case study of a child who suffered unspeakable trauma at the hands of his mother, and will discuss the interprofessional pediatric treatment model which enabled the rehabilitation team to facilitate the child's recovery across every domain in ways it would be hard to argue could have been attained had he discharged straight to home from the hospital once he was medically stable.

A Comparison of Female vs. Male Symptom Reporting on Baseline Concussion Testing Across the Pre-Adolescent to Late Adolescent Age Span

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Background: There is developing knowledge on female vs. male symptom reporting on baseline concussion testing, with research suggesting that females report more symptoms. However, the research that is available focuses on adolescent and older populations. This study sought to examine gender symptom reporting patterns extending down to the pre-adolescent age group.

Method: A retrospective study of 11,695 10 to 22-year-old athletes' baseline assessments were utilized and assigned to three groups: Pre-adolescent 10 to 12-year olds (n=1367; 12%), Adolescent 13 to 17-year olds (n=2974; 25%), and Late Adolescent 18 to 22-year olds (n=7354; 63%). Baseline Post-Concussion Symptom Scale scores (Total, Physical, Cognitive, Emotional, Sleep) were analyzed for the effects of age and gender.

Results: Significant main effects ($p < .05$) were found for age and gender on all Total Symptoms Scores and Symptom factors. Likewise, significant interaction effects were found between age and gender for all Total Symptoms Scores and Symptom factors. Importantly, in the 10 to 12 age group, females displayed lower Total Symptoms, Physical, and Sleep factors than males.

Conclusions: Females revealed greater emotional symptom endorsement across the youth age span (10-22 years). However, in the pre-adolescent age group, females did not appear to report more total symptoms than males, in comparison to the older age groups. The findings support a pattern of greater symptom reporting by females in the older groups, possibly due to the influence of physiological and hormonal factors on female development.

Prediction of The Outcomes in Pediatric Ischemic Stroke: Multilayer Perceptron Vs Random Forest Learning Methods

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We compared the predictive capabilities of the two machine learning methods Multilayer Perceptron (MLP) and Random Forest (RF) in the task of predicting the options of the outcomes "no disability" and "disability" after pediatric ischemic stroke using the data on the presence of 12 genetic polymorphisms.

Materials and Methods: Case series: data of 172 patients with pediatric arterial ischemic strokes, MRI brain confirmed. Thirteen independent variables: sex, data on the carriage of polymorphisms of the 8 thrombophilic genes (FGB: -455G>A, F2:20210G>A, F5:1691G>A, F7:10976G>A, F13:103G>T, ITGA2:807C>T, ITGB3:1565T>C, PAI-1: -675_5G>4G) and 4 folic acid enzymes genes (MTHFR:677C>T, MTHFR:1298A>C, MTRR:66A>G, MTR:2756A>G). The sex was coded as 0 (girl) and 1 (boy). The number of genetic polymorphisms was coded as 0 (polymorphisms absent in both alleles), 1 (one of the alleles has polymorphism) and 2 (both alleles are represented by polymorphisms).

Dependent Variable: disability for neurological indicators - 0 (no disability), 1 (disability). The sample (172 records) was randomly divided into a training subsample (120 records) and a test subsample (52 records). "Disability" was assessed after at last 2 years after stroke and interpreted as the state that is required constant external support and replacement of irreversibly lost functions of the nervous system.

The architecture of the Multilayer Perceptron (MLP-38-10-2 with the exponential activation function) and the number of trees in the Random Forest (62) were chosen based on minimizing classification errors on the test subsample. The precision, sensitivity and specificity of the trained models were determined on the test subsample.

Results and Discussion: Trained models showed the following results. Multilayer Perceptron (test subsample): precision = 0.88, sensitivity = 0.73, specificity = 0.90. Random Forest (test subsample): precision = 0.67, sensitivity = 0.43, specificity = 0.76.

The Multilayer Perceptron showed an advantage over the Random Forest in all three indices (precision, sensitivity, and specificity). In particular, the sensitivity of the Random Forest (0.43) makes it unsuitable for forecasting the outcome of "disability". In this case, the Random Forest can only be used as a "specific" classifier. Both models have a relatively low sensitivity compared to their specificity. This may indicate that in this sample there are no informative predictors of disability. However, the ability of the Multilayer Perceptron with a high probability of correctly rejecting the outcome of "disability" may indicates the presence in this sample of informative predictors of recovery lost as a result of pediatric ischemic stroke functions.

Conclusion: Thus, in the task of predicting the outcome of a pediatric ischemic stroke, a Multilayer Perceptron can be used as both a sensitive and a specific classifier, while a Random Forest can be used only as a specific classifier.

This work was supported by grant Russian Science Foundation 18-015-00290 A.

Gender Differences in Long-term Impulse Control Problems Following Concussion

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Concussions are a growing concern among both male and female young adults. The resulting cognitive impairments affect both sexes; however, previous research has shown that there are differences in the type and extent to which these deficits affect both sexes. Additionally, disparities may exist in the number of concussions suffered, as well as the type and severity of long-term cognitive effects. In this study, we aimed to assess these differences through a battery of tests that analyzes executive functioning, attention, and delayed memory. The number of concussions suffered by each of the participants was recorded to establish if a difference exists between the percentage of females and males who receive concussion and the number of concussions each group suffered. Data was collected from a random sample of roughly 90 undergraduate students aged 18-22. This group included 34 males and 54 females who were classified as concussed or non-concussed individuals. Our battery included the Repeatable Battery for the Assessment of Neuropsychological Status Update (RBANS), the Barkley Deficits in Executive Functioning Scale (B-DEFS), and the Delis Kaplan Executive Function System (D-KEFS). EEG data was gathered to assess frontal lobe activity during a resting state and under cognitive demand. Results indicate impulse control affects males more so than females. Significance was shown in RBANS and Barkley in regard to male subjects demonstrating more impulse control, whereas no significance shown in DKEFS. Trends indicate a disparity between male and female performance on delayed memory tasks; however, a greater number of participants is needed to establish significance. We also found that 31% of female participants and 44% of male participants suffered one or more concussions. Additionally, males were shown to suffer a greater number of concussions. These results confirm that concussions impact males and females differently, which may indicate a need for gender-based assessment and treatment.

Deficit of Visual Memory in Delayed Recall Condition in ADHD Children

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It is known that children with ADHD have deficit in prefrontal cortex function including deficit in working memory (Martinussen et al., 2012). In our previous research we have revealed that ADHD children have deficit in memory for faces and for names in delayed recall condition (Kiselev & Lvova, 2014; Kiselev & Lvova, 2016).

The goal of this research was to examine the hypothesis that children with ADHD have deficit in visual memory in delayed recall condition.

The experimental group included 17 children with ADHD at age 8-9-years. The control group included 17 typically developing children. The children from experimental and control group were matched for IQ, gender and age.

Children from both groups were assessed with visual memory subtest from Luria's neuropsychological assessment battery. This subtest is designed to assess the ability to perform visual memory for objects in immediate and delayed conditions. Two-way ANOVA was used to reveal group differences in reproducing the objects in two conditions.

We have not revealed significant differences between children from experimental and control group in the reproducing the objects in immediate condition. However, the interaction of condition type and group was significant ($p \leq 0,05$). ADHD children were less successful in reproducing the objects in delayed condition. In view of the obtained results, it can be assumed that children with ADHD have specific (not global) deficit in memory in delayed recall condition.

The research was supported by Russian Foundation for Basic Research, grant № 15-06-06491A.

The Predicting Possibility of Stroke-Related Seizures and EEG for Post-Stroke Epilepsy in Children with Arterial Ischemic Stroke

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Introduction: Pediatric arterial ischemic stroke (PedAIS) often has seizures in acute period of disease, but it is unknown whether they continue to be the epilepsy later or not.

Methods: Type of study: cohort forecast study. We investigated type of seizures and EEG features in acute period of PedAIS in 161 children diagnosed with ischemic stroke (I63.0-I63.9 ICD-10). PedAIS was confirmed by brain CT (MRI) scan; all patients had informed consent form. The period of observation lasted 3 years. Post-stroke epilepsy (n=25) was recognized in accordance with recommendations of the International League Against Epilepsy criteria (2014), all patients received prolonged antiepileptic therapy. The control group (n=136) included patients which have never been diagnosed with epilepsy during the observation period, regardless of the presence or absence of seizures in the acute phase of stroke.

Results: The incidence of seizures in the acute period of PedAIS was 31,1% (n=50) and antiepileptic drugs were prescribed to majority of them. The incidence of post-stroke epilepsy after 3 years has been rarely – 15,5% (n=25).

The prognostic value of seizures and EEG data in acute period of PedAIS (only significant data): seizures within first 5 days of stroke OR=10,73 (19 cases vs 31 controls, 3,86-29,80 CI95%, Fisher 0,0000); generalized type of seizures OR=5,68 (12 cases vs 19 controls, 2,22-14,57 CI95%, Fisher 0,0003); focal type of seizures with secondary generalization OR=16,75 (5 cases vs 2 controls, 2,94-95,49 CI95%, Fisher 0,001); focal epileptiform activity on EEG OR=4,61 (5 cases vs 7 controls, 1,30-16,34 CI95%, Fisher 0,022); non-epileptic focal changes on EEG OR=2,99 (6 cases vs 13 controls, 0,99-9,01 CI95%, Fisher 0,05).

Conclusion: The mere presence of seizures in acute period of PedAIS, as well as a certain type of seizure (generalized or focal with secondary generalization) can increase the risk of post-stroke epilepsy more than five times. The specific type of changes in the EEG (epileptic focal and focal epileptiform activity) also has a prognostic value in relation to post-stroke epilepsy as the outcome of PedAIS.

This work was supported by grant Russian Science Foundation 18-515-00008

The Deficit of Brain Holistic Mechanism in Russian-Speaking Children with Specific Language Impairment

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Children with specific language impairment (SLI) have difficulties producing and understanding language (Bishop, 1997). The brain mechanism of this developmental disorder is still not understood.

The goal of this research was to examine the hypothesis that children with SLI have deficit in brain holistic mechanism.

Experimental group included 20 Russian-speaking children with SLI at the age of 6-7. The control group consisted of 20 children. The children from experimental and control group were matched for IQ, gender and age. We used the Rey-Osterieth Complex Figure Test to assess the brain holistic mechanism in children. There is opinion that part-oriented strategy in copying Complex Figure is related to weakness in holistic processing (Luria, 1973).

One-way ANOVAs by group revealed significant differences ($p \leq 0,05$) between the groups for number of spatial errors in the Rey-Osterieth Complex Figure test. Most important, in comparison to children from control group the majority of children with SLI (70 %) had immature (part-oriented) strategy in copying Complex Figure.

In view of the obtained results it can be assumed that children with specific language impairment have deficit of the specific brain mechanism responsible for holistic processing.

Mild Traumatic Brain Injury and Vestibular Function: Current Trends and Future Prospects

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The vestibular system is the sensory system that plays a dominant role in postural control, eye-head coordination and perception of our orientation in space. Normal vestibular function is necessary in carrying out activities of daily living (eg, walking and riding in a car) and is of particular importance in higher demand activities (eg, sports-related activities). Disruption or damage in the vestibular system can result in symptoms such as movement-related dizziness, blurry vision, difficulty maintaining balance with head movements, and even nausea. Dizziness is one of the most common symptoms following mild traumatic brain injury (mTBI), or concussion, and is considered a risk factor for a prolonged recovery. Peripheral vestibular structures of the inner ear provide sensory neural input related to both angular and linear accelerations head accelerations. The two distinct sensory mechanisms include the semi-circular canals (SCCs), which detect angular head accelerations, and the otolith organs (utricle and saccule) that detect linear head accelerations. The SCCs provide the sensory neural input related to angular head acceleration, which is processed to coordinate compensatory eye and head movements via the vestibular ocular reflex (VOR). The otolith organs provide sensory neural input related to linear head acceleration. The utricle senses linear movements of the head in the horizontal plane, while the saccule senses linear movements of the head in the vertical plane. Additionally, the otoliths convey information about spinal and leg musculature for balance strategies (ankle, hip, and stepping) via the vestibular spinal reflex (VSR), which is primarily to maintain upright posture during movement. Because these 2 functional vestibular networks do not share identical neuronal circuitry, it is possible to have impairments of the VOR without impairments of the VSR. Assessment of these reflexes is critically important following mTBI, in conjunction with oculomotor control, due to the intrinsic neural circuitry that exists between the ocular and vestibular systems and the prevalence of visual-vestibular disorders with head trauma. Successful treatments depend on an accurate diagnosis to guide a management strategy. The purpose of this presentation is to review the physiology of the vestibular mediated reflexes and the visual-vestibular symptoms associated with mTBI and to discuss assessment and treatment guidelines for mTBI. Current trends and future prospects will also be addressed.

Dynamic Cerebral Autoregulation Impairment at Rest and During Physical Stress Persists Despite Symptom Resolution in Collegiate Athletes Following Concussion

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Objectives: Animal and human studies have consistently reported deficits in cerebral blood flow (CBF) following concussion suggesting impairments in CBF regulation. The pathophysiological sequelae of the injury are still poorly understood despite a high incidence of concussion occurring annually. Therefore, the purpose of the study was to examine dynamic cerebral autoregulation (dCA) in a prospective cohort study in collegiate athletes day-3, day-21, and day-90 following a concussion and compare them with non-injured controls.

Materials and Methods: Twenty-seven NCAA and recreational athletes (20±1 years) with a physician diagnosed sports-related concussions were enrolled in the study. For the injured athletes, data was collected on days 3, 21, and 90 following concussion. Twenty-five age and sports matched non-injured controls (20±1 years) were also enrolled in a cross-sectional design. Symptom number and severity was measured using the Sports Concussion Assessment Tool (SCAT-3). Depression scores were assessed with Patient Health Questionnaire-9 (PHQ-9). Continuous mean arterial blood pressure (MBP) (finger photoplethysmography) and middle cerebral artery blood flow velocity (MCAV) (2 MHz transcranial Doppler ultrasonography) was obtained while subjects were seated in an upright position (rest) and during a 5-minute squatting exercise at 0.1Hz. dCA was estimated from transfer function (Tf) analysis of beat-to-beat spontaneous fluctuations in MBP and MCAV within the low (LF, 0.07-0.20 Hz) and high (HF, 0.20-0.35 Hz) frequency ranges. Effective dCA attenuates the fluctuations in MCAV in response to spontaneous fluctuations in MBP, corresponding to a low transfer function (Tf) gain value. Independent and paired t-tests were used to compare dCA between days 3, 21, and 90 following concussion with the non-injured controls.

Results: Compared to the controls, concussed athletes exhibited greater symptom number (12.2±6.8 vs. 2.4±3.4; p<0.001) and higher PHQ-9 score (8.7±5.6 vs. 2.1±2.1; p<0.001) on day-3. LF Tf gain at rest was higher on day-3 (1.26±0.34U vs. 1.04±0.28U; p=0.016) compared to the controls. LF Tf gain continued to be high on day-21 (1.30±0.45U; p=0.025) compared to the controls despite no differences in symptoms of depression scores between the groups. LF Tf gain during exercise was higher on day-3 (1.5±0.34 vs. 1.05±0.29 U; p=0.001) and day-21 (1.47±0.22U; p=0.0009) compared to the controls. LF Tf gain normalized at rest and during exercise trial compared to the controls on day-90.

Conclusions: Dynamic cerebral autoregulation is impaired in the sub-acute phase, at least up to 21 days, following concussion despite improvement in symptom and depression. Cerebral autoregulation worsened during a physical stress in the sub-acute phase. CBF regulation estimated from transcranial Doppler ultrasonography may be useful in tracking physiological recovery and preventing the risk of second-impact syndrome in collegiate athletes.

The Neurocognitive Development of Premature Infants At 10 Months of Age

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Background: It was shown that prematurity is a risk for neurodevelopmental disorders, particularly for ADHD and autism [Anderson & Doyle, 2008]. However, the impact of prematurity on neurocognitive functions in the early stages of development is not investigated thoroughly. We have revealed that prematurity has specific (not global) negative effect on neurocognitive development in premature male infants at 5 months age (Kiselev et al., 2017). The aim of this research was to reveal the differences in neurocognitive development in premature and mature full-term infants at 10 months of age.

Method and Participants: The participants were 26 premature male infants at 10 months of corrected age and 27 age-matched healthy full-term male infants. The gestational age of preterm infants was between 29 and 35 weeks. The Bayley Scales of Infant and Toddler Development (3rd Edition) were used to evaluate the neurocognitive abilities in infants.

Results: The results were evaluated by one-way ANOVA, with level of performance in five Bayley scales as dependent variable, with group as between-subjects factors. Premature infants performed significantly ($p \leq 0,05$) more poorly than the full-term infants on cognitive scale, receptive language, gross and fine motor. No significant ($p \leq 0,05$) differences were found between preterm and full-term infants on expressive language.

In view of the obtained results it can be assumed that the prematurity has specific (not global) negative effect on neurocognitive development in premature infants at 10 months age.

Funding: The research was supported by grant of the Russian Science Foundation №16-18-10371

Medicaid Funds Allocated to Brain Injury Patients in a State with Few Resources

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The CDC and DHHS have documented traumatic brain injury as a leading cause of long-term disability in children (CDC, 2014) that occurs with greater prevalence in families of lower socioeconomic status (USDHHS, 2013). Overall health care service patterns in Medicaid patients are often significantly different from those of the privately insured, presenting unique challenges in terms of accurate diagnosis, long-term management, and coordination of care. Variable patterns of failing to seek medical care, accessing primary care in emergency departments, depending on ongoing care from providers without specialized training in TBI, and reduced access to outpatient rehabilitation all impact patient recovery, allocation of funds, and program development. These types of data collections are often a result of research generated by states, universities, and healthcare systems with significant grants and resources devoted to traumatic brain injury. However, little is known about how patterns of access to brain injury services are different in states without similar resources.

The South Carolina Brain Injury Leadership Council sought to answer this question with a retrospective study of Medicaid claims paid (2010-2015) for all ages by TBI diagnostic code, procedure code, and type of medical provider. Between 9-12 million dollars was spent annually (mean = 20,397 patients) linked to the diagnostic codes included, with equal distributions across gender but significant variability across counties in the state. Majority of monies spent were for patients over the age of 21 (33 million over 6 years) with concussion-related diagnoses and other related independent codes (often omitted from similar TBI studies). Medical specialties are ranked from most to least compensated (services reimbursed and dollars spent), with hospital-based specialty evaluation (radiology, in particular) and emergency medicine far exceeding outpatient primary medicine (despite prevalence of mild TBI codes). Rehabilitation services (PT, OT, or SLT) are noticeably absent from the claims paid, as are psychological or psychiatric evaluation or treatment. Additional comparisons are made among age groups, gender, and race allowing further consideration of variability in access to inpatient and outpatient specialty care depending on demographic variables.

Especially for states like South Carolina, accurate data regarding current Medicaid services provided and reimbursed is critical to ongoing efforts to remedy deficits in TBI care for this population. While clear limitations to data set exist, findings suggest that physicians and hospitals may choose to reduce services to this population if claims are not paid or services and funds are not allocated wisely. Efforts are also made to place the current data in a national context in terms of Medicaid funds spent on services for patients with traumatic brain injury.

Coach Perception of On-Field Decision Making and Availability of Tools to Identify Sport-Related Concussion

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Background: Sport-related concussion is a growing public health concern in the United States youth population. 13.5 million children age 6-13, and 8 million adolescents age 14-17 play sports. An estimated 1.1 to 1.9 million sport or recreation related injuries occurring annually in children 18 years old and younger in the United States. The purpose of this poster is to explore coaches' perceptions about concussion during play and the availability of tools to aid in that decision-making on the field.

Methods: Exploratory, qualitative, interview design. 1:1 semi-structured interviews conducted with key professionals or volunteers who work with children at risk for sustaining concussion. Participants were recruited from one suburban school district, a youth soccer club, a suburban park district, a rehabilitation and a children's hospital. A purposive sampling method was utilized. Healthcare professionals, coaches, athletic trainers and educators with at least 6 months of experience working with youth were eligible to participate. Audio interviews were transcribed. Thematic analysis and comparative approaches were used to develop codes and a codebook using NVivo 11.

Results: 16 participants completed the interviews. Fifty-six percent were female ranging in age from 29 to 57 years old. All participants self-identified themselves as white/Caucasian. The majority (n=12) were paid professionals, with two volunteer coaches and two serving dual roles as paid professionals and volunteer coaches. Those participants employed by a school made up 56% of the sample and were evenly distributed among elementary (n=3), middle school (n=3) and high school (n=3). Medical professionals included athletic trainers, physical therapists, physiatrist and a speech language pathologist. Four independent themes emerged related to stakeholder perceptions regarding youth concussion. These themes were: availability, usefulness and acceptability of education content and delivery, decision making readiness and availability of decision making tools, perceived parental navigation of concussion and awareness and impact of the Illinois Concussion Safety Act. We focus on results from the decision-making readiness and availability of decision making tools theme. Volunteer and paid coaches without medical training indicated a need for tools to aid their decision making on the field, especially when access to athletic trainers or other medical professionals was not available. The majority expressed discomfort in making decisions about removing a child from or returning them to play based on their knowledge about concussion.

Conclusions: The availability of non-medical or professional decision-making tools needs to be addressed. Further study of the use of these tools on the sideline by non-medical personnel is also warranted. Further study of the decision-making process coaches utilize to identify potential concussion is necessary in order to develop evidence-based practices for primary and secondary management of youth sport-related concussion.

Medicaid Funded Brain Injury Related Rehabilitation Services in South Carolina

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Even though traumatic brain injury is a leading cause of long-term disability in children (CDC, 2014) and occurs with greater prevalence in families of lower socioeconomic status (USDHHS, 2013), these children are often under-identified and under-served in schools. TBI Model System Centers increase access to multidisciplinary services, generate important research, and provide valuable education to community and state agencies, increasing the chances that all children in those states will have access to the services they need. Access to community-based evaluation and rehabilitation services can be limited for Medicaid patients living in states without these resources, putting an increased burden on schools as the primary provider of many important health-related services.

The South Carolina Brain Injury Leadership Council utilized a retrospective study of Medicaid claims paid (2010-2015) for all ages by TBI diagnostic code, procedure code, and type and location of medical provider. Between 9-12 million dollars was spent annually overall (mean = 20,397 patients) and original sample was divided in age groups (0-5, 6-12, 13-20, >21) allowing comparisons. Rehabilitation services (PT, OT, or SLT) are noticeably absent from the community-based claims paid for all ages and diagnoses, as are psychological or psychiatric evaluation or treatment. A specialty category labeled Developmental Rehabilitation (DR) by Medicaid gave investigators hope that perhaps school-age children were accessing these providers and services at school. Examination of individual procedure codes revealed, however, that DR services paid were almost solely visits to the school nurse and very rarely speech therapy, occupational therapy, physical therapy, or psychological evaluation or intervention. If claims are being filed but never paid, significant but different concerns remain as well.

South Carolina is without any formal TBI/concussion-related return-to-learn policies or procedures. While many argue that return-to-learn legislation may not be essential for proper care, children living in states without it may suffer as a result of limited information and services. Without school-based evaluation and rehabilitation services, socioeconomic discrepancies are felt more intensely by families in terms of identification and management of needs. Medicaid reimbursement and IDEA funding are intended to support these services for all children with disabilities in schools, and the absence of these funds places important programs at risk. If services are being provided but not reimbursed, SC school districts and outpatient rehabilitation providers clearly need assistance in more effectively filing claims. Although current study was intended to assist SC legislators, providers, and agencies in addressing unmet needs, current findings fill an important void in national data collection efforts and contribute to the larger conversation related to supporting children with brain injuries of all severities in the classroom.

Innovative Approach Using Neuromodulation Techniques as a Treatment for TBI Related Cognitive Impairments

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Background: An estimated 3.2 to 5.3 million Americans are living with TBI related disability. Impairments, such as cognitive deficits, can persist for years after injury and are known to interfere with daily function ultimately preventing successful return to work and pre-injury activities. Directed attention training has been shown to effectively improve cognitive test performance, however, evidence for maintained benefits and transference to daily function is limited or mixed. Transcranial direct current stimulation (tDCS), a noninvasive method for altering cortical excitability, has gained popularity since the late 1990s due to its potential to safely alter cortical activity theorized to enhance cognitive function in neurologic disorders. Preliminary evidence for use of tDCS in cognitive rehabilitation for Parkinsons Disease, Alzheimer’s Disease and stroke show promise, however, further evidence is needed to determine when tDCS should be applied in coordination with cognitive rehabilitation (i.e. before, during or after therapeutic tasks). Additional evidence suggests attention training combined with tDCS for TBI improves maintenance of the attention training benefits one month after tDCS.

Methods: Single blind, randomized, controlled pilot project. 10 participants will be randomly assigned to receive real or sham tDCS paired with Attention Process Training-III (APT-III). All participants will receive 15 treatment sessions. Site of anodal tDCS will be over the right dorsolateral prefrontal cortex (DLPFC). The primary outcome measure is the Symbol Digit Modalities Test. Additional outcome measures will include: Test of Everyday Attention, Conners’ Continuous Performance Test, Paced Auditory Serial Addition Test, Performance Assessment of Self Care Skills and the Patient Reported Outcome Measurement Information Systems – Global Health.

Results: No results will be reported with this poster. Content will focus on the design of an innovative experimental intervention combining tDCS and APT-III. This is a unique treatment designed according to evidence of the role of neural networks supporting cognitive function, brain priming, and established principles of exercise-dependent plasticity combined with an evidence-based attention training program. The dosing strategy chosen for this study is based on the premises of brain priming using brain stimulation techniques and activity dependent plasticity using proven attention training techniques during brain stimulation. The site of stimulation, right DLPFC plays an integral role in working memory and attention. We hypothesize that by providing the anodal tDCS over the right DLPFC prior to and during attention training activities, the neural environment is heightened with increased cortical excitability.

Conclusions: tDCS will be shown to be a safe, innovative and feasible neuromodulatory treatment to enhance more traditional computerized attention training. This study is designed to determine if these treatments may have an impact on activities outside of the trained cognitive components of attention when utilized in a rehabilitation model of treatment over five to six weeks.

Body-Oriented Therapy Can Impact Executive Abilities In 6-7 Years Age Children With ADHD

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Background: It is known that children with ADHD have deficit in executive abilities. The goal of this study was to reveal the effect of body-oriented therapy on executive abilities in 6-7 years age children with ADHD. We compared the efficacy of two methods of treatment (body-oriented therapy for children vs. conventional motor exercises) in a randomized controlled pilot study.

Methods and Participants: 18 children with ADHD between 6 to 7 years of age were included and randomly assigned to treatment conditions according to a 2x2 cross-over design. The body-oriented therapy included yogas' exercises and breathing techniques.

To assess the executive functions and attention in children we used 5 subtests from NEPSY (Tower, Auditory Attention and Response Set, Visual Attention, Statue, Design Fluency). Effects of treatment were analyzed by means of an ANOVA for repeated measurements.

Results: The ANOVA has revealed ($p < .05$) that for all 5 subtests on executive functions and attention the body-oriented therapy was superior to the conventional motor training, with effect sizes in the medium-to-high range (0.47-0.93).

Conclusions: The findings from this pilot study suggest that body-oriented therapy can effectively influence the executive abilities in children with ADHD. However, it is necessary to further research the impact of body-oriented therapies on the prevention and treatment of ADHD in children.

Funding: The research was supported by Russian Foundation for Basic Research, grant № 15-06-06491A.

A Novel View on Elimination EEG Cardiac Artifacts: Emphasis on The Artifacts of External Origin

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Contamination of EEG by cardiac (ECG and pulse) artifacts can significantly impede analysis of EEG. If the amplitude of ECG signal is high enough, it is possible to detect ECG artifacts using the visual analysis. In some cases, however, visual recognition of cardiac artifact (CA) is not sufficient. Particularly, it is difficult to distinguish artifacts from periodic lateralized epileptiform discharges (PLEDs), especially in the absence of ECG channel, video registration or in case of CA of external origin. CA of external origin are almost entirely limited to pediatric practice. In clinical practice, while performing an EEG in neonates, especially in preterm neonates with a small head circumference, sometimes observed a defect in the procedure, which consists in the tight fitting of electrodes by researcher's fingers pressure. This leads to the appearance of cardiac (pulse) artifact in the relevant EEG channels.

Difficulties encountered in performing awake EEG in infants determine the appearance of ECG artifacts is generated from another individual. Such ECG artifacts are a consequence of contact of electrodes with the chest (especially in mitral valve area) that dictated by necessity location of an infant on parent's knees during the procedure.

Most common approaches of eliminating ECG artifacts from EEG are based on its periodic behavior, e.g., independent component analysis and its modifications, empirical mode decomposition, spectral entropy analysis and wavelet transform. The desired algorithm should allow considering the specific features of CA of external origin that significantly improves the accuracy of their detection locally. We proposed a wavelet-based algorithm that automatically detects ECG in channels with a high degree of contamination and uses this information to remove ECG from other channels with a low degree even if the contamination is partial. Due to localization, wavelet packet transform provides better decomposition to find a narrow frequency band to remove ECG artifact. To improve the accuracy, the standard deviations (STD) of within-channel beat-to-beat and between-channels beat delays have been considered. Within-channel beat-to-beat STD represents the variation in beat rhythm and its frequency that is a key factor. Since the distribution of ECG in different directions causes a small delay in EEG channels, the beat delay should not be more than a threshold. This factor can be used to adjust and detect beats in different channels (even if they are partial). Difference between delays of artifact propagation across adjacent channels can serve as another possible factor for distinction between internal and external CA.

The results on real EEG records show that proposed approach can remove contamination with a low degree (or partial ECG) as well as with high degree. The sub-band energy of wavelet packet decomposition will be considered in future.

This work was supported by grant Russian Science Foundation 16-18-10371.

Pediatric Plasticity: Improved Recovery Through fMRI-Directed Treatment in Younger Patients

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Purpose: Our research seeks to ascertain any significant relationship between mild traumatic brain injury (mTBI) pathophysiology, symptomatology, and treatment outcomes, and age. We then aim to propose a causative mechanism for any differences.

Methods and Study Design: At the concussion clinic Cognitive FX, 99 pediatric and 507 adult mTBI patients were evaluated and treated. Prior to treatment, patients were administered an fMRI-adapted neuropsychological evaluation designed to identify variation from normal brain function in five previously identified concussion biomarkers to generate a Severity Index Score (SIS). Additionally, patients were subjectively evaluated and assigned a Post-Concussion Symptom Scale (PCSS) score. Following a week-long intensive treatment plan, patients were again evaluated and assigned post-treatment SIS and PCSS scores.

Results: Our data show that all patients improved with respect to mTBI symptomatology following treatment at Cognitive FX, as the average percent improvement in SIS was 75.15% across all patients. However, after statistical analysis, it was seen that percent improvement in SIS score tended to decrease with age ($p=0.0167$). Given our linear model and the assertion that significance is defined as $p<0.05$, it was shown that objectively measured improvement in mTBI symptomatology tended to decrease with age.

Conclusion: It should be emphasized that our results suggest substantial improvement in mTBI symptomatology following treatment at Cognitive FX, regardless of patient age. However, younger patients tend to show a greater response to treatment and a greater accompanying percent improvement of SIS. This is likely due to increased neural plasticity. This neuroplasticity provides a greater capacity for compensation and rebuilding of neural circuitry in response to damaged neurovascular networks, which is a common development in post-concussion syndrome that is not detected using standard imaging modalities.

Significance: Our data present an encouraging picture of favorable outcomes for all patients, regardless of age, but an increasingly optimistic outlook for younger patients who receive specialized neurocognitive rehab at Cognitive FX. This enhanced improvement in younger

Project BRAIN: A Tennessee Model for Student Transition after Brain Injury

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Children and youth who sustain concussions and brain injury are at risk for being unidentified or misidentified and are at risk of encountering professionals unprepared to address their unique needs.

Despite the high incidence of traumatic brain injury among children and youth, it is still considered a low incidence disability within educational settings.

Project BRAIN, funded by federal and state dollars, is a statewide brain resource and information network (BRAIN) serving students. There are three regional resource specialists, three brain injury transition liaisons (BITLs), one educational specialist and a program director. With a foundation in evidence-based research, Project BRAIN has addressed how best to support students with brain injury, since 2000.

Project BRAIN has established a statewide infrastructure to connect stakeholders who support the unique needs of children and their families who have experienced brain injury. Project BRAIN works with the Tennessee Department of Health, the Department of Education's Office of Coordinated School Health and Comprehensive Regional Pediatric Centers (CRPC): Monroe Carell Jr. Children's Hospital at Vanderbilt, Methodist Le Bonheur Children's Hospital and Children's Hospital at Erlanger. Education of family and school personnel, and referrals to appropriate health professionals effectively assists in reducing long-term sequelae.

When the IDEA implemented a category for TBI, Project BRAIN and its resource specialists were developed to provide TBI training and create educational tools for schools and others who support the needs of children and youth. Over time, feedback from families and educators identified a clear communication gap between the healthcare community and the school environment.

To address this need, in 2010, Project BRAIN designed and implemented an effective evidence-based communication intervention for transition from hospital to home to school. The intervention is known as the brain injury transition liaison process. Each liaison is located within a CRPC. Hospital staff, well-trained on the signs and symptoms of concussion and brain injury, identify children for inclusion in the BITL process. Next, parents/guardians give permission for Project BRAIN to follow up with the family and also notify the school. The regional resource specialist is included in school communications. Liaisons contact the family initially two weeks post injury. Three and six month follow ups are provided if needed. In 2017, an education specialist with an extensive background in TBI rehabilitation was added to the team to address the clinical needs of children with persistent signs and symptoms.

Data will be presented documenting the impact of the model on Tennessee families.

Since its inception, Project BRAIN has provided trainings and resources to thousands of people. To date within the BITL process, over 7,800 children have benefited. Project BRAIN's successful model, which ultimately stands on the pillar of dedicated relationships, can be replicated.

Role of Brain-Derived Neurotrophic Factor (BDNF) In Compensation for Negative Consequences of Chronic Prenatal Hypoxia

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Prenatal hypoxia regarded as a key factor of neurological impairments development during the first year of life. Oxygen deficiency leads to the development a complex of pathophysiological disorders manifesting in death of a part of neurons and changes in the activation pattern of a neural network. Late embryonic period and early postnatal period associate with an active formation of neural networks and programmed apoptosis of a part of neurons. A possibility to include a group of neurons developed in embryogenesis as a result of excessive proliferation of neuroblasts instead of hypoxic lost is one of the possible mechanisms for negation of chronic prenatal hypoxia consequences. Brain-derived neurotrophic factor is endogenous protein that regulates proliferation and differentiation of neuroblasts and also increases the viability of mature neurons in various stress factors influence. Thus, BDNF could be considered as a potential neuroprotector in prenatal hypoxic brain damage.

The aim of investigation was to study the effect of BDNF on the state of newborn mice in chronic prenatal hypoxia model.

The experimental subjects were pregnant CBA female mice and their newborn pups. First, we developed a chronic prenatal hypoxia model. Beginning with E14, pregnant mice were placed in a pressure chamber and simulated conditions corresponding to altitude 8000 m in 2 hours. The pups were weighed on P1, P7, P10, P30. At the age of 1 and 2 months, the definition of neurological impairments according to the Garcia scale and evaluation of an ability to learn and memory processes were assessed. To investigate the mitochondrial functional state, we determined the rate of oxygen consumption by mitochondria 24 hours after birth.

Mitochondria were isolated by a standard differential centrifugation. The rate of mitochondria respiration was recorded by a high-resolution respirometer Oxygraph-2k (Oroboros, Austria).

At birth, mice subjected to hypoxia had less weight than intact pups ($1,55 \pm 0,03$ g and $1,74 \pm 0,02$ g, respectively). Hypoxic mice were slower to gain weight until 10 days. Deviations in weight were negated by the age of 1 month. Changes in mitochondria functions in newborn mice affected by prenatal hypoxia was shown. The mitochondrial rate of oxygen consumption in hypoxic newborns brain tissues was significantly increased and amounted to $2486,7 \pm 155,2$ pmol/(s*ml) (intact pups - 1810.6 ± 89.5 pmol/(s*ml)).

Insignificant impairments in the strategy to reach goal in Morris water maze in mice subjected to chronic prenatal hypoxia were shown. Also, is was accessed the effect of exogenous increase of BDNF on memory and neurological status after prenatal hypoxia.

This study was supported by the Russian Science Foundation (№ 17-04-01128, 16-04-00245), Grant of the President of the Russian Federation MD-2634.2017.4. Publication also has been prepared as a part of state projects «Provision scientific research» №6.6379.2017/BP, 17.3335.2017/PP, № 6.6659.2017/PI.

Sex Specific Behavioral Deficits Following Mild Traumatic Brain Injury in Adolescent Animals

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Each year, about 2.8 million people experience a traumatic brain injury (TBI), with concussion or other mild TBI (mTBI) accounting for more than 75% of this number. Adolescents are far more likely than adults to sustain an mTBI and, for those playing contact sports, girls are twice as likely as boys to sustain an mTBI. Following mTBI, adolescent girls perform more poorly on visual memory tasks, tend to report more somatic and emotional symptoms, and take longer to recover from their symptoms than boys. The neurobiological changes that underlie these symptoms are vastly understudied in pre-clinical models. Thirty-five-day-old male and female rats were used to model mild TBI in the adolescent human. Closed head injury did not result in neuronal loss or blood-brain barrier damage, but decreased the area of the retrosplenial cortex and induced axonal degeneration in the corpus callosum in both male and female rats. Neither male nor female brain-injured rats exhibited deficits in spatial working memory in a Morris water maze-based task on days 4-7 post-injury. Brain-injured female rats exhibited a deficit in NOR memory at 3 days ($p < 0.01$), but not at 8 days, while male brain-injured rats did not exhibit deficits in novel object recognition (NOR) at either 3 or 8 days. In separate studies, 35-day-old male and female rats were evaluated for anxiety and depression-like behaviors following mild TBI using the elevated plus maze (EPM), forced swim test (FST), and sucrose preference test (SPT), at 2 and 6 weeks. A subset of brain-injured male rats exhibited a transient decrease in open arm time in the EPM at 2 weeks, but this anxiety-like behavior was no longer present at 6 weeks. Brain-injured male rats did not exhibit any alterations in immobility time in the FST at either 2 or 6 weeks post-injury. Brain-injured female rats did not exhibit alterations in open arm time in the EPM at either 2 or 6 weeks, regardless of estrous phase at the time of behavior testing. Brain-injured female rats did, however, exhibit an increase in immobility in FST at 6 weeks post-injury during the estrus phase of the estrous cycle, suggestive of a depression-like phenotype. In 35-42-day-old mice, mild impact to the intact skull resulted in periorbital allodynia only in female mice, suggestive of a headache-like phenotype. In brain-injured male mice, a deficit in sociability and social recognition was observed, which was not detected in the female counterparts. Together, these data provide evidence that mild TBI in the adolescent animal results in multiple behavioral deficits in the chronic post-traumatic period and that these deficits demonstrate a dependence on sex. Ongoing studies are focused on mechanisms underlying these various behaviors with a view to developing symptom-directed treatment strategies.

Community Reintegration Following Pediatric Acquired Brain Injury: Perspectives of Providers and Families

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Background: Individuals who sustain brain injuries as children show increased risks for depression, stress, poor quality of life, and difficult school reintegration. Families of children with brain injuries may experience increased caregiver burden, distress, and reduced family functioning (Holbrook et al., 2007; Stancin, 2008). Given the challenges associated with pediatric acquired brain injury (ABI), it is critical to understand how healthcare providers, families, and community support providers can best support a child's transition into the community following brain injury (i.e., community reintegration). Little prior research identifies intersections between inpatient health care providers, outpatient services, and family systems. Yet such an understanding is critical for developing effective reintegration plans and processes for children with brain injuries and their families. A recent review suggests that considering multiple contextual factors can increase effectiveness in rehabilitation and reintegration for patients following ABI (Ciccia & Threats, 2015). Furthermore, a better understanding of the intersections among the health care system, educational system, and family systems is needed to improve child outcomes following brain injury (Haarbaauer-Krupa et al., 2017).

Objective: The present study examined the perspectives of community service providers and families to better understand access and service usage as well as facilitators and barriers to community reintegration among families of children who experienced ABI at least 12 months prior.

Method: Fourteen service providers who work with children with ABI (speech-language pathologists, occupational and physical therapists, neuropsychologists, recreation providers, and school counselors) and 6 families (mothers, fathers, caregiver, grandparent, adult child with prior ABI) completed semi-structured interviews. Inclusion criteria for families were child with moderate or severe brain injury with at least an overnight hospitalization and being 12 months post-injury or more. Interviews explored families' experiences reintegrating into the community and facilitators and barriers to engagement in community life. Interviews were audio-recorded and transcribed verbatim. An interdisciplinary research team used an iterative qualitative coding process to identify codes and themes; theoretical coding using Bronfenbrenner's ecological systems theory (Bronfenbrenner, 2006) was applied.

Results: Preliminary results indicate that challenges with community reintegration after ABI are present within and across system levels. Microsystem factors include family financial, emotional, and behavioral abilities to appropriately support and advocate for the child. Mesosystem factors include communication between school, healthcare, and family systems. Exosystem factors include insurance and workplace policies that limit access to services. Macrosystem factors include stigma surrounding varying abilities and lack of supportive social structures. Chronosystem factors include transitions and changing needs over time. Gaps in communication among systems, limited funding and resources, and difficult transitions are especially challenging for families.

Implications: In order to optimize reintegration following moderate to severe pediatric brain injury, multi-system interventions are needed, especially those that increase communication and support transitions.

Modeling Elevated Intracranial Pressure-Induced Cellular Injury in The Brain

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Objectives: Elevated intracranial pressure (ICP) is comorbid with numerous neurological emergencies, has the potential to produce neurological damage in addition to the primary injury/disease, and is correlated with negative patient outcomes. The key to understanding the pathophysiology of elevated intracranial pressure lies in the identification of biomarkers of cellular injury, which are likely released by the cells that experience pathologic ICP. To date, the lack of a model to study the cellular pathways associated with elevated ICP-induced cellular injury has impeded progress. Identifying and characterizing the cellular biomarkers associated with elevated ICP should advance our understanding of the pathologic sequence of events leading to brain injury cause by pathologic elevations in ICP. These biomarkers may provide earlier and greater predictability of patient outcomes and potential therapeutic targets for the treatment of diseases associated with elevated ICP. Increasing pressures in both incremental pulses versus sustained increases allows for characterization of possible variable sensitivity of CNS cells mimicking pressure induced neurological diseases.

Methods: To simulate pressure induced brain injury, we developed an ex vivo model of elevated ICP, which combines 3D neural cell cultures and a newly developed Pressure Controlled Cell Culture Incubator (PC3I). Human cells were maintained in a 3D peptide-conjugated alginate hydrogels were subjected to different pressures to mimic both physiologic and pathologic conditions of untreated hydrocephalus. Culture media bathing of the cell-laden hydrogels was analyzed for injury/inflammatory biomarkers, while cellular viability was determined using an assay that measured intracellular esterase activity and plasma membrane integrity.

Results: We have shown that our 3D cellular constructs maintain about 50% cellular viability for up to 4 weeks following both sustained and pulsatile pressure exposures. ATP-release assays revealed that a time-dependent increase in neurons, but not astrocytes. Additionally, a similar cell-specific effect was revealed using multiplex assays. These was a trend for a time-dependent release of the cytokines IL-6 & IL-8 in 3D neuron cultures, but not from astrocyte cultures following sustained pressure exposures.

Conclusions: Using a novel ex vivo model of pathologic elevated ICP, this data indicates extracellular release of ATP is an important signal associated with elevated pressure, and may be a key in the early secondary injury response to elevated ICP in the developing neonatal brain. This could be used for early treatment and prevention. Further experiments using this model system will be valuable to determine other cellular biomarkers associated with pathological ICP.

Eye Tracking as an Indicator of Blast Brain Injury in a Civilian Population

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Introduction: In the military population blast injuries result in an insidious decline in overall wellbeing, impacting emotional, mental, and cognitive capabilities. Blast brain injury has been dubbed “the invisible injury” because it is difficult to diagnose since it results in neurologic damage not apparent on conventional brain imaging, and does not show variance within biomarkers typically associated with traumatic brain injuries. Ocular motility dysfunction has been noted to have a high incidence in military personnel exposed to blast brain injury. Despite knowledge from the military, there is an overall lack of reported information regarding the impacts of blast for women and children. The goal of this study was to detect blast brain injuries in a civilian population resulting from a natural gas explosion by utilizing an eye-tracking device, which has previously demonstrated high sensitivity for detecting changes in intracranial pressure and brain injury.

Methods: A total of thirty-six subjects [age (mean±sd) =35.6±17.5, range 13-70 years, 23 females] exposed to a natural gas explosion were eye-tracked, and their results were compared to age and gender matched controls. All participants underwent eye tracking, which consisted of a 220 second video travelling in a clockwise aperture on a computer monitor, completed a standardized concussion assessment (SCAT3) and underwent clinical vision assessments.

Results: Two subjects completed the assessments upon the day of injury, while the remaining survivors were recruited three to nine days after their exposure. The eye-tracking results of the subjects who experienced the blast and enrolled in the study were compared with Wilcoxon-signed rank test to their gender and age matched controls. It was found that five of the eye tracking metrics were considered to be statistically significantly different in the exposed subjects. Using logistic regression, the Blast Injury Score (BIS) was developed to analyze the results of the patients located inside of the building during the blast. This BIS showed an AUC of 0.835, sensitivity of 86.4% and specificity of 77.4% distinguishing blast exposed subjects and controls. These results also showed an increase in severity for subjects closest to the blast inside the building in comparison to those further away or outside. (spearman correlation=0.731; p-value<0.001).

Conclusion: The results of this work indicate a correlation between eye tracking and exposure to blast, and support the use of eye tracking to assess brain injury resulting from blast exposure.

Case Report: Significant MRI Brain Quantitative Volumetric and MRI DTI Abnormalities Associated with Electrical Brain Injury

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Introduction: Electrical injury (EI) occurs when electrical current comes in contact with the body, and can result in skin burns, tissue damage, respiratory arrest, and death in some cases. Many EI patients experience neuropsychological deterioration and show symptoms of memory problems, post-traumatic stress disorder (PTSD), sensory disturbances, depression, and other cognitive deficits.

Background: In this case study, we present the uncommon case of a male in his late 30's with statistically significant brain abnormalities after coming into contact with stray voltage at a park nearby his residence. The patient recalls feeling the electrical current traveling up his right arm; he developed burns on his right arm, right shoulder and inside his nose, as well as retrograde amnesia. This suggests that the electrical current entered through his right hand, and traveled upwards in search for a grounding source, until it exited through his nose.

Method: The patient's magnetic resonance imaging (MRI) scans were acquired using a 3T Siemens MRI scanner and used to perform quantitative volumetric analysis and identify various regions of interest (ROIs) that were statistically significant against 15 Functional Biomedical Informatics Research Network (FBIRN) controls. MRI diffusion tensor imaging (DTI) scans were acquired to assess white matter integrity. Using Matlab's Statistical Parameter Mapping (SPM) feature, positive and negative DTI contrasts were generated ($p < 0.01$, voxel = 30) and overlaid with the patient's anatomical scans to display ROIs in which the patient's fractional anisotropy (FA) values deviated from the control group. Using Cortech's Lab's Neuroquant software, volumes (voxels) for a number of brain structures was determined and compared against age and gender matched FBIRN controls.

Results: We found an increase in the patient's right lateral ventricle (15.75cm^3) 2 standard deviations above the mean value of the controls (mean: 8.73cm^3 , SD = 3.49cm^3), which was consistent with right-sided fractional anisotropy abnormalities observed, such as the right-sided parahippocampal gyrus (patient: 0.63; mean: 0.45, SD = 0.04; $p = 5.6 \times 10^{-7}$).

Discussion: The abnormal FA increases observed in this study are consistent with Strauss et. al's (2016) findings of increased FA in traumatic brain injury (TBI). This may be the first case in which statistical MRI DTI imaging and quantitative brain volumetric techniques were used to assess electrical brain injury. These techniques may be helpful in the assessment of other electrical brain injuries.

Optimism in mTBI Rehabilitation: How Depression in Females Affects fMRI-Directed Treatment and Recovery

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Purpose: Our research seeks to ascertain any significant differences in mild traumatic brain injury (mTBI) pathophysiology, symptomatology, and treatment outcomes between women with and without clinically diagnosed depression and to then propose a causative mechanism for any differences. We did not discriminate whether the depression developed before the patients' mTBIs or after as part of post-concussion syndrome (PCS), nor did we exclude patients with other mental health diagnoses in addition to depression.

Methods and Study Design: At the concussion clinic Cognitive FX, 193 females (72 with depression and 121 without) with a history of mTBI were evaluated and treated. Prior to treatment, patients were administered an fMRI-adapted neuropsychological evaluation designed to identify variation from normal brain function in five previously identified concussion biomarkers to generate a Severity Index Score (SIS). These neural markers gauge blood-oxygen-level-dependent (BOLD) signaling in brain areas associated with attentional ability, visual processing, verbal reasoning, executive functioning, and subcortical processing across 57 brain regions previously identified to be affected in concussion. Additionally, patients were subjectively evaluated for mood related symptoms and assigned a Post-Concussion Symptom Scale (PCSS) score. Following a week-long multifaceted treatment plan incorporating cognitive, neuromuscular, and occupational modalities, patients were again evaluated and assigned post-treatment SIS and PCSS scores.

Results: Following t-test analysis for differences in SIS improvement rates of depressed and non-depressed females, we calculated a p-value of 0.465. This denotes there is no significant statistical difference in PCS severity improvement between the two groups of women. PCSS scores similarly showed no significant variation between the groups. This lack of disparity emphasizes that the intensive cognitive treatment given to patients is effective for females, regardless of depression diagnosis.

Conclusion: It should be emphasized that our results suggest substantial improvement in mTBI symptomatology following treatment at Cognitive FX, whether or not a patient has depression. However, there is no evidence to suggest that either depressed or non-depressed patients improve at a more substantial rate. This suggests that depression, whether developed before or after mTBI, is not a prohibitive variable in PCS improvement. Further studies are needed to discriminate differences in patients who had depression previous to their concussion and those who developed it after their concussion.

Significance: It has been shown that there is substantial coexistence of depression and PCS in patients who have suffered a concussion. As such, it is important to identify if depression impacts the ability for PCS treatment to be successful. Our results indicate that depression does not adversely affect mTBI treatment success, and that depressed females will improve in mTBI symptomatology similarly to females without depression. This suggests that both depressed and non-depressed mTBI patients should be treated with similar therapy to yield comparable results.

The Use of Osteopathic Manipulative Medicine in The Treatment of Headaches for A Patient with Subdural Hematomas in The Setting of Traumatic Brain Injury

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Osteopathic manipulative medicine (OMM) is a non-surgical, interventional, hands-on approach to diagnosis and treatment of somatic dysfunction (physiological lesion). It may serve as primary or adjunctive therapy in addressing a wide range of visceral, neurological, myofascial, skeletal, and ligamentous conditions, in combination with other interventions. OMM techniques target lesion patterns in the muscles, bones, fascia, ligaments, dura, fluids, viscera, and neural circuitry, and utilize a fulcrum for change to restore motion, balance, and maximal health.

A 61-year-old Caucasian male with history of HTN, CAD s/p CABG and mechanical mitral valve replacement (2015) on chronic warfarin anticoagulation, presented on 9/12/17 for progressive bilateral lower extremity weakness and mild decrease in mental acuity. He had two prior falls with loss of consciousness when traveling to Mexico on 9/8/17 when intoxicated. Symptoms of bilateral leg weakness, decreased mental acuity, and urinary incontinence progressed over 2-3 days until he was unable to stand from a seated position. CT head revealed a right parafalcine and para tentorial subdural hemorrhage with anterior focal hematoma and a small subarachnoid hemorrhage. No surgical intervention was taken, and patient was transferred to The Institute for Rehabilitation and Research on 9/16/17 for functional deficits related to his subdural hematoma. Pertinent positives on his neurologic exam included: positive left hoffman's sign, positive left babinski sign, and left sided hemiplegia. He was able to ambulate 5-15 feet upon admission with moderate assistance. Patient complained of moderate retro-orbital headaches since his trauma and was started on scheduled Tylenol and gabapentin, and prn Tylenol and tramadol. Despite medication management, patient continued to have worsening headaches. Patient was taking up to 50 mg QID tramadol prn and 1-3 tabs hydrocodone 5-325 mg daily from 9/21/17-9/26/17 without adequate pain control.

OMM treatments were started on 9/23/17 as an adjunct therapy for headache management. Treatments focused on the following: somatic dysfunction involving the cranial vault, lymphatic system, bilateral rib cages, and viscera. Treatments lasted between 10-15 minutes and were administered between 9/23/17-10/3/17. Patient experienced a decrease in overall headache symptoms and a decrease in both scheduled and prn pain medications. Upon discharge on 10/13/17 patient no longer required scheduled or prn pain medications and was able to ambulate around the medical center while following a map with no cues. Patient experienced no adverse reactions to OMM treatments and progressed well with therapy. He was discharged home with a modified independent to independent level of functioning.

This case illustrates the safety of using OMM to treat patients with headaches in traumatic brain injury. Patient experienced no adverse reactions to treatment, had a decrease in headache symptoms and participated in therapy without barriers.

Youth Comfort in Communicating with Systems of Care Following a Concussion

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Objective: To investigate the level of comfort in children and adolescents when talking about their concussions with systems of care involved in their recovery (e.g. parents/guardians, medical, school, and sport personnel), in addition to friends and teammates.

Participants: A total of 66 youth ages 7 to 18 years old (M = 14.2, SD = 2.1) were enrolled within 14 days of injury (M = 8.6, SD = 3.8) and had a concussion diagnosis. Sixty-seven percent (n = 44) were male and 68.2% (n = 45) were Caucasian. Eighty-two (n = 54) percent sustained a sports related concussion.

Methods: Child and adolescent participants were asked to rate their level of comfort when communicating with medical, family, friends, sport, and school systems of care about their concussions using a 4-point Likert scale of "not at all", "a little", "somewhat", and "very." Participants were also asked to provide reasons for any ratings less than "very comfortable" for each system. Participants completed the survey as part of a larger study on concussion recovery following their initial concussion evaluation at a concussion specialty care clinic.

Results: The vast majority of children reported feeling "very comfortable" in talking with medical personnel (91%), parents or guardians (88%), and sport personnel (67%) about their concussions. Approximately half of participants felt "very comfortable" in talking with their teammates (58%) followed by their friends (47%). Only 36% felt "very comfortable" in talking with school personnel. Regarding school personnel, reasons for lowered comfort ratings were related to not knowing school personnel well enough, not wanting to share personal information, not seeing a reason to talk to them about a concussion, or a belief that school personnel would not understand or be concerned. For teachers especially, participants reported that their teachers might think they were "faking it" or trying to get out of school work. Reasons for lowered comfort ratings in talking to friends were attributed to feeling their friends would not understand, they were only close to a few friends, or they did not want friends to know their personal "business". For sport personnel, explanations included not wanting to be perceived as "weak" or complaining and not knowing the athletic personnel well enough.

Conclusions: The findings indicate that children and adolescents with concussions feel fairly comfortable in talking about their injuries with parents and medical professionals, as well as sport personnel. However, there is a need to improve communication between concussed youth and school professionals in order to enhance recovery and the return-to-learn process. Discussion of comfort ratings for specific personnel within each system of care will also be described.

Tele-Rehabilitation Advances Higher-Order Cognitive Remediation Following TBI: A Youth Athlete Case Study

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Reasoning, strategic learning, and other executive functions in adolescents are commonly impaired by TBI, with potential for lasting impact on academic performance, social functioning, and well-being. Cognitive impairments can persist over time, requiring ongoing management and continued access to treatment, which is often lacking due to financial and/or long-distance constraints. Adding to the complexity of cognitive rehabilitation is the multi-faceted therapeutic approach necessitated to address individualized deficits. Training metacognitive strategies to improve top-down cognitive control functions provides practical ways to engage real life mental challenges, making cognitive remediation readily adaptable and adoptable across academic and social domains. Leveraging an interactive telehealth communication platform maximizes the reach of such cognitive training delivery while minimizing costs and time/travel demands. A strategy-based metacognitive training program administered in a tele-rehabilitation format can target cross-domain deficits in a top-down fashion to maximize therapeutic time and address a person's heterogeneous deficits. This case study presents a 12-year-old middle-school athlete with persistent physical and cognitive complaints post-mild TBI (concussion sustained approximately 3½ months prior) seeking a cognitive treatment program that could maximize his cognitive performance and optimize his mental endurance in order to facilitate his recovery and return to pre-injury academic demands. A tested cognitive training program – Strategic Memory Advanced Reasoning Training (SMART) – was administered using web-based videoconferencing software across eight 50-minute sessions. Measures of abstraction as well as memory for details, working memory, cognitive flexibility, inhibition, and real-life executive functions were administered (in person) before and 3 months after training. Improvements were observed across trained and untrained domains, including gains in: 1) the higher-level discourse (learning) skills of expressing the deeper-level meanings (inferencing and abstracting) and interpretive lessons (generalizing) from text-based content, 2) aspects of cognitive flexibility and switching, and 3) real-life executive function behaviors (per parent report). In addition, the student finished his 7th grade year with a full load of classes, transitioning from a part-time to full-time schedule in the last 4-6 weeks of school, achieving all A's. Outside of the classroom, he reinitiated participation in scouting as well as swimming. Socially, parent report suggested that he was reconnecting with friends and seeking more social interaction. Later-stage booster sessions were incorporated to re-engage during his high school transition. Overall, results suggest that using a strategy-based, top-down approach could maximize the utility of technology as a cognitive training tool. Cases such as this illuminate the potential for cognitive interventions to enhance recovery post-injury and mitigate potential chronic sequelae of TBI in adolescence, a critical life stage for frontal lobe maturation and executive function development. Further, using technology to address higher-order cognitive functions following TBI may be a useful clinical tool for remediating cross-domain cognitive concerns across all ages and stages of recovery.

Cerebral Fat Emboli Syndrome Masquerades as Traumatic Diffuse Axonal Injury

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Objective: Cerebral Fat Emboli Syndrome [CFES] is a rare complication of multi-trauma injury and is often mistaken for traumatic brain injury [TBI] related diffuse axonal injury [DAI]. In this poster we will review the relevant literature and the clinical and neuroimaging findings associated with this condition.

Methods: A retrospective chart and neuroimaging review of a series of patients treated in a comprehensive designated Acquired Brain Injury rehabilitation program from 2009 - 2015. Included was an independent review of MRI imaging by a trained neuroradiologist to confirm the diagnosis of CFES. Representative MRI imaging will be presented. Outcome measures included Functional Independence Measure [FIM] and Glasgow Outcome Scale [GOS].

Results: Patients were admitted to the acute trauma center after poly-trauma accidents whether without a documented TBI or with mild to moderate TBI characterized by a GCS of 13-15. All subjects had associated orthopedic injuries including but not limited to long bone fractures. All patients had an acute decline in mentation after repair of their orthopedic injuries. All patients displayed significant discrepancies in their acute CT imaging and their post-operative clinical presentation. Subsequent MR imaging showed diffusion and susceptibility weighted imaging findings that were consistent with a diagnosis of CFES which will be discussed.

Conclusions: In poly-trauma patients with the clinical history of an initial high GCS scores with subsequent acute decline in mental status following surgical repair of long bone fractures should raise suspicion for the diagnosis of CFES. Sensitive MRI techniques are useful in confirming the diagnosis and useful in differentiating from DAI pathology related to TBI. Clinicians should be careful not to prognosticate a poor outcome based on radiographic features of this syndrome as the patients in this series has a Moderate-Good recovery as measured by FIM and GOS.

Ventriculoperitoneal Shunt Valve Reverse Polarity Following Magnetic Resonance Imaging: A Case Report

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A 58-year-old male with medical history of right basal ganglia hemorrhagic stroke and hydrocephalus status post ventriculoperitoneal (VP) shunt with a Medtronic Strata valve setting of 1.0 presented after falling out of bed and hitting his head. Workup included magnetic resonance imaging (MRI) of the brain. Following the MRI, the patient's VP Shunt was re-programmed to 1.0. Hospital course was notable for progressive confusion, hypoarousal, and difficulty ambulating.

Repeat MRI brain showed massive interval ventricular enlargement. The shunt was re-programmed to 0.5 with no improvement in the patient's arousal or ability to ambulate. Computerized tomography (CT) brain showed continued ventriculomegaly, and a skull radiograph was obtained which showed a VP shunt valve setting of 2.0. Despite numerous attempts to re-program the shunt to 0.5, skull films continued to show the setting at 2.0 – 2.5. A Medtronic representative was contacted and in conjunction with serial skull films, it was discovered that the valve had developed reverse polarity. Using skull films for guidance, the patient's VP shunt was adjusted to 1.0. Repeat CT brain showed decompression of the ventricles.

The patient showed improvement in arousal and ability to ambulate. He was initially unable to follow one-step verbal instructions or answer simple yes/no questions. Within 3 days of ventriculomegaly resolution, patient's ability to follow one-step verbal instructions and answer simple yes/no questions improved to 70% accuracy.

While MRIs present a known risk of altering the performance level setting of VP shunts, few clinical cases have been described in which the valve magnet developed reverse polarity. A warning was issued by Medtronic for their Strata II and Strata NSC Valves in January of 2017 as these carry a risk of developing reverse polarity when exposed to 3 Tesla MRI magnetic fields or greater when biological debris are present inside the valve. Medtronic has reported five complaints of reverse polarity with a rate of 0.007% over a 24-month period.

VP shunt valve reverse polarity is a rare adverse event following MRI. This case exhibits the importance of radiographically confirming VP shunt settings after MRI.

Post-Acute Structured Aerobic Exercise Following Sport Concussion in Adolescents: A Randomized Control Pilot Study

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Rationale: While preliminary human investigations using aerobic exercise (AE) interventions after concussion have shown promise, these studies are either retrospectively designed, or have focused on individuals with persistent symptoms. Given the promising evidence of the therapeutic potential of AE interventions, and the large percentage of adolescents and young adults at risk for concussion.

Purpose: (1) to determine the feasibility of implementing a standardized, graded AE intervention in the post-acute stage of concussion recovery within an adolescent cohort with respect to safety and logistics, and (2) to determine the efficacy of this intervention on expediting overall time to medical clearance and improving clinical/physiological outcomes compared to usual care.

Design and Setting: A single blinded, randomized, controlled trial with 7-, 14-, 21- and 28-day follow-up visits. A single sport medicine clinic.

Main Outcome Measures: Days to medical clearance, post-concussion symptom scores, and cardiovascular responses.

Intervention: Aerobic exercise (AE) program or usual care (UC).

Results: For individuals in the AE, no cases of significant elevated symptom severity were reported during any of the exercise sessions. We observed a trend towards greater symptom resolution for EX compared to UC from Week 1 to Week 4 post-injury. Participant retention in both groups was 100%, further indicating the safety of the intervention and the logistical feasibility of implementing this protocol on a larger scale. Measures of autonomic dysregulation across the recovery timeline were not significantly different between groups, although there was a significant group by condition interaction observed for the mean RR interval at Week 1 post-injury ($p = .02$), whereby EX participants experienced a significant increase in mean RRI upon sitting upright. However, this interaction was no longer significant by Week 4 post-injury.

Relevance and Implications: A structured, graded AE intervention administered in the post-acute following concussion appears to be potentially beneficial and future large-scale studies are warranted. Future studies should explore a wider range of exercise parameters (greater intensity of exercise, earlier timing of administration) on clinical and physiological outcomes following SRC in the adolescent population.

A Theoretical Model of Falling Behind in Academics Following Sport-Related Concussion in Adolescent Athletes

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Context: Following a concussion, cognitive rest within the treatment protocol requires patients to disengage from physical and academic activities. A step-wise progression is suggested for return to play to ensure a slow reintegration into the physical demands of sport. However, limited information is available for a step-wise progression for return to learn.

Objective: Describe a theoretical model of falling behind in academics during recovery among adolescents who have suffered a concussion

Design: General Interpretive. **Setting:** Focus groups were conducted in the library of the participants' high school.

Participants: Fifteen athletes (13 males and 2 females with a mean age 15.87 + 1.65 years old) sampled on the following criteria participated in the study: history of concussion in previous academic year, sustained concussion during sports competition, full return to learn and participation.

Data Collection and Analysis: Semi-structured interviews were conducted during four focus group sessions. The focus groups were audio recorded and transcribed verbatim by one of the researchers. Notes were taken by one of the researchers. The researchers analyzed transcribed notes and evaluated the focus group interviews for themes associated with (1) psychological responses and (2) emotional needs of the adolescent during recovery using content analysis. Credibility and trustworthiness was established through member checks and using the Certified Athletic Trainer as an auditor. Peer debriefing was utilized to evaluate themes independently and then comparing the results.

Results: Regardless of gender or number of school days missed, all participants described anxiety which led to frustration during the return to learn process. Outcomes following return to learn were dependent on effective communication, and teacher expectations. When poor communication was coupled with unrealistic teacher expectations, the participants' grades declined. This decline led to frustration and anxiety to complete work and improve grades. As participants try to reintegrate back into academics, with no intervention, the process becomes cyclic and led to further frustration, declining grades and ultimately anger.

Conclusions: Participants described poor outcomes that resulted from poor communication between educators and healthcare providers in regard to restrictions and reintegration to academics. The academic demands experienced after missing school days, assignments and tests resulted in heightened frustration and declining grades. This study identified stages during return to learn where participants can experience stress. If clinicians can intervene prior to declining grades or frustration poor outcomes following injury may be avoided. It appears that effective communication and appropriate teacher expectations that allows for a slow step-wise return to learn is necessary for successful academic outcomes. Future work should examine the generalizability of the model across geographic, socioeconomic status and cultural environments.

Validity of Motor-Cognitive Responses to Virtual Reality Gaming Protocol for Persons with and without Acquired Brain Injury

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Background/ Purpose: New neurotechnological methods have been introduced which allow mass practice in sensory enriched environments to augment patient reintegration into activities of daily living during recovery. Limited standardized testing is available to rehabilitation specialists that documents both cognitive and motor in patients. The purpose of our study was to explore the validity of a new standardized virtual-reality gaming protocol to assess combined motor-cognitive skills in persons recovering from acquired brain injury (ABI).

Methods: 25 participants (M/F = 8/17) age 35.13 (+/-11.24) years with and without ABI (5/20) over the past 12 months, performed a timed, 4-square stepping task to test dynamic balance (4SST) and then completed the standardized Montreal Cognitive Assessment (MoCA). Demographic included age, gender, history of head injury, sleep habits, level of stress, use of caffeine and alcohol. Lastly, a polar heart monitor recorded participant effort using heart rate (HR) while performing five standardized, virtual-reality games to test motor-cognitive skills. Variables of interest were: 4SST time, MoCA score, and computerized Cognitive Scores (ICOG). Nonparametric statistical methods were used to explore group performance using SPSS 24.0 (IBM) using an alpha level of 0.05.

Results: Preliminary results indicated similar performance in MoCA and ICOG scores (27.24 +/- 1.921, 28.043 +/- 2.230 respectively). However, ICOG effort ratings were significantly higher in the ABI group compared to those without ABI (2.60 +/- 1.140) vs. 1.60 +/- 1.095 respectively). In addition, the ABI group took significantly longer to complete each ICOG activities (34.056 +/- 24.461 vs. 29.964 +/- 25.727 respectively) with significantly delayed reaction times (3.598 +/- 1.542 vs. 2.825 +/- 1.630 respectively). A significant relationship between each ICOG activity score and the associated HR ($r = -0.512$, $p = 0.030$) and 4SST and AGE ($r = 0.526$, $p = 0.025$). Multiple regression analysis indicated history of concussion, previous night hours of sleep, MoCA scores, gender, and HR significantly explained 61.2% of the ICOG variance ($p = 0.005$).

Discussion: Results indicate that it is possible to test motor and cognitive performance within a virtual-reality gaming environment as seen by similar performance between the standardized cognitive assessment tool (MoCA) and the ICOG. In addition, there was a significant difference in effort scores and reaction time scores for persons with a history of MHI. This significant trend appeared to explain overall ICOG performance as presented by regression analysis.

Conclusions: Preliminary findings indicate that further research is warranted using a larger sample size to provide real-life assessments of patient performance during specific activities of daily living. The proposed computerized system appears to be a valid method by which rehabilitation specialists might document patient recovery of both motor-cognitive function in response to treatment. Our lab will continue work to define specificity of patient responses.

Cardiovascular Responses of Persons with And Without Acquired Brain Injury to An Instrumented Motor-Cognitive Assessment Using a Virtual Reality Gaming System

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Purpose: Limited standardized testing available to rehabilitation specialists document both cognitive and motor performance in patients. The purpose of our study was to explore cardiovascular responses to a new standardized virtual-reality gaming protocol used to assess combined motor-cognitive skills in persons recovering from acquired brain injury (ABI).

Methods: 25 participants (M/F = 8/17) age 35.13 (+/-11.24) years with and without ABI (5/20), performed a timed, 4-square stepping task to test dynamic balance (4SST) and completed the standardized Montreal Cognitive Assessment (MoCA). Participants provided demographic data and wore a Polar heart rate monitor to collect baseline and activity heart rate (HR) throughout the session, performing five standardized, virtual-reality games to test motor-cognitive skills. Variables of interest were: RHR, HR for activities, sleep (</> 6hrs), gender (GEN), and ABI. Nonparametric statistical analysis was conducted using SPSS 24.0 (IBM) with an alpha level of 0.05.

Results: Preliminary results indicate some difference found between gender and heart rate with a large effect size in terms of HR_1 and GEN (0.131) and RPE_5 and GEN (0.131). No significant difference was found between MHI or HR when compared to MoCA scores. A significant relationship was found between the AVG_Intendu_HR and RHR ($p=0.001$) as well as POST_4SST_HR ($p=0.022$). Large effect sizes were seen in terms of HR_4 and MHI (0.097), HR_5 and ABI (0.232), and AVG_Intendu_HR and ABI (0.098). A significant relationship was not found between the participants perceived rate of exertion (RPE) and their heart rate (HR). Previous night's sleep showed a moderate effect size regarding RPE_5 and sleep (0.88), while no other significant impact on HR or other variables measured were statistically significant regarding amount of sleep.

Discussion: Significant differences were found in terms of participants with ABI regarding the effect of the Intendu activities and impact on heart rate. Interestingly, ABI individuals displayed a typically lower mean HR, showing greater endurance. It was seen that healthy subjects without ABI increased HR while those with ABI stabilized their HR and even decreased over the course of activities. Statistical significance was found with RPE between activities and HR between activities but not across the two categories. This discrepancy of heart rate compared to reported rate of exertion, as perceived by the participants, shows a potential disconnect between perception of difficulty and performance of tasks that incorporate both motor and cognitive components.

Conclusion: Further investigation of the discrepancy of actual (HR) versus perceived exertion (RPE) is warranted using a larger sample size to investigate differences in gender, sleep, and ABI response. The Intendu system appears to be a potential method by which rehabilitation specialists might implement motor-cognitive tasks focused on eliciting a heart rate response to treatment.

Pilot Study: Characterizing Neuromuscular Trunk and Balance Responses to an Instrumented Hippotherapy Program

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Introduction/Background: The well-known benefits of hippotherapy include improvements in flexibility, strength, symmetry, postural control, balance, and motor planning as well as other abilities in populations with neuro-motor impairments. With the development of clinical mechanical horse simulators (MHS) as a rehabilitation option to live horses, an important question is whether the MHS can provide similar functional benefits like that of a live therapy horse. In addition, what might be the unique benefits of the MHS? The purpose of this study was to investigate patient trunk stability, balance and postural control in response to a standardized MHS program.

Methodology: 10 participants (M: F=7:3) who were referred for outpatient physical therapy were asked to be part of this study. All participants were sampled by convenience with following inclusion criteria: diagnosis of trunk instability caused by a neuromuscular impairment, ability to cognitively follow simple commands, age greater or equal to 18 years, no spinal musculoskeletal abnormalities or pathologies, and ability to tolerate sitting position on a MHS or bolster during treatment. After providing informed consent, all participants received standardized clinical testing for balance, gait and trunk stability including: Sitting Balance Scale (SBS), Trunk Instability Index (TIS), Timed Up & Go (TUG) and the 10-meter Walk Test (10MWT). The Health Survey Short Form -12 (HSF-12) was used to document quality of life and perceived disability. All participants then received a standardized MHS therapy protocol integrated into the regular physical therapy sessions. A standardized protocol included six primary therapy postures which incorporated increments of horse speeds (10 – 60 rpms), patient postures (head, arm & object manipulations), and duration of treatment time in increments of 5-minutes (1= 5 minutes to 6 = 30 minutes). Patients received six-weeks of therapy including 5 to 9 MHS sessions total. All patient were retested at discharge.

Preliminary Results: SPSS 24.0 was used for descriptive statistics for demographics comparisons and pre-posttest analysis. Participant mean age was 69.6 (+/12.09) with pre-test scores including: SBS = 41.2(+/- 4.94), TUG = 44.18s (+/- 54.88s), HSF-12 = 29.44 (+/- 3.78), TIS = 17.33 (+/- 3), 10MWT 0.582m/s (+/- 0.516). Although patient improvements were found in all areas, a non-parametric analysis, Wilcoxon-Rank-Sum Test, was used to compare pre/post-treatment differences in participant performance scores especially in trunk stability pre-SBS and post-SBS scores at a level of $p=0.027$.

Clinical Relevance: Preliminary results indicate that patient responses to a 6-week standardized MHS program were similar to that of live hippotherapy including improvements in both trunk and dynamic balance. Therefore, the use of MHS has the potential to make hippotherapy more accessible to larger patient populations and provide an objective way for rehabilitation specialists to objectively track patient progression and response to exercise intensity, frequency, and duration of hippotherapy.

Sympathetic Modulation in Acute Severe Traumatic Brain Injury

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The development at advanced trauma care systems in designated primary trauma centers have improved the outcomes of polytrauma victims.

Nonetheless, there is a shortcoming when it comes to polytrauma victims suffering severe traumatic brain injury. This stems from the ambiguity as to what needs to be done for the patient other than establishing the ABC's in order to save the brain from further damage.

Hemodynamic stability in the cardiac sense might not be necessarily cerebral circulatory stability due to the deranged auto regulation and CPP.

Catecholamine surge might explain in part the response to resuscitative measures and does not help the brain. On the contrary increases edema and worsens CPP.

There are still challenges to objectively guide our management.

We share our experience with methods to control this catecholamine surge and suggest ways to be better able to monitor the response of these patients

Point-Of-Care Transcranial Doppler To Guide Resuscitation Effort in Sever Traumatic Brain Injury

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The development at advanced trauma care systems in designated primary trauma centers have improved the outcomes of polytrauma victims. In parallel to this several advances have been achieved in the safety and efficacy of the resuscitative mechanism polytrauma victims are managed by nowadays.

That coupled with achieving hemodynamics stability prevents the trauma team members to think about the ongoing brain damage from either mass effect or the extensive inflammatory response that is seen in sever TBI patients. This lag of paying attention is abolished once a CT scan is done and the team can visually assess the status of the brain and call upon the neurosurgery team to evaluate and participate in the care of the patient from that point forward.

Hemodynamic stability in the cardiac sense might not be necessarily cerebral circulatory stability due the deranged auto regulation and CPP.

Mannitol cannot be given despite the its benefits, so 3% NaCl through a central line is a perfect solution as it is a resuscitation fluid and ICP lowering agent.

We present our novel approach to use transcranial doppler in the trauma room to objectively guide this brain resuscitation efforts.

Ethical Considerations for End-Of-Life Decision-Making in Sever Traumatic Brain Injury

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Sever traumatic brain injury patients are at high risk of developing significant life-threatening complications follows the primary insults. Sometimes recognizing these complications like secondary brain injury or stress ulcer etc., are challenging in comatose patients with limited examination.

Patients with critical illness, have impaired capacity to make their own medical decisions. Various ethical issues related to end-of-life care for TBI patients of various age groups.

We explore and elaborate on different ethical issues for end of life decision making for these different groups in the neurocritical care setting.

Discrepancies in Healthcare Setting for Concussion Management in a Medicaid Population

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Complex and evolving symptom clusters makes effective diagnosis and management of concussions challenging for all healthcare providers. Prolonged physical, cognitive, and emotional symptoms are common, with up to one third of patients experiencing symptoms lasting longer than 2 weeks. While hospital-based emergency services may be necessary in some cases, outpatient primary care providers are often in the optimal role to complete both the initial evaluation and monitoring of symptoms. Arbogast et al (2016) found that nearly 82% of pediatric patients had their first concussion visit within a primary care setting while only 12% of patients entered the healthcare system through the ED. However, 82.3% of the patients enrolled in the study were privately insured.

Research across all diagnostic categories has documented discrepancies between Medicaid patients and the privately insured in terms of healthcare practices, access to care, and outcomes. Better understanding of these patterns is critical to the discussion of concussion management. Knowing the healthcare setting in which patients are receiving care allows education and resources to be targeted to the most appropriate location. This is especially important in a state without a multidisciplinary concussion center coordinating care for patients or providing education to guide local providers.

A retrospective analysis of South Carolina Medicaid claims paid for concussion-related diagnostic codes from 2010-2015 was performed. Additional independent codes (e.g., Post-concussion Syndrome) often listed by local providers were identified and included in the current data set. The addition of these diagnostic codes supplement other frequently used codes including concussion with and without loss of consciousness to provide a more comprehensive analysis of concussion-related visits. Billing codes were examined for Emergency Department Services (9928x) and Office/Outpatient Services (9920x, 9921x), with comparisons of number of claims paid, Medicaid dollars spent, and average cost per procedure code. This data shows that nearly 70% of Medicaid funded services for patients with concussions were provided in the Emergency Departments, with only 4% of the 9-12 million Medicaid dollars spent annually on community-based primary care.

Limitations of this current data set are acknowledged and include inability to assess point of entry or trajectory of care. This data also includes claims paid, rather than claims filed. However, this data does provide an interesting contrast to previously reported data in a largely privately insured cohort. This study of reimbursement for concussion-related services has the potential to impact the allocations of healthcare resources and provider education for this population in the future.

Establishing Evidence for Concussion Subtypes

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Background: Concussion is a heterogeneous mild traumatic brain injury (mTBI) characterized by a variety of symptoms, clinical presentations, and recovery trajectories. While most patients recover from the symptoms of concussion within two to four weeks following the traumatic injury, an estimated 10% to 33% of patient's symptoms persist beyond three months. The variability in concussion recovery may be attributed by pre-injury and post-injury risk factors. However, the contribution of clinical profiles of post-injury factors in affecting the recovery of concussion is undetermined. Following the Targeted Evaluation and Active Management (TEAM) publication, TEAM collaborators and researchers at the Stanford Brain Trauma Evidence-Based Consortium (B-TEC) aimed to define common clinical profiles/subtypes of concussion to aid diagnosis, target treatments for rehabilitation, and drive future research. Subtypes were refined to include the following: Headache/Migraine, Vestibular, Ocular-Motor, Cognitive, Anxiety/Mood, and associated conditions of Sleep-modifier, and Cervical Strain-modifiers.

Methods: An expert workgroup of 11 participants was established to lead the effort, in addition to panel of observers (4 federal as well as several representatives from academic organizations). Following rigorous methodology, a comprehensive literature search was conducted for applicability to the subtypes of concussion followed by systematic review. Data-extraction and meta-analysis identified subtype prevalence and possible trajectories of recovery in various populations.

Results: Over 3,000 applicable studies were identified and reviewed for inclusion. Data-extraction and meta-analysis are currently underway.

Conclusions: The assessment of post-injury risk factor clinical trajectories via concussion subtypes will aid in understanding and targeting specific clinical interventions as well as drive future research.

Growth Hormone as Therapy for Fatigue in mTBI

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Background: Approximately 2 million people experience a traumatic brain injury (TBI) each year, including up to 90% mild TBI (mTBI) cases. Many mTBI patients suffer from impairments and increased fatigue for many years following the initial injury.

Objective: The goal was to determine whether central and/or peripheral fatigue can be reduced in mTBI patients with abnormal growth hormone (GH) secretion by treating them in a crossover fashion based upon GH status.

Methods: Qualified consenting mTBI patients were randomized in a double blinded crossover study. Subjects received either GH (Genotropin) or placebo for 3 months (0.4 mg per day for the first month and 0.6 mg per day for the next 2 months) followed by crossover treatment for another 3 months. All subjects received open label GH treatment for the remaining 6 months of the study. Assessments included body composition, cognition, muscle performance, muscle fatigue, perceptual fatigue, and brain connectivity (fMRI).

Results: Whole body and regional lean body mass increased in response to GH treatment while fat mass and percent fat declined. Muscle performance and fatigability remained unchanged but self-reported (perceptual) fatigue was lower after treatment. Analyses of cognition and brain connectivity data are in progress.

Conclusions: Replacement of GH may be an effective strategy for improving fatigue in patients with mTBI. The effects of GH treatment on muscle performance may be secondary to improvement in body composition and central fatigue.

Be Nimble and Quick: Developing and Implementing an Accommodations & Modifications Plan at an Independent School in Response to a Student Involved Emergency

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In the fall of 2013, three Upper School students from Wakefield School (a PK-12 Prep-School located in The Plains, Virginia) were involved in a nearly catastrophic boating accident the weekend before they were to start their Sophomore Year. The three girls were airlifted from the site of the accident and were all diagnosed with varying degrees of traumatic brain injury, future prognosis unknown. Working with medical personnel and outside clinicians, Wakefield School entered unknown territory in providing the girls with "return to school" plans.

The severity of the injuries the girls experienced were far beyond the scope of what the School had encountered before, yet Wakefield was committed to serving their needs. Each girl was a long-time member of the community, so a great deal of data existed regarding their previous academic and social histories. We also had excellent academic baseline material from PSAT scores and previous grades.

Relying on the hope of neuroplasticity and the potential for healing, the School developed academic support plans that went far beyond the scope of traditional concussion protocols. During the first year we heavily modified the academic program for each girl, inviting a great deal of both criticism and support from the faculty. Each year thereafter we worked to fine tune the accommodations and modifications in conjunction with outside clinicians, always informed by the newest research available.

Three years later, the accommodations and modifications the School put in place have proven effective as each girl has slowly dropped all academic modifications and functions with refined and basic accommodations. Each of the three girls has been accepted into College as of the time of this submission. They will all attend College with accommodations targeting academic and mental health needs. The girls and their families are all supportive of this submission and have stated that they hope the accommodations/modifications protocols used at Wakefield School might help other students. In this presentation we will share our Learning Support Plans, discuss our interactions with outside clinicians and attorneys, and share mistakes made, and lessons learned.

Discovering the Resiliency of Individuals with TBI and How It Impacts Transition

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Traumatic brain injury is increasing daily. Resiliency was examined in individuals with TBI and how it impacts transition. A female doctoral student was interviewed and demonstrated high resiliency with an acquired brain injury. In contrast, not all students have character traits of resiliency nor do they want to overcome obstacles that may be a current hindrance on their education. These findings suggest that individuals with dedicated support systems impact individual resiliency and therefore opportunities for transition success.

Keywords: TBI, resiliency, transition, post-secondary

TBI Case Study: Effectiveness of Home and Community-Based Rehabilitation Services Using Consumer-Driven Goal Planning

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Throughout the country, 29 states have traumatic and/or acquired brain injury Home and Community Based (HCBS) Waivers or 1115 Demonstration Programs available through Medicaid. The effectiveness of an intensive home and community based service program is an understudied and unfamiliar approach. Previous research has failed to address the outcomes resulting from synergy between intensive HCBS therapy, consumer driven goal planning, and community reintegration facilitated by a collaborative team of rehabilitation professionals. A model that incorporates high intensity collaborative rehabilitation between therapists and the consumer is successful in allowing individuals to attain functional outcomes of their choosing resulting in an overall increased participation in society and improved quality of life. We utilized the International Classification of Functioning (ICF) model as a framework to guide a retrospective biopsychosocial analysis of the case of a 37-year-old male Marine Corps veteran who sustained a severe traumatic brain injury resulting from a motor vehicle accident and required intensive rehabilitation services. Rehabilitation services included intermittent cognitive and occupational therapy, consistent speech therapy, physical therapy at treatment outset, and transitional (independent) living skills coaching. This model of TBI rehabilitation proved effective for the individual as he made substantial gains across expressive and receptive communication skills, physical function, ADLs and IADLs, including management of finances and health maintenance needs. Additionally, this individual achieved independent living in the community and maintained steady employment for multiple years. Further research is needed to document the effectiveness of this specific rehabilitation approach across a wider population of participants.

It Takes a Village: End of Life and Long-Term TBI

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Providing end-of-life care for TBI individuals is multifaceted. Challenges for compassionate care arise when transitioning from a brain injury rehab model to one including palliative care. Preparing the individual, family and team for managing complexities of cancer care and co-morbidities is complex.

The rehabilitation team's instrumental role in managing behavioral and cognitive issues along with medical instability becomes a true struggle in efforts to provide high quality of care to ensure comfort, utilize active listening skills and review information while addressing medical issues arising throughout disease course.

The role of the rehabilitation team is the key to success of TBI and Cancer care. This presentation will describe this process and structural supports developed and implemented for two residents requiring hospice in a long-term residential setting. Challenges for compassionate care included preparing resident, family and team for managing complexities of terminal illness and co-morbidities compounded by TBI sequelae. The rehabilitation nurse orchestrates both rehabilitation and hospice care teams to address behavioral, cognitive, and medical issues that arise throughout disease course.

Ensuring comfort and quality of life becomes priority while determining placement for Hospice and assisting clients to identify what is important and how the client and caregivers will/are coping. The rehabilitation nurse spearheads team's efforts in assisting client and family to determine the right time to shift approach from "rehab" treatment to palliative care.

The rehabilitation team faces unique challenges when balancing client concerns with those of caregivers. Medical, behavioral and cognitive concerns of patients are vital in regard to cancer care and end of life. Fluidity between them and their caregivers can consist of complex medical decision-making, disease course, grieving process, fear of unknown and moving forward after death. The rehabilitation team exemplifies exquisite skills in complex medical care coordination when transitioning from a traditional brain injury rehab model to palliative care with a broad and holistic approach. Examples of this fluidity are described via empathic approaches.

To prepare for the expected vs unexpected utilization of a "Final Wishes" form has been useful to initiate conversation. All necessary details are documented, including advanced directives should they ever be needed in an effort to support residents & family/support system through the rehabilitation process & life events which could include death. Examples of individual personal preferences are identified regarding specifics of desired type of service, music, scripture/readings and celebration.

Multiple examples of the rehabilitation team's aftercare of residents' peers, family and team members are discussed to honor the life of the residents and provide opportunity to process loss.

Disparities and Bias in the Evaluation and Reporting of Pediatric Abusive Head Trauma

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Objective: To characterize racial/ethnic disparities in the evaluation and reporting of suspected abusive head trauma (AHT) across the 18 participating sites of the Pediatric Brain Injury Research Network (PediBIRN). We hypothesized that such disparities would be confirmed at multiple sites and occur more frequently in patients with lower risk for AHT.

Study Design: Aggregate and site-specific analysis of the cross-sectional PediBIRN dataset, comparing AHT evaluation and reporting frequencies in subpopulations of White/non-Hispanic and minority race/ethnicity patients with lower vs. higher risk for AHT.

Results: In the PediBIRN study population of 500 young, acutely head-injured patients hospitalized for intensive care, minority race/ethnicity patients (n=229) were more frequently evaluated [P < 0.001, adjusted odds ratio (AOR) 2.2] and reported [P = 0.001, AOR 1.9] for suspected AHT than White/non-Hispanic patients (n=271). These disparities occurred almost exclusively in lower risk patients, including those ultimately categorized as non-AHT [P = 0.001, AOR 2.4 and P = 0.003, AOR 2.1] or with estimated AHT probability $\leq 25\%$ [P < 0.001, AOR 4.1 and P < 0.001, AOR 2.8]. Similar site-specific analyses revealed that these results reflected more extreme disparities at only two of 18 sites, and were not explained by local confounders.

Conclusion: Significant race/ethnicity-based disparities in AHT evaluation and reporting were observed at only two of 18 sites and occurred almost exclusively in lower risk patients. In the absence of local confounders, these disparities likely represent the impact of local physicians' implicit bias.

Estimating the Probability of Abusive Head Trauma Before and After Abuse Evaluation

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Background and Objective: PediBIRN investigators have derived and validated a clinical prediction rule (CPR) that facilitates patient-specific estimation of abusive head trauma (AHT) probability before abuse evaluation based on different combinations of four predictor variables. The effort required the capture of extensive, uniform, prospective data regarding 500 young, acutely head-injured children hospitalized for intensive care across 18 sites. Our objective was to derive a novel CPR that will facilitate patient-specific estimation of AHT probability after abuse evaluation.

Study Design: Secondary analysis of the cross-sectional PediBIRN dataset, including: (1) multiple logistic regression to impute the results of skeletal surveys and retinal exams never ordered or completed, (2) logistic regression with lasso penalty across 1,000 imputed datasets to identify an expanded cluster of reliable predictor variables that incorporates the predictive contributions of completed abuse evaluations and performs with enhanced predictive accuracy based on AHT definitional criteria, and (3) calculation of (mean) patient-specific estimates of AHT probability across 1,000 imputed datasets for every observed combination of the new CPR's predictor variables.

Results: Logistic regression and ranking of candidate CPRs facilitated derivation of a new 7-variable CPR with overall sensitivity, specificity, and area under the receiver operating characteristics curve of 0.83, 0.90, and 0.90, respectively. Mean estimates of AHT probability for the 72 observed combinations of its seven predictor variables ranged from 0.04 [95% confidence interval (CI): 0.02-0.07] to 0.996 [95% CI: 0.986-0.999].

Conclusion: Seven variables facilitate patient-specific estimation of AHT probability that can inform final impressions of AHT vs. non-AHT after abuse evaluation.

Electroencephalographic Trajectory of Mild Traumatic Brain Injury: A View Through the Prism of Pathogenesis

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Electroencephalographic (EEG) abnormalities caused by mild traumatic brain injury (mTBI) are often subtle and might undergo resolution rather quickly. However, recent studies show the possibility of periodization of EEG changes after mTBI. Neuroanatomic basis and neurochemical correlates of these changes are apparently complex and still poorly understood. We try to determinate the key neurochemical and morphological substrates underlying the electrophysiological abnormalities following mTBI. We put the main emphasis on EEG abnormalities defined by visual analysis as a most available method for clinicians. An initial epileptiform activity often can be registered immediately after mTBI. This fact is partially explained by increased glutamate network activity (especially in injured cortex) along with compromising inhibition of GABAergic system. Epileptiform activity is followed by a period of suppressed cortical activity lasting for several minutes (typically for 1-2). It is considered neuronal silencing to be the consequence of lowering neuronal energetics due to increased level of glutamate and decreased level of GABA. Following the EEG suppression is a period of generalized slowing that is lasting up to 60 minutes.

Decreased alpha frequency and subtle to mild generalized and focal slowing on EEG can be found within hours or days after mTBI. The decrease of high-frequency and the increase of slow-frequency EEG activity may originate from impairment in the cholinergic neural projection spreading out from the reticular formation and basal forebrain to thalamic nuclei and cortex.

Gradually increases in alpha frequency can be usually discovered on EEG within several weeks or months after mTBI. This phenomenon is presumed to be a return to the individual's initial dominant alpha frequency. It can particularly reflect recovery cholinergic transmission (in the sensory thalamic nuclei and thalamocortical radiations) underlying modulation of alpha rhythm.

The low-voltage alpha and reduced alpha power rhythm may appear at several months or years after mTBI and may indicate the persistence of dysfunction in thalamocortical circuits.

Chronic epileptiform activity is probably related to impairment of septo-hippocampal GABAergic neurons. Furthermore, at least temporal lobe epilepsy is suggested to arise due to impairment in GABAergic transmission in the septo-hippocampal pathway in these patients.

Thus, EEG abnormalities can be contingently divided into abnormalities of acute, subacute and chronic period of trauma. EEG changes, that are defined at different periods, apparently have pathogenic correlates prevailing at a certain stage of pathology.

Improvement in Auditory Comprehension Reaction Time Following a Sport-Related Concussion Is Linked to Visual Processing Abilities and Visual-Motor Speed

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Studies on mild traumatic brain injury (mTBI, concussion), common in athletic, reveal that this type of injury is heterogeneous, linked to complex and variable neuronal pathophysiology, resulted in different symptoms or recovery patterns. Post-concussion neurocognitive tests used for evaluation of athletes like ImPACT assess a wide range of cognitive functions including memory, psychomotor speed, attention, impulse control, executive function and reaction time. However, additional instruments often are included to evaluate other cognitive-communication behavior. To assess auditory comprehension abilities in athletes with concussion Salvatore et al. (2017) used the computerized version of Revised Token Test (C-RTT), and showed athletes had compromised auditory processing when compared to matched controls. Recently, we demonstrated (Bialunska and Salvatore 2017) that those deficits decreased over time. However, even 20 days after injury athletes showed accurate but delayed performance as a group. Furthermore, these athletes reached the level of controls on the ImPACT scores. We also observed that this effect was highly variable among patients, with some exhibiting little and others full recovery in reaction time during C-RTT performances. We decided to investigate these individual differences and further analyses using logistic regression modeling due to C-RTT consists of complex tasks which required auditory comprehension, but also multisensory processing (visual, auditory) and sensorimotor integration (moving objects). We tested whether a variable outcome C-RTT reaction time 20 days after injury across athletes depended on relatively spared or faster recovery of an individual's cognitive capacities, or/and other factors. We explored a variety of potential predictors namely results obtained from 143 controls and 85 athletes with concussion from three consecutive evaluation following injury on VIII Subtest of C-RTT, ImPACT, and Post-Concussion Symptoms Scale (previously published Bialunska et Salvatore 2017), together with additional data obtained on other clinical tools (fluency and balance tests), and demographic variables. Those variables were expected to predict whether C-RTT reaction time of the athlete with a concussion significantly improved from first to third evaluation.

Different models were tested; an optimal model, leading to the most satisfactory fit to the data was selected. The model provides a significant fit as compared to a null model ($-2LL = 84.01$, $\chi^2 = 23.73$, $p < 0.001$; Nagelkerke $R^2 = 0.34$). Interestingly, a positive change was predicted by visual processing capacities and visual-motor speed on second evaluation (specifically performance in both tasks of X's and O's Module, and interference task of Three Letters Module), as well as by impulse control and Efficiency Score of C-RTT from first evaluation. None of the examined verbal scores was significant. More severe deficits in C-RTT performance and impulse control right after the injury, low visual processing, but a prompt visual-motor speed foster a positive outcome timing of C-RTT performances on third evaluation.

The First National Concussion Return to Learn Consensus: Supporting the Interdisciplinary Needs of Children & Adolescents at School During Recovery

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The presenter of this session co-led the First National Concussion Return to Learn Consensus for the National Collaborative on Children's Brain Injuries (NCCBI) to guide professionals working with students following a concussion. Fourteen national organizations from across the United States involved in the fields of pediatrics, education, healthcare, sports, rehabilitation, and brain injury participated in the Concussion Return to Learn Consensus process. To date, emphasis in the literature has focused on return to play and sports for student-athletes. However, proper school-based concussion management includes a two-pronged approach (return to learn + return to sports) and must include all students, both athletes and non-athletes. Students following a concussion should return to the full day classroom environment without academic adjustments in place due to unresolved concussion symptoms, before the return to contact sports progression begins. However, there is a paucity of valid and accurate literature-based return to learn guidance available to schools, parents, and healthcare providers on this topic. Return to learn must involve consistent communication between medical, school, student, & family entities to facilitate potentially faster recovery and provide a supportive learning environment. This presentation highlights the importance of an interdisciplinary team approach led by school staff to address student concussion management. The consensus emphasizes the critical importance of collecting academic and symptom data during the school day to justify and guide educational decisions. Roles and responsibilities of school staff and healthcare providers are discussed. Use of correct educational terminology is emphasized. Discussion of the importance of establishing school-based return to learn concussion management teams and procedures are reviewed.

Objectives:

1. Participants will be able to identify the importance of establishing consensus-based topic areas to facilitate smooth school reintegration for students who experience a concussion.
2. Participants will be able to describe the consensus process and the national organizations who participated.
3. Participants will be able to explain the importance of school and healthcare management, as well as the specific roles and responsibilities of educators and healthcare providers during the course of a student's return to learn process after experiencing a concussion.

Neurolinguistic Evolution and Profile of Pediatric Patients Diagnosed with Autoimmune Encephalitis after an Intensive Rehabilitation Programme

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Introduction: Autoimmune Encephalitis is an entity which is becoming more frequent in our pediatric population. It presents involuntary movements, disorder of consciousness as well as language/speech. This entity was described by the first time in 2007. Due to its recent appearance, there has not been objective data available yet about its prevalence in the world and in our environment.

Objective: To describe the neurolinguistic evolution and linguistic profile when diagnosed-autoimmune-encephalitis patients were discharged after having received intensive rehabilitation treatment while being hospitalized.

Method: Retrospective, descriptive study of 6 autoimmune encephalitis diagnosed patients hospitalized between 2007 and 2017 in a neuro-rehabilitation centre. A neurolinguistic profile was defined when hospitalized and discharged, classifying them in two levels: Group A (aged 1 to 5) and Group B (aged 6 to 12). When being assessed standardized scales were used according to the age of the patient (ROWPVT, EOWPVT, TELD-3, CELF-4).

Results: 6 patients were included (5 of them had positive antibodies anti NMDA). The average age was 7.4 +/- 4.5 years old. 83% were males. When they were hospitalized 100% of the patients scored 4 or less according to Rancho Los Amigos Scale (RLA) displaying disorder of consciousness and language/speech as well as oromotor dyskinesia. 100% of the patients recovered their consciousness level showing an average score when being discharged (RLA score 7 and 8). When being discharged Group A exhibited average receptive abilities and showed difficulties in verbal expression. Group B presented below average linguistic abilities exhibiting difficulty in both comprehension and expression abilities.

Conclusion: The current study registers the favourable evolution in both groups. Group A achieved a linguistic performance (comprehension abilities) according to average age whereas loss of acquired linguistic abilities were observed in Group B. More samples are needed in order to develop a profile on this ethiology.

The First Results of Neurocognitive and Socio-Emotional Development Assessment in Children with Arterial Ischemic Stroke Started in the Early Stages of Life

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Paediatric Arterial Ischemic Stroke (PedAIS) is a severe disorder which can lead to motor and mental delay.

It is extremely important to study the recovery process of mental functions after PedAIS.

The aim of this research was to investigate the relationship between the time from PedAIS onset and neurocognitive development data in infants.

The Design: case-control study in small groups. We assessed neurocognitive and socio-emotional development of 11 children (5 male and 6 female). All of them had PedAIS, confirmed by brain MRI within 4 months of life or in fetal period (presumed perinatal ischemic stroke). The first point was at 5.7 months old, the second point was at 10.3 months old. Bayley Scales of Infant Development, third edition (BSID III) were carried out by two experienced specialists independently. Control group included 11 typically developed children matched in sex, gestation age, and current age at the time of BSID III assessment. All parents signed informed consent form.

Nonparametric criterion differences U for independent samples were measured (SPSS Statistics).

Results: The significance difference between the following scales at the first point were found: «Fine motor» (U=.010, p=.05), «Gross motor» (U=.023, p=.05), «Motor Sum» (U=.007, p=.05), adaptive behavior scale «Leisure» (U=.048, p=.05), and «Social Environment» (U=.020, p=.05).

There were no significant differences at cognitive, speech, social-emotional development according to all BSID III scales at the second age point of assessment.

Conclusion: The first results in small groups demonstrate the absence of differences in neurocognitive and socio-emotional development in children 10 months after PedAIS in comparison with the results in immediate post-stroke period as well as data in control group. Neuroplasticity of children brain on early stages of life, medical and rehabilitation interventions within the acute and the recovery periods and other modifying factors were considered to have the significant impact and are required to be investigated further.

TBI Advocacy Navigation Amidst Hospital Bias: A Case Study

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Persons with traumatic brain injury often face quality of life issues related to secondary medical complications. Rehabilitation nurses have been invaluable providing ongoing and comprehensive advocacy for their medically complex patients receiving care outside their TBI program. While being equally passionate about identifying and justifying functional rehab goals to ensure safe return to their program it is especially critical to help navigate advocacy of chronic brain injury care through a continuum that can include transition challenges and bias management. Continuity of medical care across environments and appropriate placement to meet cognitive and/or behavioral needs hinges on meaningful brain injury education for all caregivers and advocacy training for family and team members.

This case study illustrates the role and support of rehabilitation nurse advocates in the management of an individual 31 years post TBI living in a supported residential setting who experienced significant respiratory complications with co-existing comorbidities requiring hospitalization. Transition management, bridging communication within the hospital team and focused advocacy of special health care needs facilitated a discharge process to decrease biases surrounding this individual's rights. Coordination of care promoted a quality outcome. Presentation will identify conflict resolution in care decisions between physicians, rehabilitation team and insurance provider.

Is Involving Relatives and Friends Using the Three Dimension Model, Improving Emotional Stability After Brain Injury?

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Objectives: The 3-Dimension Model (TDM) has been presented in 2014 on a conference in Belgium as a psycho-educational and psychotherapeutic model in psychiatry, using an integrated position of the brain in psychiatric disorders.

In 2015 we presented in a new research that TDM could be a useful instrument in the rehabilitation of people with emotional lability after Brain Injury (12th Annual NABIS Conference on Brain Injury).

In 2016 we compared TDM with classic Cognitive behavior therapy (CBT) (11th annual world congress IBIA). In this pilot-study we try to find any difference in improvement of emotional stability when involving relatives and friends or not.

Method: In this prospective open label study we described the improvement of emotional stability using the Lability Affect Scale-Short Form (LASSF). We included 22 out-patients, 14 men and 8 women, with ABI. All subject were adults. We started the first measurement before the first TDM session. We repeated the sessions one and two months later and repeated the measurements one month after each session. In 11 patients we didn't involve relatives and friends (G-), in the other group of 11 patients we did involve them (G+).

All three sessions were mediated by the same investigator in presence of the patient. Sessions were limited in time to 60 minutes. Satisfaction of the sessions were qualified from 1 (very poor) to 5 (very good) by the patients at the end of the pilot-study.

Results: All subjects showed a marked improvement in the LASSF one month after the first TDM-session compared with the LASSF before starting the TDM-sessions. Two and three months later, less improvement in the LASSF has been showed in G- compared with G+.

Patients in G- qualified their satisfaction about the quality of the sessions less than patients in G+. No drop out has been recorded

Discussion: This pilot-study suggests that involving relatives and friends using TDM, improves emotional stability after brain injury more than when support group does not participate.

Further observations and investigations is needed to evaluate and confirm this pilot study.

Early Intervention Protocols Decrease Unplanned Hospitalizations in a Post-Acute Setting

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As we provide care to individuals who experienced their traumatic brain injury (TBI) many years ago, medical issues related to chronic problems associated with their disability arise. Reducing or avoiding unplanned hospitalization was the focus of an initiative to improve quality care within our post-acute setting. This paper will describe the process for identifying diagnostic categories that previously caused unplanned hospitalizations, the development and implementation of preventative practices and early intervention protocols and resultant outcomes.

Early intervention protocols have been utilized effectively in chronic diagnoses such as heart failure and asthma management to decrease ER visits and revolving door of hospital readmissions. The concepts of assessment and treatment interventions from these models of care delivery were applied to our care delivery model. The goal of the early intervention protocols was to avoid hospitalizations and minimize Emergency Department utilization for these primary care diagnoses that can be safely treated in the post-acute setting. The data suggests early interventions and preventative therapies have reduced the number of unplanned hospitalizations.

Late Cognitive Decline Following Deployment-Related Traumatic Brain Injury

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Traumatic brain injury (TBI) is a leading cause of morbidity and disability in veterans and active duty service members following combat deployment to Iraq and Afghanistan. Although mild TBI (mTBI) accounts for about 82% of all traumatic brain injuries in this military population, multiple deployments are common, and it is likely that a portion of this population has sustained repetitive mTBI. Preclinical research has demonstrated the deleterious effects of repetitive TBI, even when it is mild, and clinical studies conducted with post-deployment mTBI samples provide some initial evidence for changes on neuroimaging and the potential for late development of chronic traumatic encephalopathy (CTE). However, data from longitudinal studies examining post-deployment populations are just now starting to address the long-term effects of combat-related TBI.

Since 2009 a longitudinal study of deployment-related TBI has enrolled participants at the Michael E. DeBakey Veterans Affairs Medical Center in Houston, Texas. As of 10/31/2017, this project was following a total of 177 Operation Enduring Freedom/Operation Iraqi Freedom/Operation New Dawn veterans and reservists, including 137 individuals who reported a history of at least one deployment-related TBI (TBI Group) and another 40 with no history of TBI (Comparison Group). At that time the participants in these two groups did not differ significantly for age, education, estimated IQ (Barona), or years since deployment. Significant differences were found on the Combat Exposure Scale, Mayo-Portland Adaptability Inventory-4 Participation Index, total score on the Posttraumatic Stress Disorder (PTSD) Checklist - Civilian, Consistent Long-Term Retrieval (CLTR) from the Verbal Selective Reminding Test, the written score from the Symbol Digit Modalities Test, and the Mental Component Score from the Veterans RAND 36 Item Health Survey.

Twelve out of the 137 TBI Group participants (approximately 9%) were found to have exhibited a decrease of one standard deviation or more on CLTR between study assessments that were at least 18 months apart. Over this same time frame, these twelve participants were stable or exhibited improvement on measures of symptoms associated with common psychiatric conditions, including depression and PTSD. In addition, a review of their medical records revealed no other psychiatric or medical conditions that could explain the decline on cognitive testing. None of the Comparison Group participants had decreased performance on CLTR and about 12% exhibited improvement.

Cognitive decline within this subset of TBI participants and the absence of other conditions that might explain the change is most consistent with the diagnosis of Mild Neurocognitive Disorder due to TBI. This progression may reflect the late development of TBI-related neuropathology, such as CTE. Additional follow-up assessments, including the use of research neuroimaging, are being performed as part of this ongoing project.

Use of Preference Assessments with Children with Disorders of Consciousness

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Introduction: Disorders of consciousness (DOC) can result from severe brain injury and are characterized by a lack of/ variable awareness of self and environment. Given subtle, inconsistent responses, this population poses unique challenges to engagement in rehabilitation. Individualized treatment programs are recommended, specifically, using personally salient items with assessment/ treatment (Perrin et al., 2015) or to shape command following (e.g., Lancioni et al., 2010). Structured behavioral preference assessments can help identify items for patients, including children with DOC, who may not be able to verbalize preferences (Amari et al., 2017). This study describes the methodology and application of preference assessments with children with DOC.

Methods: Clinical data for a series of children (ages 6 months- 21 years) with DOC who admitted to an inpatient unit for interdisciplinary neurorehabilitation were retrospectively reviewed. As part of clinical care, caregivers and staff were interviewed via structured questionnaire (the Preference Assessment for Youth with Disorders of Consciousness (PAYDOC); Amari et al., 2017) and unstructured interview to identify potentially salient and/or motivating stimuli based on past history and current observation, in addition to subtle and emergent response topographies. Individualized preference assessments were conducted with all participants. Based on interview, select items were systematically presented through repeated randomized trials. Idiosyncratic positive, neutral, and negative responses were operationalized and recorded across trials.

Results: Across the pediatric age range, preference assessments resulted in identification of subtle, differential responses to stimuli. Specific stimuli were associated with increased positive responses (i.e., alertness, positive affect, calming), in addition to observed negative responses (i.e., grimacing, turning away, increased tone). In some cases, subtle variations in the stimuli presented affected the response elicited. Salient stimuli were subsequently incorporated into patients' therapies to help with arousal, calming, or to provide motivation for specific tasks.

Conclusions: Despite age and profoundly limited communication, these children with DOC were capable of exhibiting differential responses when personally relevant stimuli were presented. Systematically conducted preference assessments can yield clinically useful information to incorporate into a rehabilitation program for children with DOC. Purposeful utilization of these items has the potential to increase arousal and/or positive affect, enhance participation in rehabilitation therapies, and promote quality of life for those with DOC.

Inter-Alpha Inhibitor Proteins (IAIPs) Reduce Neutrophilic Infiltration into Brain and Relative Increases in Systemic Neutrophils in Neonatal Rats after Hypoxic-Ischemic (HI) Brain Injury

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Background: Inter-Alpha Inhibitor Proteins are anti-inflammatory serine-protease inhibitors that we have previously shown to exhibit neuroprotective properties. IAIPs reduce histopathological brain injury, apoptotic cells in the brain, and improve neurobehavioral outcomes in neonatal rats after HI. However, the mechanism(s) of neuroprotection remain to be determined. Neutrophils are systemic immune cells that can penetrate the blood brain-barrier (BBB) after HI brain injury exacerbating neuroinflammation.

Objective: To determine the effects of IAIPs on neutrophilic infiltration into the brain and systemic effects by measuring the Complete Blood Counts (CBCs) in neonatal rats after exposure to HI brain injury.

Design/Methods: Postnatal day 7 rats were assigned to one of three groups: a non-ischemic sham-control group (Sham), a right carotid ligation and hypoxia-exposed (8% oxygen for 90 min) placebo-treated group (PL-HI), or an IAIP treated group (IAIP-HI). Rat sex was recorded. IAIP (30 mg/kg) or PL was given intraperitoneally at 0, 24 and 48 h after HI. Number/group/sex ranged from 6-11. 72 hours after HI brain tissue and whole blood were collected. We performed immunohistochemistry with MPO (neutrophil selective) and MMP9 fluorescent markers. Stereological analyses with the StereoInvestigator 10.0 Fractionator probe was performed without knowledge of group assignments to quantify neutrophils and MMP9 positive cells in the brain. CBCs were analyzed (Siemens Advia Analyzer) on whole blood to quantify the total number of white blood cells (WBCs) and % neutrophils per total WBCs.

Results: Immunohistochemical analyses showed that MPO positive cells were significantly reduced in male IAIP treated rats compared with PL-HI in the overall damaged hemisphere ($p < 0.01$) and the corpus callosum ($p < 0.05$). MPO and MMP9 staining co-localized. Treatment with IAIPs reduced the number of MMP9 positive neutrophils in the cortex of male rats vs the PL-HI group ($P < 0.05$). CBC analyses showed no significant differences in the number of WBCs between PL-HI and IAIP-HI groups. However, % neutrophils was reduced in male, but not female, IAIP-HI rats as compared to the PL-HI group ($p < 0.05$).

Conclusion(s): Taken together our findings suggest that IAIPs may exert their neuroprotective effects in part by reducing the percent of circulating neutrophils resulting in a potential reduction in neutrophil infiltration in the brain of HI male but not female rats.

When Normal Is Wrong: Cognitive Challenging in The Assessment of Mild TBI

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In the neuropsychological assessment of persistent post-concussion syndrome, it is not uncommon for a patient to perform normally on standard neuropsychological measures despite complaints of cognitive difficulty. Some resolve this dilemma by trusting the test results as a true reflection of a normal cognitive state. This opinion does not have good “ecological” validity. In the 1970’s there was a debate regarding the long-term impact of alcohol use on cognitive functioning. Many studies indicated the absence of long-term cognitive impairment. Following a series of investigations conducted by Butters & Cermak, in which they demonstrated that the lack of consistency in the literature was due to poor sensitivity of the neuropsychological tests utilized. Recently, in the area of mild cognitive impairment (MCI) it has been demonstrated that patients who complain of cognitive changes in spite of the presence of normal neuropsychological test results (Stage 1 Alzheimer’s—asymptomatic), actually demonstrated impairment when the neuropsychological assessment utilized a non-standard “challenge” task that allowed the examiner to evaluate vulnerability to proactive and retroactive forms of interference. In the present investigation, 30 individuals with a history of persistent post-concussion and subjective cognitive complaints were evaluated using a standard neuropsychological assessment approach with an additional cognitive challenge task the measures the patient’s ability to tolerate distraction when attempting to encode new verbal/auditory information (recalling brief 4-word lists of words). Recalling a brief list of words while being distracted challenges the “working memory” system and encoding process. A lack of cognitive efficiency is often a consequence of mTBI. Unfortunately, the measures used to evaluate memory are not sensitive to subtle changes in cognitive efficiency and it’s not uncommon for a patient to complain of “memory” difficulty despite normal test results. In this investigation, patients with normal neuropsychological profiles but with cognitive complaints were compared to normal controls and also individuals diagnosed with ADHD utilizing the short-term memory challenge test. This test is sometimes referred to as the Four-Word Short Term Memory Test and requires the individual to recall lists of 4 words (e.g. stain, lawn, cottage, angel) while at the same time being purposely distracted by counting backwards from a three-digit number (e.g. 100) for either 15-seconds or 30-secnds. There are 5 trials randomly disbursed for each condition (length of time being distracted). The results indicated that those patients with normal neuropsychological profiles but with subjective complaints of memory difficulty scored significantly lower (less tolerance for distraction) on both the 15 and 30-second distraction periods than both ADHD diagnosed individuals and normal controls. These results point out the importance of using challenge approaches when an individual has subjective symptoms but normal results on standardized testing.

Females with History of Brain Injury Improve Depression During 8 Week Intervention

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Background: Brain injury can trigger depression. We document the effect that a facilitated community intervention has in females with a history of significant brain injury.

Methods: Participants from 5 continents who finished a community based depression and anxiety educational program were studied. Those who chose to participate met once a week for 8 weeks for a 2-hour program. It consisted of a 45-minute DVD presentation followed by a small group discussion. The program was offered in Spanish and English by previously trained facilitators that were certified. This program focused on educating participants on healthy behaviors such as exercise, plant-based diets, thought control, brain exercises, sleep hygiene and others. Each participant answered at the beginning of the program and at the end of the program the Depression and Anxiety Assessment Test (registration TX 7-398-022). It assessed depression level based on DSM-5 [The Diagnostic and Statistical Manual of Mental Disorders Volume 5] criteria, demographics and patient history including brain injury history. The depression was classified according to DSM-5 into 4 categories as none (0-6), mild (7-10), moderate (11-19) or severe (20 or more). Not all participants have a history of brain injury and not all participants were depressed.

Results: From n=5,861 participants that finished the 8-week program, n=212 were females with a history of significant head injury. This group's mean age was 52.8 (SD 15.5).

Baseline average depression was 15.3, SD 7.1, median 16, mode 21. The distribution of depression severity was 13.6% with no depression, 15.5% had mild depression, 36.3% had moderate depression and 34.4% had severe depression. By the end of the program the percentage that had some degree of improvement by severity was 93.1% with those with severe depression, 81.8% with moderate depression and 81.1% with mild depression.

At the end of the 8-week program the group end mean depression was 8.8 SD 6.7, median 8. mode 21. The end group depression distribution was 44.8% with no depression, 15% mild depression, 32% moderate depression and 8% severe depression.

The change in depression was significant $t(211) = 14.71$ with a $p < .001$.

Conclusion: The program is effective in the vast majority of participants with depression. This study was focus only on the immediate effects of the program a long term follow-up is planned.

Investigation of the Effect of Shear Stress and Intracranial Pressure in Impact Induced Coup and Contrecoup Brain Injury

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Traumatic brain injury (TBI) due to impact is one of the major cause of decease in car accidents. Based on the location of the impact, TBI can be divided into coup and contrecoup injuries. In case of impact, both coup and contrecoup brain injury may happen. However, different studies and observations suggest that contrecoup brain injury can be more severe and the main cause of fatality compared to coup injury.

In this study, using finite element method, several simulations were conducted with different speeds of rigid body impact under identical boundary condition. Pressure and maximum shear stress was calculated at coup and contrecoup site of the impact. The acquired results show that the ratio of the negative contrecoup pressure to the positive coup pressure increases as the speed of impact and brain acceleration increase demonstrating that the cushioning effect of CSF at the contrecoup site decrease as the impact gets harsher. Moreover, results indicate that maximum shear stress at the contrecoup site is approximately two times greater compared with the coup site.

If there is no skull fracture due to impact, it can be concluded that the decreasing cushioning effect of CSF and higher maximum shear strain in the contrecoup site can lead to more severe contrecoup injury compared with coup injury.

Comparative Study of Child and Adult Skull Vibration Frequency Response

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Numerical and analytical modeling of human head have been used in number of the brain injury investigations. In addition to validate the numerical simulations, head models should have similar frequency responses to the actual head. In this study, an adult finite element (FE) skull model was constructed and experimentally validated using modal analysis techniques. Furthermore, a dry middle aged female skull was scanned by 3D laser scanner. The created geometry model was meshed to be used in FE modeling. The skull was hanged by rubber band as free boundary condition and by using the roving hammer impact technique, the frequency response of the skull was measured to validate the numerical model. There are numerous studies on adult brain injury using the FE head models, however, the pediatric brain injury needs to be studied more. Child head size is approximately 6 in which is 67 percent smaller than an adult head (9 in). To this end, by changing the scale of the skull FE model, ratio of child and adult skull natural frequency were calculated. Experimental results showed that the first and second natural frequencies of an adult skull are 496.9 Hz and 560.9 Hz respectively. In addition, the natural frequencies of adult FE skull model for the vibration mode one is 518.2 Hz and mode two is about 536.67 Hz. However, the child skull FE model natural frequencies for mode 1 and 2 gives the 773 Hz and 801 Hz which are approximately 49 % higher than adult skull model. It can be concluded that although the geometry of child skull model is 67 % smaller, the natural frequency is 49 % higher than adult with the identical stiffness. This finding can be used in numerical brain injury study of child head models.

An Educator's Perspective

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Traumatic Brain Injury encompasses a vast array of outcomes for individuals who have sustained anywhere from a mild closed head wound to a major life-changing head injury. While sports-related concussions have increased the public's awareness of this issue, it is still largely misunderstood and difficult to recognize the daily struggles facing those impacted by brain injuries. Changes in learning modality strengths are often misunderstood by the individual impacted when trying to do things in the same manner that worked in the past.

After the medical community completes psychological testing and rehabilitative therapies, an educational TBI Specialist should assess and create a learning profile. The focus of this assessment is not to just report scores and note discrepancies, but rather to look for patterns in the responses that lead to pinpointing relationships between test performance and one's ability to acquire and retain new skills, and generalize and incorporate using them in novel situations.

There are four assessments that are ideal for analyzing the after-effects of a TBI on an individual's learning profile. "The Test of Memory and Learning" examines all modalities (visual, auditory, and kinesthetic) for random recall, sequential recall, paired recall, backwards recall, and the effect of repeated rehearsals on recall over time. It provides information about how the quantity of information presented may impact one's ability to retain what is presented, process, manipulate, and respond to it, and whether pairing visuals with verbals improves recall.

"The Test of Visual Perceptual Skills" closely examines seven components of visual perception and allows the examiner to determine specific areas impacting one's ability to manipulate visual information. Early learning is largely comprised of visual instruction through the primary grades, so developing foundations in visual perception are tied closely with learning to read and performing mathematical skills beyond rote learning. The test examines one's ability to recognize similarities and differences including when items are rotated in space, recall isolated and sequential visual information, recognize how parts fit together to form a whole, and ability to isolate information within cluttered backgrounds.

"The Test of Information Processing Skills" assesses how well a person learns and retains new information (either seen or heard), and the effects of interference on those processes. The main components examined include free recall, directed free recall, word fluency, short-term recall, sequential vs. random recall, working memory, delayed memory, and the effects of acoustic intrusions. This test is instrumental for detecting whether an individual is having issues with environmental distractions.

"Screening for Scotopic Sensitivity Syndrome" is highly recommended because the condition is closely tied to this population and often occurs following a concussion. SSS is a light sensitivity that contributes to blurred vision, issues with depth perception, and headaches.

Exploring Gender Role Conflict and Social Expectations Among Women with Traumatic Brain Injury

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Gender role conflict is a psychological state that occurs when socialized gender roles conflict with current demands or pressures resulting in negative consequences or emotional distress. Persons with traumatic brain injury (TBI) may experience changes in social roles due to changes in employment, relationships, functional abilities, or independence, as well as expectations from others, which may result in gender role conflict. Scant literature exists on role conflict following TBI and no study has examined gender role conflict among a sample of ethnically/racially diverse women with TBI. Therefore, we explored gender role conflict and perceived social expectations among a diverse sample of community-dwelling women with TBI.

Using purposive quota sampling, women with TBI living in the community at least 3 months following discharge from a Level 1 trauma hospital or an inpatient rehabilitation hospital (Mean = 56.9 months) were recruited. Purposive sampling was based on time post injury (< 2 years, 2-5 years, >5 years) and race/ethnicity (White, Black, Latina/Hispanic). In-person, semi-structured qualitative interviews regarding the impact of TBI on gender role identity and perceived social expectations were conducted with 27 women at their residence or the research center. Interviews were audio-recorded and professionally transcribed. Transcripts were inductively analyzed by two independent coders using a grounded theory approach and entered into qualitative data analysis software (NVivo) to identify themes related to gender role conflict and social expectations.

More than half of the women perceived a change in their gender role identity leading to gender role conflict following TBI. Several changes were noted in how they view and express themselves as women, such as changes in body image, confidence, emotional functioning, fear or perceived vulnerability, femininity, pre-injury abilities, relationships, self-expression, and social roles. Others believed no gender role identity changes occurred; however, many of them experienced changes in social roles or body image. All of the women believed others placed certain expectations on them following injury, such as expecting them have the same pre-injury abilities or a more pronounced disability. Many women placed high expectations on themselves, such as having a faster recovery, returning to work or finishing school, which caused frustration and stress.

Gender role conflict may occur in women when they do not feel they fit their ideal view of how a woman should be, when they fit the socialized gender norms for women, but it causes them stress, or when their roles change due to the TBI-related consequences. These experiences may cause emotional distress, which is consistent with gender role conflict theory. The results of this study support the need for further investigation of the role of gender role conflict and social expectations to improve psychosocial adjustment to TBI among women with brain injury.

EEG Correlates with DTI Measures of White Matter Injury in Subacute Sports Concussion

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Objective: Prior reports utilizing advanced imaging modalities such as diffusion tensor imaging (DTI) in sports-related concussion studies have documented alterations in several brain regions at both subacute and chronic post-injury intervals. However, the relation between imaging-detectable alterations and clinical assessment remain largely unresolved. This study investigates potential relationships between DTI-detectable metrics and electroencephalogram (EEG) parameters in a multi-site study of concussed male and female collegiate athletes with prolonged return-to-play (RTP; greater than 14 days post-injury, with a mean of 24 days to RTP) based on clinician assessment (n=18) and in a healthy comparison group of uninjured, non-contact sports athletes (n=16).

Methods: Participant groups did not differ in age (concussed mean=19.8 ± 1.8 years; uninjured mean=19.8 ± 1.2 years; range 17-24 years), gender (concussed: 9 males/9 females; uninjured: 8 male/8 female), race/ethnicity, or handedness. All participants underwent magnetic resonance imaging on Siemens Prisma 3T scanners within 72 hours of sustaining a concussion. Diffusion-weighted images were preprocessed with VISTASOFT dtlinit software. Deterministic tractography using Automated Fiber Quantification (AFQ) software to reconstruct 18 white matter tracts including the corpus callosum genu and splenium, the right and left cingulum bundle (CB), the right and left inferior fronto-occipital fasciculi (IFOF), the inferior longitudinal fasciculi (ILF), the superior longitudinal fasciculi (SLF), and the uncinate fasciculi (UF). DTI metrics including fractional anisotropy, mean diffusivity, axial diffusivity, and radial diffusivity were assessed. EEG metrics, including measures of coherence, phase synchrony, entropy, and bipolar amplitude were collected using the portable Brainscope Ahead200® device. Pearson correlations were used to examine the relation between DTI and EEG parameters.

Results: Within the comparison group of uninjured athletes, correlational analysis revealed few significant correlations between the EEG and DTI parameters. However, several significant correlations (p<0.001) between DTI and EEG parameters were found within the concussed group, particularly in the left CB, right and left IFOF, right and left ILF and the left UF, and mainly for EEG measures of coherence and phase synchrony. In these correlations, higher diffusivity metrics were often associated with lower coherence and phase synchrony.

Conclusion: Alterations in EEG measures of coherence and phase synchrony appear related to DTI-derived metrics in several long white matter pathways in concussed athletes. These findings suggest the possibility of both structural and functional disruption following concussion with symptoms that persist beyond 14 days. Acute EEG may be useful in identification of athletes likely to have prolonged RTP and require additional intervention to manage their recovery.

A Case Series Investigating the Effect of Chiropractic Sacro Occipital Technique (SOT) and SOT Cranial Techniques Along with Neurotransmitter Enhancing Supplementation on Traumatic Brain Injury (TBI) Prognosis for Five Patients

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Introduction/Rational: This case series reviewed the effects of chiropractic care with and without nutritional neurotransmitter supplementation to enhance outcomes of TBI patients. Five patients were selected that fit the following criteria: (1) TBI insults were from under 3 months to 6 months, (2) patients were treated within the past 12 months, and (3) patients completed treatment that occurred from 30–180 days.

Case Series History: (1) 15-year-old patient suffering from fatigue and headaches from a post-automobile accident TBI. (2) 53-year-old female patient suffering from short-term memory loss resulting from a TBI after a fall on a concrete sidewalk. (3) 59-year-old female patient suffering from tinnitus from a post-automobile accident TBI. (4) 53-year-old male patient suffering from severe headaches and memory loss resulting from a post-automobile accident TBI. (5) 38-year-old patient suffering from TBI related headaches, fatigue and chronic neck pain from a strangulation event with severe neck injury.

Method/Approach: All 5 patients received chiropractic SOT and SOT cranial techniques and 3 of the 5 patients also received neurotransmitter enhancing supplementation. At the beginning and conclusion of care all patients had their neurotransmitter levels tested.

Results/Effects: The 3 patients who received both chiropractic care and nutritional supplementation improved in all neurotransmitter levels both inhibitory and excitatory. The 2 patients that only received chiropractic care did have increases in serotonin levels, but the other neurotransmitter levels only showed a trend toward normal levels, not as significant as those supplemented. Assessment of the 5 patients noted significant symptomatic improvement, with decreased pain and increased function.

Conclusions: The case series investigated how effective chiropractic care alone and chiropractic care with neurotransmitter supplementation might be on 5 patients suffering from TBI. While the chiropractic care rendered appeared to have a positive effect on pain and function, greater outcomes were found when combining neurotransmitter nutritional support, since this led to improved neurotransmitter levels on post-testing. Greater study is needed to determine if SOT chiropractic care and neurotransmitter nutritional supplementation could function as a conservative method of care for patients' suffering from TBI.