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North American Brain Injury Society's 12th Annual Conference on Brain Injury **Abstracts**



Dear Colleagues,

It is with great pleasure that we present the accepted abstracts from the North American Brain Injury Society's 12th Annual Conference on Brain Injury in this issue of the *Journal of Head Trauma Rehabilitation*. The conference will take place in San Antonio, Texas, on April 29-May 2, 2015.

This year we were delighted to have received an increase of over 40% in the number of abstract submissions from our previous conference. Submissions came from investigators and researchers from over 16 countries and from some of the world's leading academic and research institutions. Moreover, we were especially pleased with the high quality of the research submitted and with the broad range of topics that truly reflect the advances now being made across the continuum of care in the field of brain injury.

For those of you unable to attend the NABIS meeting, we hope that the abstracts presented in the following pages will at least give you a feel for our annual event. In addition the nearly 130 oral and poster presentations abstracted in this issue of the *Journal of Head Trauma Rehabilitation*, over 40 invited speakers will present on the latest advances in the science, rehabilitation and treatment of traumatic brain injury. The conference planning committee has developed an integrated educational program that promises to be of interest to researchers, clinicians, administrators, and other brain injury professionals. Emphasis will be placed on a multidisciplinary approach in the management of patients with brain injury from acute care through to community re-entry and beyond. The conference will be a four-day, multi-track event that will cover a variety of brain injury topics including medical best practices, rehabilitation, research, life-long living, pediatrics, and advocacy. The preliminary conference program is posted on the NABIS website, www.nabis.org.

This year, NABIS is pleased to offer two new exciting pre-conference sessions. The first session, led by Jeffrey Kreutzer, is entitled *Neuropsychology for Non-neuropsychologists: A Guide to Evaluation, Reporting, and Treatment*. The second pre-conference session is entitled *Neuropsychiatry of Traumatic Brain Injury* and will feature a panel of experts including David Arciniegas, Marilyn Kraus, Thomas McAllister, and Jonathan Silver.

We hope that you will join us in the Lone Star State this April! We also encourage you to consider becoming a member of our multi-disciplinary society by visiting www.nabis.org. Whether it is in the area of research or clinical care, NABIS stands behind the premise that advances in science and practices based on application of the scientific evidence will ultimately provide the best outcomes for those with brain injuries and the community as a whole.

Sincerely,

Jonathan Silver, MD
Conference Chair

Mariusz Ziejewski, PhD
NABIS Chair
Abstract Chair

The North American Brain Injury Society is entirely responsible for the scientific content of these abstracts. These abstracts have undergone peer review by NABIS to determine suitability for their national conference. No additional peer review of these abstracts was performed by the editor or editorial board of *JHTR*.

DOI: 10.1097/HTR.0000000000000150

0001**Strategies for Successful Implementation of Behavior Intervention Plan for Clients with TBI**

Category: Neurorehabilitation- Case report/Clinical Research

Author's preference: Oral

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Introduction/Rationale

Touchstone Neurorecovery Center (TNC) serves clients with traumatic brain injury (TBI). Many of the clients engage in significant physical, verbal, or sexual outbursts. Despite clinical need, there is a paucity of research providing examples of effective clinical strategies for direct care staff implementing behavior intervention plans (BIPs) to address these behaviors. Creating an interactive tool to educate direct staff on a client's behaviors, underlying needs, antecedents, and environmental triggers would facilitate successful implementation of BIPs. This study presents the case of a 25 year old male client (Ct) with TBI who exhibited significant outbursts directed toward TNC staff.

Method/Approach

An interactive guide was collaboratively developed between therapists and the Ct in conjunction with a BIP as reference for appropriate behavioral responses to interactions with others. The interactive guide included a psycho-education component to serve as a reference for information about receiving positive and negative attention from others, emotions, and healthy relationships, and was developed for the Ct to use alone, or with help from TNC staff members, to find appropriate responses for de-escalating inappropriate behaviors. It also assisted the Ct in identifying warning signs, choosing a coping strategy, and managing mood appropriately without engaging in outbursts.

Results/Effects

Prior to using the BIP and interactive guide, the Ct engaged in significant verbal, sexual, and physical outbursts requiring chemical restraint, on average; once per 3 days. Once the BIP was put into effect, the Ct engaged in significant physical, verbal, or sexual outbursts only twice during a 190 day period. Chemical restraint was required during one outburst only. The Ct's longest period of consecutive days of appropriate behavior was 102 days. Additionally, the Ct began initiating requests to talk with therapists and trusted staff, or engaged in self-soothing behaviors outlined in the interactive guide without prompting when noticing anxious features, and successfully managed their mood without escalating behaviors.

Conclusions/Limitations

When addressing appropriate management of mood functioning and maintaining appropriate interpersonal behaviors for one particular Ct, the use of an interactive guide, in conjunction, with the BIP created between therapists and the Ct was found to be beneficial. Case studies by design, however, do not provide standardized results that are readily generalized. Additionally, it is difficult to determine the extent of efficacy for the BIP versus their interactive guide. Further research is

recommended in order to determine the extent of each strategy's efficacy and propensity for generalization to other clients with TBI.

0002**Changes in Intracranial Pressure Gradients Between the Cerebral Hemispheres in Patients With Intracerebral Hematomas**

Category: Neurotrauma- basic research

Author's preference: Oral

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Introduction/Rationale

Intracranial-pressure (ICP) monitoring is useful for patients with increased ICP after hemorrhagic stroke. In this study, we investigated the changes in pressure gradients between the two cerebral hemispheres after hemorrhagic stroke of one side and after a craniotomy.

Method/Approach

Twenty-four patients with acute cerebral hemorrhages and intracerebral hematomas who exhibited mass effect and mid-line shift to the contralateral side on computed tomography were selected. After admission, both sides of the cranium were drilled, and optical fiber sensors were implanted to monitor the brain parenchyma pressure (BPP) of both cerebral hemispheres. All patients underwent surgical hematoma evacuations. The preoperative and postoperative BPP data of both cerebral hemispheres were collected at different time points and compared in a pair-wise fashion.

Results/Effects

The differences in the preoperative BPP values between the two hemispheres at three different time points were statistically significant ($P < 0.01$). The differences in the BPP values between the two hemispheres at the time of surgery and 24 and 48 h after surgery were not statistically significant ($P > 0.05$). The BPPs of both hemispheres significantly decreased postoperatively compared to preoperatively.

Conclusions/Limitations

BPP sensors should be placed in the injured cerebral hemisphere, and the injured cerebral hemisphere becomes the source of increased ICP. Hematoma evacuation surgery effectively decreases ICP and eliminates the pressure gradients between the two cerebral hemispheres, thus allowing brain shift correction.

0003**Neurobehavioral Rehabilitation - A Case Study: Successful Progression Through a Continuum of Care**

Category: Neurotrauma - case report/clinical research

Author's preference: Poster

Tonia Wells, Melissa Hopkins

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Introduction/Rationale

Brain injury studies have shown that the first 18-20 months after brain injury presents the optimal window for neurorehabilitative recovery. This case study involving Steven R. illustrates successful progression through a neurobehavioral rehabilitative continuum of care 30+ years post-injury. Steven R. sustained frontotemporal brain injury secondary to a 10-15 foot fall at the age of 7, resulting in chronic behavioral dysregulation, including physical aggression, anxiety disorder, and seizure disorder. Steven R. received no rehabilitation intervention. In 1999, he ceased all prescribed medications marking the beginning of a critical decline in his mental health status and an increase in significant legal troubles.

Method/Approach

Touchstone Neurorecovery Center's treatment model is a post-acute continuum of care designed to be patient-centered, meeting the individual's needs and providing for freedom of choice. This treatment model provides tailored services including neuromedical management, rehabilitation services including therapeutic and behavioral programming, independent living services, vocational/educational services, and structured day programming. Residential services are provided through a series of cottages that provide a homelike setting with varying levels of support ranging from high levels of supervision to supported independent living.

Results/Effects

Upon admission, Steven R. exhibited cognitive deficits; pressured speech; poor concentration; perseveration; poor reasoning, judgment, problem solving, and decision making skills; poor understanding of cause/effect; poor impulse control; and physical aggression. He required maximum assistance with instrumental activities of daily living. The goal of this case study was to illustrate how, despite the lack of early rehabilitative intervention, Steven R. successfully progressed through the treatment model continuum of care at Touchstone, from secure neurobehavioral residential treatment targeting stabilization, constraints to learning, coping skills, and maladaptive behaviors, to eventual community living focusing on independent living skills, self-regulation, and vocational training and productivity.

Conclusions/Limitations

When designed by person-centered principles, neurobehavioral rehabilitation is a successful intervention regardless of the duration of injury.

0006

Adjustment in Life After Traumatic Brain Injury: The Impact of Cognition, Employment, and Perceived Sense of Purpose in Life

Category: Neurorehabilitation - basic research
Author's preference: No preference

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Malvern, Victoria, Australia, ⁵Austin Hospital, Heidelberg, Victoria, Australia, ⁶Royal Talbot Rehabilitation Centre, Keew, Victoria, Australia

Introduction/Rationale

Traumatic brain injury (TBI) affects the most wide-ranging domains of survivors' lives, markedly reducing emotional health and quality of life. The primary objective of this study was to explore the widely proclaimed therapeutic effect of employment on psychological wellbeing (PWB) and quality of life (QoL) relative to perceived sense of purpose in life (PIL). An additional aim was to examine the influence of factors involving cognitive function, injury severity, age at time of injury, gender, and pre-injury education, on survivors' work ability and return to work (RTW).

Method/Approach

A mixed methods design was used for an in-depth and comprehensive understanding about adjustment in life post-TBI. Participants (N = 40; 10-18 months post-TBI) were grouped according to age: 18-39 years (younger group), 40-55 years (older group) and injury severity (Glasgow Coma Scale scores): mild TBI (n = 25), moderate-severe TBI (n = 15). Quantitative Component: Neuropsychological testing and questionnaire surveys were performed to evaluate participants' cognitive function, levels of perceived work gainfulness, PIL, PWB, and QoL. Qualitative Component: 12 participants (6 from each severity group) were randomly selected for digitally recorded semi-structured interviews, predominantly concerning the impact of work and life meaningfulness on adjustment process.

Results/Effects

Quantitative data was analyzed using bivariate and multivariate analyses of variance, aided by SPSS computer software. Qualitative interviews were analyzed using grounded theory methodology. Findings indicated that PIL, in comparison to employment, cognitive function, and injury severity, made the strongest unique contribution in explaining PWB and QoL (p < 0.001). Employment potential was largely affected by memory and injury severity, with memory deficits (p < 0.01) and injury severity (p < 0.05), respectively, associated with deteriorated employment potential.

Conclusions/Limitations

Having a strong sense of life as purposeful, notwithstanding employment, cognitive function, and injury severity, encouraged survivors to focus on their lives and important life goals and to, ultimately, achieve a promising life with healthy wellbeing.

0007

Botulinum Toxin Type-A in the Management of Spastic Equinovarus Deformity After Stroke: Comparison of Two Injection Techniques.

Category: Neurorehabilitation- Case report/Clinical Research
Author's preference: Oral

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Introduction/Rationale

Botulinum toxin is commonly used to treat post stroke lower limb spasticity. At this time, however, there has been no agreement on the number of injection sites for the best delivery of the toxin into the calf muscles in order to elicit its therapeutic effects. The objective of this research was to compare, retrospectively, two injection techniques in the management of spastic equinovarus deformity after a stroke.

Method/Approach

Patients with stroke were seen at King Hussein Medical Center in 2009. Botulinum toxin was injected into the calf muscles at 2 sites in group I (12 patients) and at 4 sites in group II (14 patients). Functional gain was evaluated by the amount of time it took to walk 10 meters at month 1, 3, and 6, compared with the baseline.

Results/Effects

There was significant improvement in walking time in each study group. There was, however, no significant difference between the two groups as measured by the 10-meter walking time.

Conclusions/Limitations

Fewer injection sites would minimize patient discomfort and possibly the production of antibodies, yielding similar therapeutic effects.

0008

Association of Boxing Commissions Brain Health Survey

Category: Neurotrauma – prevention and public health
Author's preference: Oral

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Introduction/Rationale

Acute and chronic brain injuries are the most common injuries sustained by boxers. The sport has long been regulated by state commissions, but unfortunately, these governing bodies vary greatly in providing for the neurological health of boxers. With studies estimating that up to half of all boxers will suffer from chronic traumatic brain injuries (TBIs), it is critical that all states develop uniform minimum requirements for brain safety. This research developed a cross sectional survey to determine the uniformity of neurological care among various state and tribal athletic commissions regarding combat sport participants in the United States.

Method/Approach

A cross sectional survey was sent by email to each active state and tribal commission of the Association of Boxing Commissions (ABC). Data was collected online through the completion of a formal questionnaire.

Results/Effects

Of 66 active state and tribal athletic commissions listed on the ABC website, a total of 27 responses were received (40.9% response rate). Of those respondents, only 7.4% required baseline neuropsychological testing prior to obtaining licensure. 11.1% required neuropsychological testing after a technical knock out (TKO) or knock out (KO) loss. 11.1% required neuropsychological testing on “high risk” fighters and/or those 35 years and older. In the same subset of “high risk” and/or older fighters, 44.4% of respondents required a formal evaluation by a neurologist or neurosurgeon in order to be granted further clearance to compete.

Conclusions/Limitations

The evaluation of brain “fitness” to fight in combat sports is quite variable, and is dependent upon specific jurisdiction. Traditional approaches used to determine a readiness to return to sport participation after a concussion are inconsistently applied when compared to other contact/collision sports. Furthermore, few athletic commissions require either formal consultation with a neurological specialist (i.e. neurologist, neurosurgeon, or neuropsychologist) or formal neuropsychological testing before returning to fight.

0009

Acute Spontaneous Cervical Spinal Epidural Haematoma, A Very Rare Presentation During Sleep

Category: Neurorehabilitation- Case report/Clinical Research
Author's preference: Oral

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Introduction/Rationale

The purpose of this paper is to report a unique case of Acute Spontaneous Cervical Spinal Epidural Haematoma (ASCEDH). This involved a patient waking up early in the morning due to severe neck pain and significant weakness on the left side of the body. ASCEDH is an uncommon neurological condition with no identifiable aetiology. Its presentation during sleep is a very rare phenomenon. It is an uncommon cause of acute spinal cord compression.

Method/Approach

In this paper we report a case of ASCEDH in a 42 year old male army officer who had no previous medical illness. The magnetic resonance imaging (MRI) of the cervical spine revealed a cervical epidural haematoma at C3/C4, mainly on the left side, with spinal cord compression.

Results/Effects

An emergent C3/C4 hemilaminectomy and evacuation of haematoma was carried out within 24 hours of presentation. The patient's neck pain resolved after surgery and he was able to walk, after one week, despite requiring bladder catheterization upon discharge.

Conclusions/Limitations

It must be noted that the clinical presentation of the cervical epidural hematomas can be “hemiparesis” and can be misdiagnosed as a cerebral vascular accident (CVA) at the emergency room. The patients must, therefore, be screened for ASCEDH in order to prevent this kind of diagnosis.

0010

Project Career: Development of an Inter-Professional Program to Support the Transition of Students With TBI From Postsecondary Education to Employment

Category: Technology – basic research

Author's preference: Oral

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Introduction/Rationale

Individuals with traumatic brain injury (TBI) and cognitive impairments, such as deficits with memory, often have difficulty gaining and maintaining employment. Best practices exist in the field of assistive technology that help individuals compensate for cognitive impairments, and in the field of vocational rehabilitation that enhance employment outcomes. These practices have not yet been merged, however, to address the needs of individuals with TBI who are transitioning from undergraduate settings to employment. Kent State University, West Virginia University, Boston University, and JBS International have developed a program merging assistive technology and vocational rehabilitation best practices to support veteran and civilian postsecondary students, with TBI, who transition to employment.

Method/Approach

From 2013-2018, the project team is testing and refining a cadre of services and supports with a minimum of 150 civilian and veteran students with TBI. iPads provide the technological infrastructure for providing supports and services, including cognitive support technology (Apps), mentoring, case management, and follow-along support, to maximize students' career readiness and transition to employment settings. Additional services include field-based internship placements and support for post-graduation job placement. Program activities and qualitative and quantitative outcomes are assessed at regular intervals to assess the impact on students' academic and career outcomes and to continuously improve the program's activities and processes.

Results/Effects

In year 1, the project served 30 students, with TBI, at 11 universities. Two thirds of the students were male; the age range was 19-47; and one third were veterans. Students reported difficulty with memory, organization, frustration, fatigue, etc. due to their TBI. One half of the students had difficulty performing job tasks due to their TBI. As part of the program,

students have been matched with Apps using the Matching Person and Technology process and have received technology training/support, and educational and vocational support. One third of the students have been matched with mentors and one third have secured an internship, or paid work.

Conclusions/Limitations

Students have provided positive testimony about the project's benefit to them. The strength of the project lies in the individualized support provided, including comprehensive assessments and tailored services and supports that meet students at their level of function. The project helps students gain insight into their career choice, realize their strength, and helps motivate them, as well as feel more secure and confident. Mentoring is an essential component that is seen as very beneficial for guiding students. Increased attention to helping students secure internships to obtain work experience, and testing the usefulness of apps in professional settings, is needed.

0011

Medical Professional Presence and Return to Play Compliance in Concussed High School Athletes

Category: Neurotrauma – prevention and public health

Author's preference: Oral

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¹National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, Atlanta, GA, USA, ²Colorado School of Public Health, Aurora, CO, USA, ³SciMetrika LLC, Research Triangle Park, NC, USA

Introduction/Rationale

This study describes concussion rates in high school athletes and the involvement of medical professionals in complying with return to play (RTP) guidelines not previously examined.

Method/Approach

High school athlete concussion data were obtained from the National High School Sports-Related Injury Surveillance System (HS RIO™) for academic years 2009/10-2012/13. Certified athletic trainers (ATs) completed injury reports for each event. Compliance with guidelines, in days to RTP, was analyzed using logistic regression, adjusting for sport and injury related variables.

Results/Effects

There were 5,611 concussions sustained during 15,712,475 athlete exposures (AEs), a rate of 3.57 concussions per 10,000 AEs. Medical professionals were less likely present at the time of concussion for girls' sports, lower competition levels, and practices. Athletes treated by an AT, combined with another medical professional, reported more concussion symptoms, compared to those treated by an AT only (mean of 5.8 vs. 4.2, $p < 0.01$), and had a higher compliance rate with RTP guidelines (OR = 11.9, 95% CI = 6.3-23.0). Compliance was also higher based on physician type, recurrent concussions, school grades, sport, symptoms reported, and when a medical professional made the RTP decision.

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Conclusions/Limitations

Compliance with RTP guidelines, and the presence of medical professionals, varied by sport, gender, level of play, and exposure type. High school athletes sustaining concussions are best served by a multidisciplinary approach with ATs supervising the RTP protocol with support from physicians.

0012

Extradural Optic Canal Opening via Trans-superior Orbital Fissure Approach for Treatment of Traumatic Optic Nerve Injury

Category: Neurotrauma - case report/clinical research
Author's preference: Oral

Kentaro Mori, Hideaki Ueno, Naoki Otani, Satoshi Tomura, Kojiro Wada, Arata Tomiyama

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Introduction/Rationale

Current treatments for traumatic optic nerve injury include observation, steroid therapy, and optic canal opening. No optimum method has, however, been established. An optic canal opening can be performed by intradural and extradural methods. We retrospectively reviewed eight consecutive cases of traumatic optic nerve injury in patients aged 9 to 81 years (mean 57 years). The patients were treated by an extradural optic canal opening using mini-peeling of the lateral wall of the superior orbital fissure (trans-SOF approach), from 2000 to 2014. In this paper, we discuss operative techniques and the effectiveness of this method.

Method/Approach

After a fronto-temporal craniotomy, the frontal and temporal bases were flushed. The meningo-orbital band was cut and the dura propria of the lateral wall of the superior orbital fissure (SOF) and the anterior part of the cavernous sinus was partially peeled to expose the anterior clinoid process (ACP). The ACP was drilled away and the optic canal was opened widely using a micro-punch. Un-roofing of the orbit was added if the intra-orbital pressure was high.

Results/Effects

Traumatic optic nerve injury had occurred on the right in 4 cases and had occurred on the left in 4 cases. Preoperative visual acuity was blind in 2 cases, light sensitive in 5, and absent light reflex in 1. Optic canal fracture was recognized in 4 cases. Retro-orbital hematoma was seen in 2 cases and brain contusion in 2 cases. All cases were treated as emergent except for one case that was treated on the day after admission. Orbital un-roofing was added to extradural optic canal opening in two cases. Visual acuity recovered to useful in 6 patients. The two blind patients showed no change.

Conclusions/Limitations

Extradural optic canal opening, via the trans-SOF approach, is effective for traumatic optic nerve injury except for blindness. This approach is purely extradural without opening the

dura mater, so it is minimally invasive and applicable to patients with brain contusion.

0013

A Comparative Study on the Protection Efficiency of Combat Helmets Against Ballistic Impacts and Blast Waves

Category: Neurotrauma- basic research
Author's preference: Oral

Hesam Sarvghad-Moghaddam, Asghar Rezaei, Mariusz Ziejewski, Ghodrat Karami

North Dakota State University, Fargo, ND, USA

Introduction/Rationale

Blast and impact induced traumatic brain injuries (TBIs) are major concerns among military members as they can lead to post-traumatic stress disorder (PTSD), or even death. It is critical, therefore, that improvements continue to be made on protection of the head against these assaults. Currently, the Advanced Combat Helmet (ACH) is used in battlefields by service members. Although the helmets are designed specifically for ballistic protection, they need to provide maximum protection against blast shockwaves, as well. Accordingly, the protection capability of these helmets needs to be evaluated under ballistic and blast loading to highlight their performance in both conditions.

Method/Approach

The efficiency of current helmets, under both blast waves and ballistic impacts, was studied. North Dakota State University's (NDSU's) finite element head model (FEHM), supported by a padded ACH helmet, was employed to find the mechanical response of the brain when the helmeted head was subjected to blast waves, as well as to a projectile impact. LS-Dyna, a transient finite element (FE) solver, was used to perform both contact-impact and blast modeling. The head was exposed to both impact and blast loading from the front direction and tissue responses, in terms of intracranial pressure (ICP) and shear stress, were measured.

Results/Effects

The primary results revealed that at a given acceleration, the brain can predict different tissue responses due to the differences in the generation and propagation of stress waves inside the brain under impact and blast loads. Based on the peak values of ICP and shear stress, the helmet and padding system showed much higher protection efficiency under impact.

Conclusions/Limitations

It is believed that the study presented here can contribute to optimizing the design and configuration of the helmets shell and the padding system. Moreover, the results highlight the need for incorporating the tissue response of the brain as the main injury criteria in the design of protective headgears.

0014

The Influence of Directionality on Correlating Kinematical Severity to Tissue Level Injury of the Human Head

Category: Neurotrauma- basic research

Author's preference: Oral

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Mariusz Ziejewski, Ghodrat Karami

North Dakota State University, Fargo, ND, USA

Introduction/Rationale

Traumatic brain injuries (TBIs) can occur from incidents such as motor vehicle crashes, falls, and sports activities and are a major cause of death. The kinematical (accelerations) and tissue level (intracranial pressure (ICP), shear stress and strain injury-related biomechanical parameters of the head are used as the injury predictors for TBI. The mechanism of brain injury is dictated by the level of stress and ICP developed inside the intracranial space. Although kinematical response of the head is commonly used as the injury predictor, the correlation between kinematical and tissue level injury thresholds is essential in ascertaining the risk of injury.

Method/Approach

A numerical analysis was performed on the effects of the directionality by correlating the two brain injury thresholds to highlight the directional-dependency of the head mechanical response. Finite element (FE) simulations of four blunt impact scenarios were performed through the collision of an impactor with a validated FE head model at 1, 2, 3, and 5 m/s velocities using Ls-Dyna explicit nonlinear solver. The variation of shear stress, ICP, shear strain, brain acceleration and the head injury criterion (HIC) were evaluated. For a given load, a correlation analysis was performed among the biomechanical parameters in each direction.

Results/Effects

The primary results showed that there is no clear correlation between the kinematical and tissue level injury thresholds. It is asserted that the structural inhomogeneity of the head and the variations in the head components, in terms of the material properties and tolerance, leads to different mechanical responses of the head when the head is subjected to blunt impacts from different orientations.

Conclusions/Limitations

When defining the injury thresholds based on the kinematical response of the head, it was concluded that, the effect of directionality needs to be considered. Moreover, it is believed that the tissue responses should be considered as the main injury predictors as they reveal the level of damage to brain tissue. These findings have potential for contributing to the modular design of protective headgear.

0015

Airway Pressure Release Ventilation (APRV) use in TBI Patients: A Case Series

Category: Neurotrauma - case report/clinical research

Author's preference: No preference

Joseph Shiber, David Skarupa

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Introduction/Rationale

TBI patients often require mechanical ventilation (MV), sometimes for prolonged periods. The mode of MV can impact their recovery significantly. Traditional MV modes can be uncomfortable and often require additional sedation in order to tolerate the MV. This may not only interfere with performing neurological assessments but may also increase the incidence of delirium and impair cognitive performance. As a spontaneous mode, airway pressure release ventilation (APRV) is known to be more comfortable than other types of MV and thus requires less sedation. Being awake and breathing spontaneously is also associated with improved secretion clearance.

Method/Approach

18 patients, older than 14 years of age, admitted to a Level 1 Trauma Center Intensive Care Unit (ICU) with moderate to severe TBI between 6/1/2014 and 12/31/2014 were studied. The authors applied APRV as the primary mode of MV in these patients. We did a descriptive analysis of these patients looking at the use of sedation, occurrence and severity of delirium, need to change the MV mode, and need for therapeutic bronchoscopy. We also noted any adverse effects thought to be due to APRV.

Results/Effects

Most patients benefited from APRV requiring less sedation compared to conventional MV with less need for "sedation windows" to perform neurological examinations and less delirium. We changed other MV to APRV in order to assist in resolving delirium and to allow cognitive emergence. Patients requiring deep sedation for management of elevated intracranial pressure (ICP) did not fully benefit from APRV since without spontaneous breathing it becomes pressure control with an inverse I/E ratio. APRV can increase ICP if the elevated intra-thoracic pressure reduces cerebral venous outflow. We did not eliminate ventilator associated pneumonia (VAP) but secretion clearance was improved with less need for therapeutic bronchoscopy.

Conclusions/Limitations

APRV use in our series of patients appears to have been generally well-tolerated and associated with reduced need for sedation (particularly the use of Propofol, Fentanyl, and Midazolam). We believe that this led to less delirium in severity and duration. Although secretion mobilization was excellent we still had VAP occurrence. If deep sedation, or paralysis, is needed for ICP management then APRV is not recommended due to the lack of spontaneous ventilation potentially causing hypercarbia. Concomitant ARDS requiring high intra-thoracic pressure may reduce cerebral venous return.

0017

Management of Adult Post-Traumatic Hydrocephalus

Category: Neurotrauma - case report/clinical research

Author's preference: Oral

Ihab Zidan

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Introduction/Rationale

Post-traumatic hydrocephalus (PTH) is considered to be one of the complications that can affect the prognosis after

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traumatic brain injury (TBI) because of controversy about the best way of management. The goal of this work is to study the management and prognosis of adult patients with PTH.

Method/Approach

This study was performed in Alexandria University Hospital and included all adult patients who were admitted to the emergency department between January 2012 and December 2014 and were diagnosed with PTH. The diagnosis of PTH was based on both clinical and radiological criteria. The Glasgow Coma Scale (GCS) was used for initial assessment, as well as for monitoring the prognosis.

Results/Effects

In the present study, twenty five patients (18 men and 7 women) presented with hydrocephalus following head injury. The onset of hydrocephalus was immediate after trauma in 10 (40%) cases, whereas a delayed onset was observed in 15 (60%) cases. Of the 25 patients diagnosed with PTH, 8 patients were treated with an external ventricular drain, 12 patients underwent ventriculoperitoneal shunt placement, and 5 patients were treated with endoscopic third ventriculostomy (ETV). Long-term improvement was observed in 13% of the patients treated with external ventricular drain, 50% of the patients treated with shunts and 40% of patients treated with ETV.

Conclusions/Limitations

PTH can lead to significant morbidity and mortality. Ventriculoperitoneal shunts still remain as the most appropriate way of management, however, endoscopic third ventriculostomy can be beneficial in some conditions. The final outcome is related mainly to the initial GCS score, regardless of the management tool used.

0018

A Case Study on the Relationship Between Sensory Processing Skills and Academic Achievement in a 14 year old Female With Electrical Status Epilepticus During Sleep (ESES)

Category: Neurorehabilitation- Case report/Clinical Research
Author's preference: Oral

Dechantal Montano, Sara Naegele

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Introduction/Rationale

This case study shows a relationship between increased sensory processing skills and academic achievement for a 14-year-old female with infantile stroke and electrical status epilepticus of sleep (ESES) among other disorders. The objective of this study was to determine the relationship between an increase in sensory processing alertness/engagement and academic achievement for a student with ESES.

Method/Approach

An independent psychoeducational evaluation, modified Brigance Testing, and 7-sense diet tracking were used to gather baseline data. Diet measured levels of engagement (LoE) and alertness (LoA) on a 5 point scale. Modified 7- sense sensory diets were implemented up to 6 times a day in the first

4 months lasting for 15-30 minutes, and up to 3 times a day for the last 8 months. The academic program was two to three formal 30-minute individual, or small group, periods, and two formal 30-minute whole group periods for 12 months. A direct instruction model was used. Post-test academic and sensory processing achievement was measured one year after baseline was determined.

Results/Effects

At baseline, the student presented with an aversion to the diet protocol (0% for both LoE and LoA). The student tested at the pre-kindergarten level for word recognition and computation and kindergarten level for rote counting. For post-testing the student had to be alert 86.7% at level 3 (calm, neutral/neutral/awake) and 13.3% at level 2 (sleepy, intentional eye-closure) and engaged 68.3% at level 4 (engaged for 75% of the activity), 26.7% at level 3 (engaged for 50% of the activity) and 5% at a level 2 (engaged for 25% of the activity). Modified Brigance-Testing had her at 3rd grade on word recognition and computation (addition, subtraction, multiplication and division).

Conclusions/Limitations

This case study shows positive correlation between increased sensory processing alertness/engagement and academic achievement when sensory diets are administered. Increased sensory processing alertness/engagement plays a part in increasing academic achievement in children with ESES. Please note that additional therapies were performed throughout the student's day and may have played a role in her overall increase in academic achievement. Further work on the efficacy of sensory processing skills needs to be studied within a clinical based setting to determine if the benefits are generalized to other children within this population, as well as to other populations.

0019

KPT-350, A Selective Inhibitor of Nuclear Export (SINE) Compound, Improves Behavioral and Histological Parameters in a Rat Model of Traumatic Brain Injury

Category: Neurotrauma- basic research
Author's preference: Oral

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Introduction/Rationale

KPT-350, is a small molecule, orally bioavailable Selective Inhibitor of Nuclear Export (SINE) compound, which inhibits Exportin 1 (XPO1/CRM1). Exportin 1 is the primary nuclear export protein, with >200 cargos that include a variety of proteins involved in neuronal survival and inflammation. We have recently reported KPT-350 exerts therapeutic benefits in animal models of traumatic brain injury (TBI) by nuclear sequestration of some of these anti-inflammatory and neuroprotective cargo proteins including I κ B α , NF- κ B, Nrf2, AKT, and FOXO1.

Method/Approach

Here, we determined the optimal dosing regimen of KPT-350, by altering the dose (7 mg/kg and 15 mg/kg), the frequency of dosing and the timing of initial dose administration (2-48 hr) post-TBI; and by assessing behavioral and histological outcomes in comparison to vehicle and progesterone (1 mg/kg) treatments. For this, adult Sprague-Dawley (SD) rats were subjected to TBI by controlled cortical impact (CCI) injury, tested on motor coordination and balance, and motor activity using the rotarod test and the motor asymmetry test, respectively, and their brains were assessed for neuro-structural damage and inflammatory signals.

Results/Effects

KPT-350-treated SD rats exhibited significantly better behavioral performance up to 2-fold improvement as early as 4 hr after initial treatment compared to vehicle controls, which were sustained over 18-days after moderate TBI and 36-days after severe TBI. This indicated that KPT-350 was well tolerated with no overt adverse effects. Histological analysis of KPT-350-treated animals showed a dose-dependent reduction of cell death in the core impact and peri-impact cortical areas. Furthermore, cytokine profiling demonstrated that KPT-350 treatment decreased key markers of inflammation in areas of TBI. Initiation of KPT-350 between 2 and 48 hours after moderate TBI afforded significant behavioral and histological benefits.

Conclusions/Limitations

Altogether, these data clearly support KPT-350 as a robust and long-lasting therapeutic agent for the treatment of TBI. Vis-à-vis comparison between KPT-350 and progesterone revealed that while progesterone was more effective at early time-points post-TBI, KPT-350 was more effective over time. The findings also indicated that combination therapy of KPT-350 and progesterone did not enhance motor function and only provided minimal neuro-structural benefits after TBI, compared to stand-alone treatments.

0020

TBI and Sexuality: Development of Comprehensive Assessment and Education on Sexuality for Patients With Brain Injuries and Their Families

Category: Neurorehabilitation – activities and participation

Author's preference: Poster

Allison Clark

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Introduction/Rationale

Our pediatric inpatient rehabilitation unit identified the need to address the issue of sexuality with our patients with brain injury to maximize education and highlight concerns such as aggressive behaviors, risk for abuse, and risk for abnormal development. This is an area that is often neglected or taught at a minimal level. Given the fragile state of development when many of our patients are injured, we felt this was a crucial area that needed to be addressed.

Method/Approach

The method/approach that has been developed is as follows:

1. Completed Literature Review and reviewed CARF expectations.
2. Completed Needs Assessment of our staff using a confidential survey and completed staff education using powerpoint presentation and discussion with peers.
3. Developed pathway and education plan (including written education sheets) to address these needs as appropriate for patients and families, depending upon their level of injury, age, and readiness.

Results/Effects

This program will be initiated in early 2015, with preliminary results available by April, 2015.

Staff comfort level and education level will be assessed on an ongoing basis. Parent and patient opinion, based on the education received during, the program will also be assessed on an ongoing basis.

The need to bring the information to a wider audience (website, outpatient therapy locations, physician groups) will be assessed as well.

Conclusions/Limitations

Staff improved their comfort level and educational level with this discussion. Ongoing assessment from patient and family intervention was valuable.

Literature review, with a focus on the pediatric population, was limited due to lack of availability of sources.

0021

Pediatric Traumatic Brain Injury and Secondary Attention Deficit Hyperactivity Disorder: A Systematic Literature Review

Category: Neurotrauma - case report/clinical research

Author's preference: Poster

Robert Eme

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Introduction/Rational

Although there have been sporadic reports in the literature on the occurrence of attention deficit hyperactivity disorder (ADHD) following pediatric traumatic brain injury (pTBI), there has yet to be a systematic review of studies on this topic.

Method/Approach

This study conducted a systematic literature review to assess the frequency of an ADHD disorder following pTBI, commonly referred to as secondary Attention-Deficit/Hyperactivity Disorder (SADHD) to distinguish it from the developmental ADHD. Inclusion criteria were: (a) the article was written in English, (b) the research was original, and (c) the study excluded pre-existing cases of ADHD.

Results/Effects

Nine studies were found of 619 juveniles with pTBI, ranging in age from 4 to 19, with the mean age of juveniles ranging from 6 to 13, and the mean age of assessment after TBI ranging from

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3 months to 5 years. Three studies had an orthopedic injury group to control for the emotional trauma of an injury, rather than brain trauma, being the cause of the SADHD. The mean frequency of SADHD weighted for sample size was 29%. This frequency, in general, was higher for cases of severe TBI.

Conclusions/Limitations

The most significant limitation in the literature with regard to diagnosis of SADHD was the failure to appreciate the growing recognition that emotional dysregulation is a core component of ADHD. Many of the symptoms following pTBI such as disinhibition, aggression, affective lability, and others that are typically understood as 'personality change,' are probably better understood as symptoms of ADHD. The most important implication of the study's findings is that the efficacy of stimulant treatment for SADHD, which is the first line treatment for developmental ADHD, should be thoroughly evaluated. Unfortunately, at this time, there are only 2 randomized control trials (RCTs) for SADHD.

0022

Case Study for Neurorehabilitation of Hypoxic Encephalopathy Secondary to Synthetic Marijuana Use

Category: Neurorehabilitation- Case report/Clinical Research
Author's preference: Oral

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Introduction/Rationale

Synthetic marijuana are designer drugs in which herbs, incense or other leafy materials are sprayed with lab-synthesized analogs to mimic the effects of the naturally grown marijuana plant. Synthetic marijuana, marketed under names like "Spice" or "K2", first became available in the U.S. in 2008 and were popular with high school students and young adults until banned in the U.S in July 2012. In 2011, a college student suffered hypoxic encephalopathy secondary to a seizure triggered by K-2 inhalation. In this study, we describe the student's clinical presentation, subsequent neurorehabilitation, and long term deficits from his brain injury.

Method/Approach

Case Study

Results/Effects

Following 5 months of intensive post-acute rehabilitation, the subject made significant progress participating in supported living.

Conclusions/Limitations

We believe this is the first report of hypoxic encephalopathy secondary to synthetic cannabis (K-2) use. This exposure resulted in left temporal epilepsy and subsequent severe cognitive, emotional, behavioral and psychological defects. After five months of residential therapy and treatment, the subject made significant improvements in cognitive, social and emotional function.

0023

Can Paraprofessional Staff be Used Effectively in the Post-Acute Brain Injury Rehabilitation Environment?

Category: Neurorehabilitation – activities and participation

Author's preference: No preference

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Introduction/Rationale

In traditional rehabilitation settings, paraprofessionals are under utilized. Often, the main source of all therapeutic intervention is completed by a therapist and other trained professionals. At Neurological Rehabilitation Living Centers (NRLC) we have created an environment where paraprofessionals and professionals have equal importance in the management of client programs. Paraprofessionals are responsible for performing ancillary therapy activities and providing feedback to a therapist concerning performance and community involvement. Therapists work with Program Directors to change programs and train staff.

Method/Approach

NRLC created a 12 hour structured schedule in which all therapeutic interventions were reinforced by structured programming from 7:30 a.m. to 9:30 p.m., including four cognitive/social/behavioral classes a day, physical programming at an exercise center, and social outings into the community each evening. In addition, NRLCL provided incentives for the staff to undertake the Certified Brain Injury Specialist Certification exam. Furthermore, NRLCL had weekly meetings in which all client programs were reviewed and an in-service was given. The weekly staff meetings were directed at paraprofessionals becoming educated on treatment protocols, asking questions on direct intervention techniques, as well as challenging questions of the therapists.

Results/Effects

By creating a structured program for clients, providing extensive training of the paraprofessional staff, and a 3-1 staff ratio, NRLC was able to increase the total time on therapeutic activity from 8% of the day to 73%.

Conclusions/Limitations

An effective rehabilitation environment can be created when staff are reliable, respectful, and predictable. Giving consistent feedback is necessary for learning when cognitive impairments impede the process. Paraprofessionals can help promote consistency in a rehabilitation environment. Paraprofessionals, with extensive training, can provide rehabilitation and follow through on treatment protocols twenty-four hours a day. Paraprofessionals can account also for incidental teaching when clients are not in one-on-one therapy sessions. Certified Brain Injury Specialist Certifications and internal staff training are essential for an effective rehabilitation environment.

0027

The Role of Non-Profits in Service Provision for Individuals With Brain Injury

Category: Neurotrauma – prevention and public health

Author's preference: Oral

Deborah Crawley

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Introduction/Rationale

The mission of the Brain Injury Alliance of Washington (BIAWA) is to increase public awareness, support, and hope for those affected by brain injury through education, assistance, and advocacy. BIAWA continues to grow and expand direct support services, not available elsewhere, to enhance the quality of life for individuals with brain injury, their care providers and families.

Method/Approach

Our approach is to respond to the expressed needs of callers and clients by connecting them to resources in their communities for needs in all domains of life impacted by brain injury. We serve the entire state of Washington via our Resource Line, accessing the expertise of specialists answering the line, as well as our extensive resource database. In select counties of the state, covering over 90% of the area in which reported traumatic brain injuries (TBIs) occur, we provide in-person assistance. This year, we are also piloting peer mentoring and brain health and wellness programs.

Results/Effects

Services provided by BIAWA are designed to increase the quality of life by accessing healthcare, social supports, government assistance, support groups etc., and by enhancing a community of understanding for those with brain injury and their families/caregivers. This level of access increases the quality of life for those we serve.

Conclusions/Limitations

Collaborative relationships with medical professionals and support agencies take time to build. Informing the general public of our services, connecting those in need with our services, and providing services to meet an increasing demand have been challenging. Building bridges with medical providers and support agencies create better system of support for the brain injury community and will enhance the quality of care we are all able to provide.

0028

Emergency Preparedness and Ensuring the Safety of Persons With Brain Injuries

Category: Neurotrauma – prevention and public health

Author's preference: No preference

Cindy Daniel

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Introduction/Rationale

The most lethal part of an emergency is the lack of preparedness in dealing with it, people are caught off guard, and can become confused, frightened, and disoriented. These challenges are even more pronounced for those with disabilities - particularly hidden ones such as brain injuries. This became apparent in 2004 with Hurricane Katrina, when thousands of evacuated people simply "fell through the cracks". After critical analysis of what went wrong, and under new legislation

mandating precise procedures, we now have a more refined means of guiding people through emergency situations. The efficacy of this can be seen in more recent disasters.

Method/Approach

The major failings in dealing with Katrina were lack of communication, education, and resources for dealing with large-scale chaos. Notably, emergency service providers were simply ill-prepared for handling the volume of people in shock. As the result of responsive education and protocols that have been put into place to solve these problems, we are now seeing fewer casualties in disaster scenarios.

The key indicators of this process improvement are that supplies are being made accessible more quickly, emergency workers are better prepared to help citizens leave efficiently, and increased trust in preparedness protocols and evacuation processes has yielded more collected attitudes through disaster scenarios.

Results/Effects

We can be better prepared for future emergencies by distilling the lessons learned over the last decade into these four steps of prevention:

- Answering the question of why we don't prepare.
- Understanding people with disabilities
- Accommodating people with disabilities in an emergency
- Preparing for an emergency

Conclusions/Limitations

It is possible for everyone to have a clearer understanding of why we should prepare before an emergency occurs and what to do when it happens. This also dramatically improves aid to persons with disabilities, especially persons with brain injuries. The following questions can help everyone be better prepared:

- Do you have a "go kit" ready?
- Do you have an emergency plan, or know where to go if you are evacuated?
- Is your hospital/shelter fully accessible to people with disabilities in a disaster?
- Do the service providers have the means of providing accessible transportation in an emergency?

0029

Clinical Predictors for Brain Injuries in Infants With Minor Head Trauma

Category: Neurotrauma - case report/clinical research

Author's preference: No preference

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Introduction/Rational

The aim of this study is to identify clinical predictors for brain injuries in infants who have suffered minor head trauma.

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Method/Approach

We retrospectively enrolled 554 infants admitted with minor head trauma between 2007 and 2013 at a single center. The following data were recorded: age, sex, mechanism of trauma, fall type, fall height, and scalp hematoma.

Results/Effects

Forty-nine patients (8.8%) had suffered traumatic brain injuries (TBIs). It was determined that age (<7 months), fall height (>80cm), and size of scalp hematoma (>3cm) were related to brain injury.

Conclusions/Limitations

We should take these factors into consideration when making decisions on radiological examinations in infants with minor head trauma.

0030

Health Outcomes Following Severe Traumatic Brain Injury (TBI) in Young Children

Category: Neurotrauma – health services and outcomes

Author's preference: Poster

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Introduction/Rationale

The Multi-attribute Health Status Classification System (MHSCS) is a Health Related Quality of Life (HRQoL) parent/proxy administered tool that provides descriptive measures of ability, disability, and health status. Children and youth have documented decreases in HRQoL following traumatic brain injury (TBI). Our objectives were:

1. to assess the HRQoL outcomes of young children who sustained a severe TBI using the MHSCS at 3 and 5, or more, years after injury;
2. to compare the 3 and 5, or more, year MHSCS HRQoL outcomes; and
3. to consider the role of pre-existing conditions on the MHSCS HRQoL outcomes.

Method/Approach

This is a retrospective chart review of 19 children who sustained severe TBI before 12 years of age. Ethical approval was granted. The MHSCS questionnaire results, along with demographic, accident variables and clinical data were analyzed using SPSS version 16.0.1. T-tests and chi square tests were used to assess equivalency between groups. MHSCS scores were compared between groups using Multivariate analyses of variance (MANOVAS) and Multivariate analyses of covariance (MANCOVAS).

Results/Effects

An independent t-test on Total MHSCS scores revealed a non-significant difference between groups ($t(17) = -1.3$, $p = .20$) at 3 and 5 or more years. A MANOVA on MHSCS scale scores showed no significant overall difference in HRQoL between the two groups. However, Univariate tests revealed significant differences for sensation ($F(1,17) = 6.26$), $p = .02$), emotion ($F(1,17) = 5.16$, $p = .04$) and cognition

($F(1,17) = 5.84$, $p = .03$). Significant multivariate effects on MHSCS scores were found for pre-existing emotional regulation ($F(8,5) = 5.63$, $p = .037$) and social skills problems ($F(8,4) = 8.71$, $p = .026$), but not for attention deficit hyperactivity disorder (ADHD) ($F(8,4) = 0.88$, $p = .59$).

Conclusions/Limitations

Children experiencing early TBI have more difficulties with cognition and emotion at 5 or more years than at 3 years in follow up. There are also increasing problems with emotion and pain over time relating to emotional regulation and social skill problems presenting shortly after injury. Problems with sensation are greater at 3 year follow-up than at 5 or more years. Intervention for ADHD shortly after the initial injury may be a factor in attenuating later problems with emotion, cognition and pain.

0031

Concussion Risk Associated With Head Impact; An Analysis of Pooled Data From Helmeted Sports

Category: Neurotrauma – prevention and public health

Author's preference: Oral

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Introduction/Rationale

Since 2003 there have been more than 40 publications describing an analysis of head impacts among helmeted athletes, primarily football players, and the concussion outcome of the impact. Several authors have used these data to model concussion risk in the general population. These studies have been subsequently employed in post hoc injury risk analyses in medicolegal or forensic settings. There are a number of obvious and substantial limitations of the use of such data in assessing the injury risk of a real world event.

Method/Approach

In the present analysis, we performed a comprehensive literature review of studies of head impacts to helmeted athletes in which linear and angular acceleration and Head Injury Criterion (HIC) was assessed. Risk of concussion versus head impact metric, per player, was modeled using a logistic regression analysis based on the highest magnitude impact sustained by each player, versus the presence or absence of a concussion.

Results/Effects

There were 41 relevant publications, 13 of which were not duplicative. There were data available for a total of 2,227 players who had sustained 239,554 head impacts, among whom there were 265 concussions (11.9%). There were 312 non-duplicated subjects for whom there were data available regarding concussion status and linear acceleration, angular acceleration, or HIC. The average linear acceleration, HIC, and angular acceleration in the concussed players were 93.2 g, 381, and 5,239 rad/sec², respectively. Binomial logistic regression indicated a 5% risk of concussion at 29.1 g linear acceleration, HIC of 4, and angular acceleration of 1,009 rad/sec².

Conclusions/Limitations

Head impact data, from helmeted athletes, provides a basis for understanding the wide range of impacts at which concussions occur in this population. At lower levels of impact

severity, the data demonstrate substantial scatter. Injury risk estimates at the lower levels of impact severity are not particularly reliable or meaningful. These data have no reliable application to the assessment of injury risk of head impacts sustained by the non-helmeted populations. Prior authors' use of these data to assess concussion risk based on rates consisting of the number of observed concussions versus the total number of head impacts is methodologically flawed.

0032

The 3-Dimension Model: "A Useful Instrument in the Rehabilitation of People With Brain Injury and Their Relatives?"

Category: Neurorehabilitation- Case report/Clinical Research
Author's preference: Poster

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Introduction/Rationale

The 3-Dimension Model (TDM) has been presented in 2014 as a psycho-educational model in psychiatry, using an integrated position of the brain in psychiatric disorders. TDM is an instrument of psycho-education (PE) for patients with psychiatric disorders and their relatives. It improves quality of life for both, helping relatives to understand how the patient thinks and feels. Emotional lability frequently occurs following acquired brain injury (ABI), and has an important negative influence on the quality of life of patients and their relatives.

Method/Approach

In a prospective open label study we described the improvement of quality of life using the Lability Affect Scale-Short Form (LASSF). We included 12 outpatients, 6 men and 6 women, with ABI. We started the measurement before using TDM in the first PE-session. We repeated the sessions one and two months later and repeated the measurements one month after each session. All three sessions were mediated by the same investigator in the presence of the patient and two relatives. Sessions were limited in time to 60 minutes. Satisfaction of the sessions was qualified from 1 (very poor) to 5 (very good).

Results/Effects

All subjects showed a marked improvement in the LASSF one month after the first PE using the TDM. Two and three months later there was still an ongoing improvement. Both patients and relatives qualified their satisfaction about the quality of the sessions as very good. No drop out has been recorded.

Conclusions/Limitations

The degree of improvement, even after three months, suggests that the TDM can be useful in improving quality of life of both patients with ABI and their relatives. More observations and investigations are needed to evaluate whether this way of psycho-education is better than other types of existing psycho-educational programs.

0033

Integration of Technology in Neurorehabilitation

Category: Technology – clinical research/applications
Author's preference: Poster

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Introduction/Rationale

For neurorehabilitation populations, key therapeutic goals are ultimately focused on maximizing independence, with psychologists often focusing on cognitive and psychological aspects of care. A perceived weakness with traditional psychological assessment and intervention, however, is the limited ability to replicate the challenges that occur outside the hospital setting. With advances in technology, the possibility of simulating real world situations, while being able to control stimulus delivery and measurement, is closer to fruition. Despite the exciting potential of virtual reality (VR) and brain-computer interface (BCI) technologies with neurorehabilitation populations, there is a paucity of replicable studies using these technologies.

Method/Approach

After a brief overview of VR and BCI use within psychology, two studies will be introduced. One project will involve individuals following acquired brain injury (ABI) enrolled in a multidisciplinary outpatient day neurorehabilitation program. Patients were immersed in a three-dimensional (3D) virtual apartment and virtual classroom using a head-mounted display, allowing a 360 degree view. They completed cognitive tasks in these virtual settings while exposed to auditory and visual distractions. The second project explored the feasibility of BCI in an inpatient spinal cord injury rehabilitation unit. The electroencephalogram (EEG) Emotiv system was used in conjunction with a game-based BCI cube rotation and manipulation paradigm.

Results/Effects

The VR and BCI paradigms have been well tolerated by patients across age ranges, educational/vocational backgrounds, and diagnoses. Despite specific space, time and technology related challenges that will be discussed, patient enthusiasm for the technologies and staff receptivity has been encouraging.

Conclusions/Limitations

Our preliminary experiences from these studies indicate that VR and BCI have the potential for integration into outpatient and inpatient neurorehabilitation. The current challenge is to create paradigms targeting key rehabilitation goals that can be compared to traditional methods of care. Without such outcome studies, the benefits and generalization of VR and BCI remains speculative.

0034

Cognitive Functioning Following an Industrial Explosion: A Group Analysis

Category: Neurotrauma- basic research
Author's preference: Poster

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Introduction/Rationale

Survivors of major plant explosions may and often do develop cognitive and emotional disabilities requiring psychotherapy. It is important, therefore, that proper and comprehensive cognitive profiles be developed to best assist these individuals. Understanding the cognitive functioning of these individuals as a group is important as this provides a general overview of the cognitive impairments that can be expected when providing psychotherapeutic treatment. The current study evaluated cognitive functioning in a group of individuals who experienced the same industrial explosion.

Method/Approach

A general cognitive profile was developed from archival data involving 17 survivors of the same industrial plant explosion. The mean age was 36 and mean completed education level was 11 years. Data from cognitive testing were analyzed to evaluate cognitive abilities and independent living capabilities. Signed releases were obtained from all individuals. All individuals included in the data analysis passed validly measures.

Results/Effects

The mean scores and standard deviations were found to be as follows: KBIT-2 Total Standard Score = 81.23 (SD 11.27), Verbal = 82.53 (SD 11.04), Nonverbal = 82.61 (SD 12.9); Scales of Independent Behavior Standard Score = 79.11 (SD 18.02); Trails A = 47.76 Seconds (SD 18.38), Trails B = 101.53 Seconds (SD 39.77); MMSE Total Score 27.41 (SD = 2.82); Shipley Institute of Living Scale Total T-Score = 41.47 (SD 7.43), Vocabulary = 34.75 (SD 9.26), Abstraction = 45.31 (SD 8.31); Animal Naming Raw Score = 45.31 (SD 8.31); and Symbol Digits Modality Test Raw Scores = 38.94 (SD 11.06).

Conclusions/Limitations

Cognitive test results, of those involved in an industrial plant explosion, suggested that the majority fell in the low average range of general intellectual functioning. Impairment was noted in the areas of executive functioning, verbal fluency, and attention. Activities of daily living fell in the borderline range. Importantly, the range of abilities was vast. This suggested that neuropsychological evaluations, prior to psychotherapeutic treatment, would be valuable to determine therapeutic approaches. Overall, the results suggested those involved in industrial explosions may possess cognitive dysfunctions that can complicate psychotherapeutic treatment. Presenting psychiatric problems must be treated, therefore, with consideration to co-morbid cognitive impairments.

0035

Are Traumatic Brain Injuries Identified and Conceptualized in Psychotherapy With Children and Adolescents?

Category: Neurorehabilitation - basic research

Author's preference: Poster

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Introduction/Rationale

Every year, children sustain Traumatic Brain Injuries (TBIs), which can have lasting cognitive, emotional, behavioral and

social consequences. These changes, when coupled with cognitive impairments, can make psychotherapeutic treatment more complex. As such, evaluation for TBI history in children and adolescents undergoing psychotherapy is important, as both the emotional and behavioral problems must be conceptualized and treated in conjunction with cognitive changes. The current study hypothesizes the number of articles that exist in psychotherapy journals that could assist in the identification, conceptualization, and treatment of children and adolescents with a TBI history, but are not disseminated to the larger psychology community.

Method/Approach

The current study reviewed the top journal publications with the highest h5-index ranking in child and adolescent psychology for topics pertaining to TBI in children and/or adolescents and psychotherapy for the past five years. The table of contents of each journal was reviewed for articles that related to, or discussed, TBI in children and/or adolescents. If articles were identified, abstracts were reviewed to assess relevance of the topic to identification and conceptualization of TBIs regarding children receiving psychotherapy.

Results/Effects

Out of the 10 journals reviewed, only 11 articles on TBI were found, with only two articles directly focusing on psychotherapy and TBI. Other articles focused on co-morbidity of post-traumatic stress disorder (PTSD) and TBI, psychological and behavioral functioning after TBI, health-related and quality of life outcomes, family functioning, and timing of TBI and intellectual functioning.

Conclusions/Limitations

As TBI can result in behavioral and emotional problems. Coupled with cognitive impairments, both the psychiatric and cognitive disorders must be treated together. The paucity of literature on the effects of TBI on the overall conceptualization and development of therapy indicates the need for greater study in this area, along with increased dissemination for, and education of, psychotherapists to understand and inquire about TBI history.

0036

Psychotherapy With Brain Injured Adults: Are We Learning What We Need?

Category: Neurorehabilitation - basic research

Author's preference: Poster

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Introduction/Rationale

About 1.7 million people a year in the United States (U.S.) sustain a traumatic brain injury (TBI). Following a TBI, people often experience cognitive impairment along with emotional and behavioral changes, including novel psychiatric disorders. As a result, following a TBI, people may seek psychotherapy to cope with emotional and behavioral changes, and adjustment to new cognitive impairments. The combination of psychiatric disorders and cognitive impairments can make psychotherapy

more challenging. The current study hypothesizes that there are a limited number of articles in psychotherapy journals to assist in the identification, conceptualization, and treatment of adults with a history of TBI.

Method/Approach

The current study reviewed 20 of the top journal publications with the highest h5-index ranking for psychology. Two journals were excluded because one was not relevant to adults while the other focused on specific psychologists' contributions to psychology. Eighteen journals were evaluated, therefore, for their inclusion of articles pertaining to TBI and brain injuries in adults. The table of contents of each journal was reviewed for articles that related to, or discussed, TBI in adults. Abstracts in identified articles were then reviewed to assess for relevance of the topics of identification, conceptualization, and psychotherapeutic treatment of TBI in adults.

Results/Effects

Of the 18 journals reviewed, only seven articles were identified that pertained to TBI and brain injuries in adults. Surprisingly, none of the articles directly addressed psychotherapy with TBI patients. Five articles primarily focused on the conceptualization of psychiatric symptoms either resulting from or in conjunction with brain injuries. One article focused on both the cognitive and emotional functioning following a mild TBI (mTBI), six-years after injury. Lastly, one article outlined differences between sport and non-sport mTBI. All of the five identified original research articles were based on populations outside of the U.S., while two were review articles.

Conclusions/Limitations

As emotional and behavioral changes can, and often, follow a TBI, diagnosis and treatment can often be more complex. For example, executive functioning deficits may require alternative strategies for problem solving, while memory impairment may require assistive devices, or compensatory strategies, in conjunction with psychotherapy. The lack of published literature in high-ranking psychology journals underscores the need for increased awareness and dissemination of psychotherapeutic methodology for treating adults with TBI, for the general psychotherapeutic community.

0037

Coping Strategies of Traumatic Brain Injury Survivors and Primary Caregivers

Category: Neurorehabilitation- Case report/Clinical Research
Author's preference: Oral

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Introduction/Rational

The research aimed to answer "What are the coping strategies utilized by survivors and primary caregivers to manage the effects associated with traumatic brain injury (TBI)?" The purpose was to explore the coping strategies identified by TBI survivors and primary caregivers and, with this knowledge, add to the development of theory related to rehabilitation and counseling. Results of the research uncovered specific needs associated with various deficits incurred by the brain injury.

Suggestions for mental health professionals were identified, to more effectively treat survivors of brain injury, spouses, and the family system.

Method/Approach

A phenomenological qualitative research approach was used with seventeen respondents participating in a series of semi-structured interviews. The 5 sub-questions asked were: 1. What were the coping strategies utilized by the survivor and primary caregiver to manage the effects of TBI? 2. How were these coping strategies developed? 3. What were the greatest needs for TBI survivors and primary caregivers? 4. What were the greatest obstacles that TBI survivors and primary caregivers have had to overcome? 5. How could mental health professionals utilize the knowledge of these coping strategies in developing a theory of counseling for helping the TBI survivor and primary caregiver?

Results/Effects

Both TBI survivors and primary caregivers identified a myriad of deficits that required accommodation. Although no two brain injuries were alike, there were similarities depending on the lobe or area affected by the injury. Additionally, specific recommendations were made to mental health professionals addressing how to work more effectively with TBI survivors and primary caregivers. The findings indicated that problem-focused, emotion-focused, avoidant coping, and spiritual coping were utilized to some degree throughout the rehabilitation process. Grief and ambiguous loss surfaced as major issues requiring effective coping measures.

Conclusions/Limitations

The findings indicated problem-focused, emotion-focused, avoidant coping, and spiritual coping were utilized to some degree throughout the rehabilitation process. Grief and ambiguous loss surfaced as major issues requiring effective coping measures. The research covered four major themes: 1. deficits 2. needs 3. suggestions for mental health professionals; and 4. coping strategies. Identified coping strategies addressed deficits such as short-term memory loss, anger, fatigue, personality changes, self-esteem, self-care, grief, and spiritual issues. Suggestions were provided for mental health professionals regarding accommodations and theory development addressing how to more effectively treat TBI survivors and primary caregivers.

0038

Adults With TBI May Have Problems Understanding Diplomatically Framed Language

Category: Neurorehabilitation- Case report/Clinical Research
Author's preference: Oral

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Introduction/Rationale

Despite intact language skills, many adults with severe traumatic brain injury (TBI) have problems with indirect language, e.g. sarcasm (saying one thing but meaning the opposite). Indirect language is used in other ways than sarcasm and for different purposes. When hinting, the speaker says something

that is linked to what they mean in varying degrees of subtlety. Determining the true meaning requires combining various cues, including the emotional demeanor of the speaker. Many people with TBI also have problems reading emotional cues. This study aimed to determine how well people with TBI are able to understand hints with and without emotional cues.

Method/Approach

31 adults with severe TBI and 31 matched healthy adults watched 12 video vignettes in which one speaker hinted to the other what they wanted, using three increasingly explicit hints. At each hint, the participant was asked to explain its meaning. If they were unable to do so, the participant was shown the next vignette and they were asked again, and so on. In the first six videos the actors enacted the script in a 'deadpan' fashion. In the next six vignettes the actors were overtly emotional.

Results/Effects

The TBI group performed similarly to the control group overall but, unlike the controls, their accuracy did not improve for the emotionally laden hints relative to the 'deadpan' hints. Poor performance on the deadpan hints was correlated to deficits in cognitive flexibility, reasoning and social cognition. Performance on emotional hints was associated with social cognition alone.

Conclusions/Limitations

This study extends prior work by showing that problems understanding indirect language following TBI extend beyond recognizing flagrant sarcasm. Hints are commonplace as a means to diplomatically negotiate social settings. Problems interpreting such remarks are a significant obstacle to successful social interaction and are an important target for remediation.

0039

Multidisciplinary Treatment of Patients With Persistent Post Concussive Complaints Significantly Reduces Symptom Burden

Category: Neurorehabilitation- Case report/Clinical Research
Author's preference: Oral

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Introduction/Rationale

Since 2000, an estimated 258,000 mild traumatic brain injuries (mTBIs) have been diagnosed among service members worldwide. Many have been compounded by psychiatric comorbidities such as post-traumatic stress disorder (PTSD). Although only about 5% of those with an mTBI experience have persistent post-concussive symptoms (PPCS), they have had considerable resources devoted to treating these symptoms. Evidence that this treatment is effective in reducing symptoms, however, is lacking. We investigated change in PPCS and PTSD symptom reporting pre- to post-treatment in patients with chronic mTBI-related symptoms seen at the Brooke Army Medical Center (BAMC) TBI Clinic from 2008-2013.

Method/Approach

We studied 257 multidisciplinary patients for whom we had pre- and post-treatment results. Using the Neurobehavioral Symptom Inventory (NSI) and PTSD Checklist-Military version (PCL-M) respectively, global pre- to post-treatment PPCS and PTSD symptom change were evaluated using paired t-tests. Independent group t-tests were performed comparing PPCS scores for patients with mTBI only vs. those with mTBI and PTSD. Analysis of covariance models were run to evaluate the impact of demographic-, injury-, and rehabilitation-related variables on persistent symptom change.

Results/Effects

Global PPCS resolution (mean NSI: 35.0 pre vs. 23.8 post; $p < 0.0001$) and PTSD symptom resolution (mean PCL-M: 43.2 pre vs. 37.7 post; $p < 0.0001$) were statistically significant. Compared to those with only mTBI, patients with mTBI and PTSD reported greater global PPCS impairment both pre-treatment (mean NSI: 48.7 vs. 27.9; $p < 0.0001$) and post-treatment (mean NSI: 36.2 v. 17.4; $p < 0.0001$). After adjusting for pre-treatment NSI scores, patients with co-morbid PTSD reported poorer PPCS resolution compared to those with mTBI only (mean NSI: 27.9 pre vs. 21.7 post; $p = 0.0009$).

Conclusions/Limitations

Patients with PPCS experienced a notable reduction in both PPCS and PTSD symptoms following the long-term multidisciplinary treatment approach implemented at BAMC TBI Clinic. PTSD was the most important factor associated with change in post-concussive symptoms. This study was unable to determine if outpatient multidisciplinary treatment approaches to mTBI care, in a specialty clinic, are either efficacious or cost effective. Future studies are needed that identify specific components of care that are efficacious and cost-effective in both primary and specialty care settings.

0040

Applied Behavior Analysis in Acquired Brain Injury Rehabilitation: A Meta-Analysis of Single-Case Design Intervention Research

Category: Neurorehabilitation- Case report/Clinical Research
Author's preference: Poster

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Introduction/Rationale

The purpose of the meta-analysis was to provide a synthesis of the existing behavioral intervention studies with individuals with an acquired brain injury (ABI) diagnosis and to expand on previous review papers in a number of ways. First: the reported characteristics of, participants, interventions, outcomes, and the methodology used in both skill acquisition and behavior-reduction studies were examined with both children and adults with an ABI diagnosis. Secondly: the use of functional assessment was coded for reductive procedures. Thirdly: interventions were classified in a more detailed manner. Fourthly: quantitative measurements of intervention effectiveness (i.e., calculations of effect sizes) were included using a well-defined coding system. Finally, interventions were classified using two existing evidence-based practice frameworks.

Method/Approach

Peer-reviewed journals were searched using PsycINFO, Medline, and ERIC databases with combinations of terms such as brain injury, behavior disorder, behavior therapy, behavior modification, behavior analysis, and verbal behavior. The data extracted from each study included specific details about the participants, target responses, intervention characteristics, use of functional assessment, and outcome characteristics. A data extraction software program was also used to extract data from graphs to calculate the percentage of non-overlapping data as an effect size. The studies were then evaluated along several dimensions from multiple evidence-based practice frameworks.

Results/Effects

A total of 112 acquisition and reduction studies met the established inclusion criteria. Collectively, interventions targeted a wide range of behaviors for acquisition and reduction, but only five interventions were classified as well established, according to the American Psychological Association Division 12 criteria. Furthermore, methodology of the identified studies was found to be relatively poor.

Conclusions/Limitations

Although we identified numerous concerns with the methodological rigor of this literature, several behavioral interventions were classified as well established and several more were classified as probably efficacious according to the American Psychological Association (APA) Division 12 guidelines. This evidence should communicate to researchers interested in contributing to this area that there are both well-conducted studies and a need for improvement in this literature. A few limitations should be considered. One limitation was the intervention categories assessed using the evidence-based practice frameworks were often components of an intervention package. Other limitations of the current review were the disadvantages associated with the chosen quantitative measurements of intervention effectiveness.

0041

Eye Movement Rehabilitation by CN-NINM Intervention: A Set of Case Studies

Category: Neurorehabilitation- Case report/Clinical Research
Author's preference: No preference

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Introduction/Rationale

The neurorehabilitation of sensory and motor functions after brain damage and loss of brain functions is underdeveloped, especially in the recovery of eye-movement control. There are very few methods that show the possibility of enhancing eye movements affected by brain injuries or disease. The goal of our research was to investigate how cranial-nerve non-invasive neuromodulation (CN-NINM) can reduce the effects of oculomotor impairments and help improve eye movement control in people with stroke, Parkinson's disease (PD), multiply sclerosis (MS) and traumatic brain injury (TBI) symptoms.

Method/Approach

The CN-NINM therapy includes a combination of targeted exercises for recovery of balance and gait motor control while receiving electro-tactile tongue stimulation, using the Portable Neuromodulation Stimulator (PoNStm device). Assessment of oculomotor function was performed before and after the CN-NINM intervention using a 4-channel binocular eye tracking system (VisualEyes, Micromedical Inc) and custom analysis software. To evaluate the state of the subject's eye movements, we used three static nystagmus tests (vertical and horizontal gaze, and spontaneous nystagmus) and three dynamic tests (random saccade, smooth pursuit and optokinetic). All of the tests were performed without tongue stimulation.

Results/Effects

Balance, gait and eye movement control gradually improved in all of the tests. We also observed the improvement of eye fixation, accuracy and stability in nystagmus and gaze tests, increased eye movement accuracy and precision, improved gain and velocity of target tracking, and changes in both smoothness and synchronization of binocular movement control in oculomotor tests.

Conclusions/Limitations

The improvements of eye movement control demonstrated by this set of case studies suggest that CN-NINM therapy may benefit people affected by stroke, PD, MS, TBI symptoms and could offer a novel treatment option for oculomotor disorders.

0042

Post Acute Brain Injury Rehabilitation Gains: Racial Differences

Category: Neurorehabilitation – activities and participation
Author's preference: Poster

Robert Perna, Lee Wiegand, Jerome Caroselli

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Introduction/Rationale

Race is a significant variable in terms of many health outcomes including incidence of stroke. Despite race being relevant to some brain injury variables, limited research has been published on brain injury rehabilitation outcomes and race. Some research has found significant racial differences in functioning of persons after traumatic brain injury (TBI) but, essentially, those differences were largely predicted by pre-injury issues such as education and cause of injury. The hypothesis of this current study is that there will be some significant racial differences in rehabilitation outcomes.

Method/Approach

This study involved 317 participants (Caucasian = 224, African American = 93) who were involved in an outpatient multidisciplinary brain injury rehabilitation program. Most individuals had suffered either a TBI or stroke within three months of treatment. Groups (African American/Caucasian) were similar in terms of mean age (46.3 vs. 48.3), education level (15.4 vs. 17.2), and admission injury severity (as measured by the Mayo Portland Adaptability Inventory; MPAI-4) across

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all three subscales and total scores. Admission MPAAI scores suggested that both groups had mild ability and adjustment symptoms and mild to moderate interference with community participation.

Results/Effects

MPAAI change scores (admission minus discharge) and discharge scores were not significantly different between groups (via anova comparisons) and both groups benefitted significantly from the rehabilitation program (when discharge scores were compared to admission scores).

Conclusions/Limitations

Results appeared to suggest that there are far more similarities than differences between these two racial groups when measuring early (6 months post injury) brain injury rehabilitation outcomes with the MPAAI. This research is consistent with previous research on the topic. Limitations of this study include the higher than average educational level of the participants, limited outcome measures, and the limited number of racial groups.

0043

Post-acute Rehabilitation Outcomes in Hemorrhagic Strokes: AVM Compared to Aneurysms

Category: Neurorehabilitation – activities and participation

Author's preference: Poster

Robert Perna, Lee Wiegand, Jerome Caroselli

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Introduction/Rationale

Although both aneurysms and arteriovenous malformations (AVMs) can cause hemorrhagic strokes, the pathophysiology of AVMs and aneurysms is very different. AVMs are often congenital and may affect cerebral perfusion, but both involve long-term structural anomalies. Limited research has compared rehabilitation outcomes of these groups. The research hypothesis of this study is that these groups would have significant differences in functioning during, or after, post-acute treatment.

Method/Approach

This study involved 204 participants (aneurysm = 151, AVM = 53) with both groups having a similar mean age (55.5 and 53.3), and educational level (16.8 and 17.8), and level of disability at admission, as measured by the MPAAI-4 (Total = 48.1 versus 49.70). The participants all began treatment in the 1st few months after injury and participation in the post-acute rehabilitation program was three days a week for approximately ten weeks.

Results/Effects

Change scores (admission minus discharge MPAAI scores) were significantly different on all MPAAI scales. The aneurysm group had significantly more change in abilities (10.0 versus 6.6), participation (9.3 versus 6.6), and MPAAI Total change

scores (25.5 versus 19.0), but not psychosocial adjustment (4.6 versus 5.4). It is unclear why the aneurysm group benefitted more from rehabilitation since both groups were similar in terms of time since injury and admission severity level.

Conclusions/Limitations

Both groups were functioning at a similar level (per MPAAI-4 scores) at admission, but approximately three months later and 4 to 5 months after injury, individuals with aneurysms were functioning significantly better. Based on the findings and the lack of any systematic differences in the post-acute treatment received, it may be that these groups have different recovery timelines, or perhaps recovery curves. Further research is needed to clarify these differences.

0044

The Prevalence and Impact of Pseudobulbar Affect Symptoms in Former Professional Football Players: Results of an Online Survey

Category: Neurotrauma - case report/clinical research

Author's preference: No preference

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Introduction/Rationale

Pseudobulbar affect (PBA) occurs secondary to multiple neurologic conditions, including traumatic brain injury (TBI). PBA is characterized by sudden, uncontrollable, laughing and/or crying episodes that are exaggerated or incongruent to mood or social context. The disruptive and embarrassing nature of PBA episodes can lead to social isolation and impaired quality of life (QoL). Given the increasing recognition of sports-related head injuries, a survey was conducted through the Gridiron Greats Assistance Fund, an organization providing medical assistance and support to former professional football players, to explore prevalence and impact of PBA symptoms among this population.

Method/Approach

An online, 15-minute survey was conducted 13 Nov 2014 to 01 Dec 2014. Survey invitations were sent to the Gridiron Greats Assistance Fund email database. Former players (or family members/caregivers) answered questions related to their history of head injury, concussion, TBI, or blows to the head (with or without sequelae) during their football career. PBA symptom presence was assessed using the Center for Neurologic Study-Lability Scale (CNS-LS), and a question about uncontrolled laughing/crying. Participants also answered questions related to impact of uncontrolled laughing/crying on everyday activities, and social/family relationships, their feelings about these episodes and whether they had ever sought medical attention regarding the episodes.

Results/Effects

7,000 invitations were sent, 516 (474 former players; 42 family members/caregivers) responded. Most of the players (99%) experienced some form of head injury, or blow to the head, during their career; with the mean being 9.3 injuries/player. PBA symptoms (CNS-LS \geq 13 or “yes” to uncontrolled laughing/crying question) occurred in 33% of the players. Of those with PBA symptoms, 30% reported episodes \geq once/week. Uncontrollable laughing/crying episodes were associated with feelings [occurring “most of the time”] of depression (50%), isolation (39%), loneliness (38%), and embarrassment (36%). Episodes interfered most often with relationships, time with family/friends, work, or social activities. Most players (73%) hadn’t discussed symptoms with a healthcare professional.

Conclusions/Limitations

This survey showed that head injuries are common in former professional football players, but only about one third report PBA symptoms. Uncontrollable laughing and/or crying episodes are frequently associated with negative feelings such as depression or embarrassment, and impact social and occupational activities. Most former players do not talk to healthcare providers about these episodes. Study supported by: Avanir Pharmaceuticals, Inc.

0046

The Polytrauma Transitional Rehabilitation Program (PTRP)-San Antonio: First Year Functional Outcomes

Category: Neurotrauma – health services and outcomes

Author’s preference: Poster

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Introduction/Rationale

The Polytrauma Transitional Rehabilitation Program (PTRP) residential brain injury program was developed for veterans and active duty service members with complex injuries that limit community reintegration and return to duty.

Method/Approach

Comparison of admission and discharge clinician outcome ratings from 38 patients using the Mayo Portland Adaptability Index (MPAI-4) were analyzed.

Results/Effects

Results indicated significant improvement across all functional domains including, abilities ($t = 7.16$; $p < .001$), adjustment ($t = 4.60$; $p < .001$), and participation ($t = 5.20$; $p < .001$), as well as the MPAI total score ($t = 6.22$; $p < .001$).

Conclusions/Limitations

Rehabilitation through the PTRP produces significant functional improvement and enhances community reintegration.

0047

Optimizing Environmental Enrichment to Model Pre-clinical Neurorehabilitation

Category: Neurotrauma- basic research

Author’s preference: Oral

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Introduction/Rationale

Environmental enrichment (EE) consists of increased living space, complex stimuli, and social interaction that promotes exploration and confers improvements in behavioral outcome and histopathology after experimental traumatic brain injury (TBI) vs. standard (STD) housing. As a model of rehabilitation, however, continuous EE is not clinically relevant due to the timing parameters of the typical EE and thus translatability could be limited. Specifically, TBI patients typically receive rehabilitation only after critical care has been provided and then for only 3-6 hours per day.

Method/Approach

To mimic the clinic, the goal of this study was to determine whether delaying EE by three days and providing only six hours per day would provide benefits similar to continuous EE. To address this rehabilitation relevant issue, isoflurane-anesthetized male rats were subjected to a controlled cortical impact (2.8 mm depth at 4 m/s) or sham injury and randomly assigned to TBI+EE (continuous), TBI+EE (3 day delayed, 6 hr day), and respective sham controls. Motor function (beam-balance/beam-walk) was assessed on post-operative days 1-5. Spatial learning/memory (Morris water maze) was evaluated on days 14-19.

Results/Effects

The data showed that EE, regardless of timing, improved motor and cognitive function compared to STD housing ($p < 0.0001$). Moreover, there were no differences between the TBI+EE (continuous) and TBI+EE (3 day delayed, 6 hr day), $p > 0.05$.

Conclusions/Limitations

These data demonstrate that delayed and abbreviated EE produces motor and cognitive benefits similar to continuous EE after TBI and thus further supports EE as a pre-clinical model of neurorehabilitation. Ongoing studies are evaluating the effects of longer delays in implementing EE after TBI.

0048

Gait Oriented Dual Task Training Supplemented With Rhythmic Auditory Stimulus

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Category: Neurorehabilitation- Case report/Clinical Research
 Author's preference: Poster

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Introduction/Rationale

Primarily, this study aimed to determine the feasibility of coupling Rhythmic Auditory Stimulation (RAS) with gait-oriented Dual Task Training (DTT) in the brain injured population, and secondarily, to assess the efficacy of this intervention. While DTT has been shown to improve gait outcomes after the occurrence of a traumatic brain injury (TBI), the requirement of increased divided attention may inhibit progress due to the inherent attentional deficits that follow the injuries. Implementing RAS may facilitate higher quality gait training by improving gait automaticity via entrainment, ultimately decreasing the cognitive burden, and may produce greater gains than standard therapy.

Method/Approach

An open-label, within-subject design, was used to compare an individual's progress with standard gait training to training supplemented with DTT and RAS. A control period, including ten therapy sessions, was completed over two weeks. Therapy sessions lasted 45 minutes and focused on stretching, strengthening, endurance, and balance tasks for the lower extremities. The intervention period consisted of ten therapy sessions over two weeks. Five of the sessions included DTT and RAS gait training for a minimum of 15 minutes. The secondary tasks varied depending on the participant's ability to perform. Tasks were designed to be challenging, yet completable.

Results/Effects

The Dynamic Gait Index (DGI), 10 meter walk, 6 minute walk, and the Timed Up and Go (TUG) were used to assess gait performance. During the control period, DGI improved from 15/24 to 20/24, 10-meter walk time decreased 1.5% (10.25 to 10.1 s), 6-minute walk distance increased 33.8% (1024 to 1370 ft), and TUG time increased 7.0% (10.4 to 11.13 s). During the intervention period, DGI improved from 20/24 to 22/24, 10-meter walk time decreased 9.6% (10.1 to 9.13 s), 6-minute walk distance increased 8.5% (1370 to 1487 ft), and TUG time decreased 22.4% (11.13 to 8.63 s).

Conclusions/Limitations

Upon implementing DTT and RAS to the gait training, the participant continued to improve in all areas of gait. The participant's gait velocity, measured with a ten meter walk and the timed up and go test, increased notably more during the intervention period. The use of DTT in TBI rehabilitation is necessary to promote the divided attention needed for community reintegration. The addition of RAS to facilitate DTT produces a more feasible training environment for the TBI population. Apart from studying a larger sample, more research is necessary to determine which TBI survivors would benefit from this intervention.

0049

Sleep Deprivation Exacerbates Pathophysiology of Concussive Head Injury: Neuroprotective Effects of a Multimodal Drug Cerebrolysin

Category: Neurotrauma- basic research
 Author's preference: Oral

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Introduction/Rationale

Our military personnel on combat duties are often subjected to sleep deprivation (SD) of varying periods. Since SD induces biochemical changes in the brain, it is quite likely that additional trauma, or head injury, may aggravate brain pathology in SD. In this investigation pathophysiology of concussive head injury (CHI) in SD was examined in a rat model. In addition, neuroprotective effects of the multimodal drug Cerebrolysin (Ever NeuroPharma, Austria) were also investigated.

Method/Approach

Rats were subjected to SD using an inverted flowerpot model for 24 to 72 hours. CHI was inflicted in these rats using an impact model that delivers 0.224 N on the exposed right parietal bone under Equithesin anesthesia. The blood-brain barrier (BBB), brain edema and neuronal changes were measured 8, 12 and 24 h after CHI. Cerebrolysin (Ever NeuroPharma, Austria), a balanced composition of several neurotrophic factors and active peptide fragments, was administered in CHI animals with SD (2.5, 5 or 7.5 ml/kg, i.v.) 60 or 120 min after CHI. Rats subjected to CHI without SD were used as injured controls.

Results/Effects

CHI induced a pronounced increase in BBB breakdown, brain edema formation and neuronal injuries in SD rats, as compared to CHI alone. This effect was positively correlated with the duration of the SD. Interestingly, SD alone induced a slight increase in the BBB breakdown, brain edema formation and neuronal injury as compared to intact controls that were progressive with SD duration. Cerebrolysin treatment in high doses (7.5 ml), at 60 or 120 min after trauma, significantly attenuated these pathological changes following CHI in SD. Lower doses (5 ml) of cerebrolysin were sufficient, however, to induce neuroprotection in CHI without SD.

Conclusions/Limitations

Our observations are the first to point out that CHI in SD induced exacerbation of brain pathology, and in such cases high doses of neuroprotective agents e.g., Cerebrolysin, is needed to induce neuroprotection. Further studies on dose and time related investigation of Cerebrolysin, in this model, are needed to see whether behavioral and pathological changes were also reduced by this drug treatment.

0050

TiO₂ Nanowired Cerebrolysin Attenuates Overexpression of Ubiquitin and Nitric Oxide Synthase and Induces Neuroprotection Following Spinal Cord Trauma

Category: Neurotrauma- basic research
 Author's preference: Oral

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Introduction/Rationale

Our military personnel are often prone to traumatic brain injury (TBI) or spinal cord injury (SCI) during combat operation. No suitable therapies have, however, yet been developed to treat personnel with these injuries. Exploration of novel therapeutic strategies is, therefore, needed. Our previous studies showed that SCI induces upregulation of neuronal nitric oxide synthase (nNOS) and ubiquitin expression in the cord in relation to cell injuries. Thus, in this investigation, we investigated potential neuroprotective effects of Cerebrolysin, a multimodal drug, on nNOS and ubiquitin expression in our rat model of SCI.

Method/Approach

A focal SCI was produced in rats by a longitudinal incision of the right dorsal horn of the T10-11 segments (2 mm deep and 4 mm long) under Equithesin anesthesia. The animals were allowed to survive 12 to 48 h after trauma. In separate groups Cerebrolysin (Ever Neuro Pharma Austria) was administered 2.5 or 5 ml/kg, i.v., either alone, or tagged, with TiO₂ nanowires after 2, 4 or 8 h of SCI. In these rats ubiquitin and nNOS expression was examined, using immunohistochemistry and the blood-spinal cord barrier (BSCB), edema formation and cell injuries were investigated using standard procedures.

Results/Effects

A focal SCI induced pronounced upregulation of ubiquitin and nNOS in distorted neurons and glial cells around the perifocal trauma that was most marked in the ipsilateral side. The magnitude and intensity of these expressions was progressive over time. Cerebrolysin treatment alone was significantly effective if given after 2 hours post SCI. Whereas, TiO₂ nanowired delivery of cerebrolysin attenuated ubiquitin and nNOS expression together with cell injuries even when administered 4 to 8 hours after trauma. There was a close correlation between breakdown of the BSCB to albumin and edema formation with cell injuries and ubiquitin or nNOS expression in SCI.

Conclusions/Limitations

Our observations are the first to show that nanodelivery of Cerebrolysin has superior neuroprotective effects in attenuating ubiquitin and nNOS immunoreaction together with cell injury in SCI, even when administered later after the primary insult. This indicates a future role of nanodelivery of drugs e.g., Cerebrolysin, for the effective treatment of SCI in clinical conditions.

0051

Complex Intervention Development: A Positive Focused Mindfulness Group Intervention Compared to Healthy Living After TBI

Category: Neurotrauma – health services and outcomes
Author's preference: Oral

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Introduction/Rational

Despite the chronicity of traumatic brain injury (TBI), few interventions have been piloted that are rigorous and effective. We tested two complex interventions focused on mindfulness group therapy versus healthy living after the occurrence of a TBI to determine whether depression symptoms, chronic stress, or psychological functioning were mitigated.

Method/Approach

This randomized control trial (RCT) involved 25 persons reduced from 33 who were initially randomized. 360 minutes of active classes, followed by 240 minutes of telephone booster interventions, were trialed. 85% of participants attended the classes and, we believe, engaged in outside practice. We evaluated TBI and depressive symptoms, psychological functioning, and chronic stress, pre and post 8-week intervention group programs, and examined the 12 week sustainability.

Results/Effects

Mindfulness over healthy living, after a mild to moderate TBI, demonstrated small to medium effect sizes on reducing chronic stress, depressive and TBI symptoms, as well limited as effects on psychological functioning. Positive focused mindfulness therapies, however, seemed to be acceptable and beneficial in persons who are, on average, 9 months post injury.

Conclusions/Limitations

We believe that both interventions demonstrated acceptability and benefits to the participants. Our sample was small and recruitment occurred in the Midwest during winter months. Additionally, this included only 25 participants from the original 33 who were randomized. Generalization is limited until we have expansion to multiple sites reflecting the general population of those with mild to moderate TBI.

0052

Post-traumatic Olfactory Impairment Following Traumatic Brain Injury: A Systematic Review

Category: Neurorehabilitation - basic research
Author's preference: Poster

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Introduction/Rationale

Schofield, Moore, and Gardner (2014) found an incidence of olfactory impairment ranging from 20-61%, depending on the severity of injury and other related factors. Interestingly, Fortin, Lefebvre, and Ptitto (2010) noted that 40-44% of brain injury survivors, with olfactory impairment, were unaware of their deficit. As olfactory impairment can pose serious concerns to one's safety and compromise quality of life, establishment of consistent procedures for screenings, assessments, and treatment approaches could facilitate identification of impairment sooner, this could assist practitioners in developing treatment plans, allowing for improved adjustment and quality of life for those affected.

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Method/Approach

Key issues were reviewed regarding post-traumatic olfactory impairment following a TBI including screening, comprehensive evaluation, and management strategies for improved awareness of impairment and better quality of life. A literature search was conducted from 1984 to present using the following databases: A Med, CINAHL, Cochrane, Google Scholar, Medline Plus, Medline/PubMed, and Ovid Medline. Articles in English were limited.

Results/Effects

Although olfactory impairment is a common sequelae of a TBI, it is not adequately appreciated by most practitioners, patients, or caregivers. Professionals working with this population should be aware of assessment techniques, the impact of olfactory impairment and the compensatory strategies available to assist patients. A comprehensive approach to treatment should include strategies to improve quality of life, safety, and coping.

Conclusions/Limitations

Based on our review, further prospective, randomized and blinded research is needed to define the true incidence of olfactory impairment after a TBI. Risk factors across the spectrum of brain injury severity, are the best tools for assessment, and they can determine the efficacy of management techniques in an effort to establish a systematic approach for identifying and managing this common impairment.

0053

Acceptance Commitment Therapy- A Novel Intervention in Traumatic Brain Injury

Category: Neurorehabilitation- Case report/Clinical Research
Author's preference: No preference

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Introduction/Rationale

High levels of psychological distress following a Traumatic Brain Injury (TBI) have been well documented. A systematic review in a study by Guillaumondegui et al (2011) it was concluded that there was a 33% prevalence rate of depression from 1 year and later post-injury. Individuals with a TBI may no longer have a stable sense of "who they are" and they tend to view themselves more negatively after a TBI (Carroll & Coetzer, 2011).

Method/Approach

Cognitive behavior therapy (CBT) had long been considered particularly applicable for those with a TBI because of the structured nature of the treatment and the ability to adapt the therapy to individual requirements (Khan-Bourne & Brown, 2003). Like CBT, Acceptance Commitment Therapy (ACT) emphasizes the relevance of language and cognition in psychopathology and psychotherapy. ACT, however, considers that thoughts and beliefs do not directly cause other behaviors.

Results/Effects

When primary outcome measures were compared, ACT outperformed CBT interventions in all cases (Francisco J. Ruiz,

2012). First, ACT seemed to obtain generally better results than CBT when comparing primary outcomes. Secondly, ACT reduced anxiety symptoms to the same degree as CBT, and possibly produces greater reductions of depression symptoms. Lastly, studies indicated that ACT might show better immediate improvements on quality of life when compared to CBT.

Conclusions/Limitations

Limited studies have been accomplished in the field of traumatic brain injury using ACT.

0054

Balance Markers in Adolescents at 1-month Post-Concussion

Category: Neurotrauma - case report/clinical research
Author's preference: Poster

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Introduction/Rationale

Approximately 30% of adolescents suffering concussion have functional consequences including balance deficits. Center of foot pressure (COP) measurements objectively quantify balance. The evidence of this in pediatric concussion, however, is limited. This study compared measures from the Balance Error Scoring System (BESS) and COP (Nintendo® Wii Balance Board:WBB) between adolescents aged 13-17 years, 1-month post-concussion (cases) and non-injured adolescents (control).

Method/Approach

This single center case-control study prospectively recruited cases from the emergency department (ED) and age/gender matched the community controls. 26 cases (mean age = 14.2 ± 1.2, 62% female) were tested by a single examiner between 28 and 40 days after injury. Baseline characteristics were similar in the 22 controls (mean age = 14.8 ± 1.5, 68% female). Participants completed the BESS followed by four 2-minute trials standing on a Wii Balance Board (WBB): i) double-leg stance, eyes open (EO); ii) double-leg stance, eyes closed (EC); iii) single-leg stance, eyes open (SIN); and iv) dual-task (DT) combining double-leg stance and Stroop color-word test.

Results/Effects

Significant group differences for COP balance variables included:

1. DT: 95% ellipse (2510 mm² vs. 452.2 mm², p = 0.01), anterior-posterior (A/P) velocity (16.20 mm/s vs. 9.949 mm/s, p = 0.04), medio-lateral (M/L) velocity (15.92 mm/s vs. 6.364 mm/s, p = 0.01)
2. EC: 95% ellipse (1083 mm² vs. 323.9 mm², p = 0.007), M/L velocity (8.811 mm/s vs. 6.039 mm/s, p = 0.04).
3. EO: 95% ellipse (723.6 mm² vs. 269.4 mm², p = 0.02)

Groups were not different on the BESS total scores (11.7 vs 9.05, p = 0.2).

Conclusions/Limitations

At 1-month post-concussion, cases continued to demonstrate balance deficits in COP control for both easy (EO) and difficult (EC, DT) tasks despite scoring similar to matched controls on the BESS. Simple COP measures of balance may identify subtle impairments not captured by BESS.

0055

A Visual-Vestibular Approach to Head Trauma

Category: Neurorehabilitation- Case report/Clinical Research
Author's preference: No preference

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Introduction/Rationale

Studies indicate that dizziness is the #1 predictor to post-concussion syndrome and it reveals significant visual impairments status post (s/p) head trauma. In the evaluation of visual and vestibular function, s/p head trauma warrants consideration, as it can provide information regarding appropriate integration into a rehabilitation program.

Method/Approach

Pre-post scores of Graded Symptom Checklist, SOT scores, VOR function and Convergence – initial evaluation to discharge were used in the study.

Results/Effects

Results included improved scores of post-concussive questionnaires, sensory organization, vestibular ocular reflex function and convergence.

Conclusions/Limitations

It was concluded that functional integration of visual-vestibular exercises in the rehabilitation program, s/p head trauma, results in improvement in symptoms and function.

0056

Unique Client Engagement in a Transitional Brain Injury Rehabilitation Setting: A Case Series

Category: Neurorehabilitation – activities and participation
Author's preference: Poster

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Introduction/Rationale

The concept of engagement in the context of neurorehabilitation has been found to be critical for optimizing outcomes. Watson (2014) found a correlation between poor compliance and “poorer rehabilitation outcomes.” The concept of person-centered planning identifies the outcomes, or goals, that are relevant to the client when establishing a treatment plan. Sometimes, however, this is challenging such as when the client lacks insight and awareness regarding their functional limitations. Ideally, the transdisciplinary team, including the client, should work together to develop overarching goals for the rehabilitation process. Hooson (2012) found this type of rehabilitation team approach as the most valued.

Method/Approach

Tree of Life Services, Inc., a community-based brain injury neurorehabilitation program, provides transitional services, as well as long-term care, for high-functioning clientele. Discipline specific evaluations are conducted with input from the client to establish a holistic treatment plan including providing unique opportunities for non-traditional treatment approaches.

Results/Effects

Client 1 was able to review gun safety, return to shooting at a local gun range, and complete physical training specific to police department requirements. Client 2 discovered an ability to draw with his non-dominant hand following an acquired brain injury (ABI) with hemiparesis. We assisted him in creating an “Etsy” account, where he now gets paid for his artwork. Client 3 climbed ladders while carrying various objects in a safe, supported environment, in order to evaluate his abilities and facilitate his return to industrial steam cleaning. By incorporating client 4's pre-injury interest in snowboarding, by using adaptive sports accommodations, his commitment to balance and coordination activities increased.

Conclusions/Limitations

Incorporation of personal goals can facilitate client progression through rehabilitation with a return to the community via employment and leisure interests. Unique treatment approaches can, and should, be used while incorporating the philosophy of client centered care.

0057

A Look at Pediatric Injuries From Motorcycle and Scooter Crashes

Category: Neurotrauma – prevention and public health
Author's preference: No preference

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Introduction/Rationale

In Florida, one must be at least 16 years old (≥ 16) to legally drive a motorcycle or scooter. Helmeted children below age 15 may ride as passengers. The law does not specify, however, what signifies a proper helmet fit, or the minimum size, or age of a child who is capable of riding safely. We examined crash statistics to understand the impact and injury patterns of riders under age 15 (≤ 15). We hypothesized that children ≤ 15 would be more likely to suffer head injuries than older riders.

Method/Approach

We reviewed, from 1991 to 2013, motorcycle crash (MCC) and scooter crash (SC) data at our Level I trauma center. For patients ≤ 15 , we examined age, gender, rates of subdural/epidural hematoma to control for shear injury, and head versus extremity injuries. Statistical tests were completed using a Z-test for proportions ($p < 0.05$).

Results/Effects

Patients ≤ 15 were more likely to be in SCs (10.4%) than MCCs (1.4%) ($p < 0.01$), and more likely to be male

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($p < 0.01$). There were twice as many subdural/epidural hematomas in SCs (18.6%) vs. MCCs (8.6%), but this did not reach significance ($p = 0.09$). MCC patients ≤ 15 were more likely to have a brain/head injury (44.8%) than extremity injury (27.6%) ($p = 0.027$), and more likely to have a brain/head injury than MCC patients ≥ 16 ($p = 0.016$). SC patients ≤ 15 were more likely to have a brain/head injury (51.3%) than extremity injury (26.9%) ($p < 0.01$), and more likely to have extremity injuries than patients ≥ 16 ($p = 0.025$).

Conclusions/Limitations

Children 15 years and younger in motorcycle crashes may be more likely to suffer head injuries than older riders, this is possibly due to body proportions, poorly-fit helmets, and minimal enforcement. Despite being easier to enforce because of a child's size, laws in many states do not adequately protect young riders. To prevent injuries or death, states must enforce proper helmet use for children, or prohibit children from riding on motorcycles and scooters.

0058

"Oil Cans and Safety Nets": Resource Facilitation as a Core Service for Individuals With Brain Injury and Their Families

Category: Neurorehabilitation – activities and participation

Author's preference: Oral

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Introduction/Rationale

For more than a decade, a number of United States Brain Injury Alliance Member Organizations have deployed programs of Brain Injury Resource Facilitation (RF). The goal of RF is to help people "live well" with brain injury and to reduce the range of untoward outcomes (i.e. unemployment, incarceration, psychiatric inpatient commitment) often associated with disabilities resulting from it. RF services provide early identification and support for individuals with brain injury, families, caregivers and professionals. RF services are also instrumental for many who find themselves "stuck" in their efforts to access and retain medical, insurance, and disability services and supports.

Method/Approach

Although there is a range of models for RF across the country, programs in Iowa and Minnesota are substantively similar in philosophy and operation. Outcome data collected for these programs offer a model for a "best practice" in this service as it continues to emerge across the nation.

This presentation provides an overview of:

1. Policy strategies that have led to the initial and sustained funding for RF programs in Iowa and Minnesota; and
2. Outcome and trend data associated with the programs.

Results/Effects

Efficacy, efficiency and access to services data will be presented and discussed.

Conclusions/Limitations

Recommendations for core components of RF best practices will be proposed.

0059

Time Course of Circulating MicroRNA Expression After Traumatic Brain Injury in Rats

Category: Neurotrauma- basic research

Author's preference: Poster

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Introduction/Rationale

MicroRNA (miRNA) are recently discovered small (~22 nucleotides), non-coding ribonucleic acid (RNA). Though there are only hundreds of miRNAs, each of them can potentially regulate hundreds of target genes, via base-pairing with complementary sequences in mRNA. This provides one approach that targets a single miRNA to have effects on multiple genes. Recent reports show that blood miRNAs are significantly altered in experimental animals as well as in patients with acute brain injuries, including traumatic brain injury (TBI). A time course study of miRNA expression, post-TBI, will help define the therapeutic window of using miRNA mimics or inhibitors for treating TBI.

Method/Approach

Using the moderate lateral fluid percussion-induced TBI model, we examined miRNA expression in blood at different time points (10min, 30min, 3hr, 24hr, 7d and 14d) post-TBI in rats.

Results/Effects

As compared to sham operation, only a few miRNAs (i.e., miR-140, miR-3562) were altered significantly, and fold changes were small (<2 folds) at 10 or 30 min post-TBI. More miRNAs (i.e., miR-125b, miR-122, miR-146a, miR-140, and others) were altered, however, with much higher fold changes at 3 and 24hrs, and then decreased at 7 and 14 days post-TBI. For example, miR-125b was down-regulated 5.3 folds at 3 hrs, 10.2 folds at 24 hrs, 2.8 folds at 7 days and 3.2 fold at 14 days post-TBI.

Conclusions/Limitations

This suggests that miRNAs have the potential to be early, as well as late, biomarkers following a TBI. Ongoing studies are testing whether elevating miR-125b at different time points (0-12hrs, and 1-14days post-TBI) attenuates brain damage post-TBI, using the newly developed in vivo polyethylene glycol-liposome based miRNA transfection method.

0060

Effect of Post Sport-Related Concussion Health Decisions for the High School Athlete: A Case Study

Category: Neurotrauma - case report/clinical research
 Author's preference: No preference

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Introduction/Rationale

Each year, concussion comprises a substantial number of traumatic brain injuries (TBI) among high school athletes. Unreported injuries result in non-treatment, or treatment delays and premature return to physical or cognitive activities. This can potentially increase the risk for subsequent injury, prolonged symptoms, and symptom severity. Early recognition of concussion symptoms, and linkage to healthcare providers for timely intervention, is necessary to optimize health outcomes, this relies on the athlete's self-report at the time of injury. The purpose of this qualitative case study was to explore influential factors regarding the process of health-decision making by high school athletes who had sustained sports-related concussions.

Method/Approach

Grounded theory methodology fostered exploration of high school athletes' healthcare decision making after a sports concussion. Purposive sampling was used, between August 2012 and July 2014, to identify English speaking varsity athletes who had experienced a sports-related concussion. Two 17-year-old male athletes represented diverse socioeconomic high school varsity athletic programs. Data was gathered during semi-structured interviews facilitated by an interview guide. An iterative, constant comparative process was utilized to code concepts prevalent within participants' interviews. Prolonged engagement and persistent observation were used to establish credibility, while peer review and member checking of qualitative data validated interpretations.

Results/Effects

Participants described a trajectory from time of injury through their return to self. Critical junctures within the trajectory included injury event, sideline assessment, return to play and school, symptom progression, and return to self. Multiple ecological factors influenced aforementioned junctures, including intrapersonal factors, social relationships, school resources, athletic success, accessibility to healthcare, and sport culture. Participants perceived non-brain injuries as more difficult to conceal, thus providing more distinct signs and symptoms to facilitate injury reporting and engagement in the healthcare system for treatment.

Conclusions/Limitations

Interviews were coded utilizing an inductive, iterative process. Athletes' described post-concussion decision-making with interrelations between ecological concepts and health seeking behaviors. Both athletes described inadequate pre-injury concussion knowledge to help link symptoms with concussion. Sideline evaluation did not detect concussion in either athlete, perceived as a conclusive medical diagnosis. Access to healthcare, return to play, symptom progression, quality of life, and return to self differed based on athlete school, and personal and socioeconomic resources. Limitations include small sample size and lack of ethnic and gender diversity. This

case study frames a larger study examining health decisions of athletes post sports-related concussions.

0061

Differential Effects of Melatonin on Amyloid- β Peptide 25-35 Induced Down-Regulation Expression of the PGC-1 α and mtTFA in Hippocampal Neurons at Different Stages of Culture

Category: Neurorehabilitation - basic research

Author's preference: Poster

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Introduction/Rationale

Mitochondria play an important role in neurodegenerative disorders, including Alzheimer's disease (ALZ). Melatonin (MEL) may also exert a neuroprotective effect in neurodegenerative disorders. The protective effect of MEL is, in part, mediated by mitochondria. To determine whether, any different effect there is on mitochondria biogenesis disorders in neurons induced by amyloid- β ($A\beta$) at different stages of culture, we investigated expression of the peroxisome proliferators-activated receptor- γ coactivator-1 α (PGC-1 α) and the mitochondrial transcription factor A (mtTFA) in cultured rat hippocampal neurons induced by $A\beta$. We also investigated the protective effect of MEL at different stages of culture.

Method/Approach

Young hippocampal neurons (10 days in vitro) and senescent hippocampal neurons (25 days in vitro) were divided into a Control Group (only serum-free medium), MEL Group (10^{-5} M MEL, $A\beta$ Group (25μ M $A\beta$ 25-35), $A\beta$ plus MEL Group 1 (25μ M $A\beta$ 25-35 and 10^{-5} M MEL) and an $A\beta$ plus MEL Group 2 (25μ M $A\beta$ 25-35 and 10^{-6} M MEL), respectively. Rat hippocampal neurons were incubated with $A\beta$ 25-35 alone, or pre-treated with MEL (10^{-5} M or 10^{-6} M MEL). PGC-1 α and mtTFA of hippocampal neurons were analyzed by RT-PCR and Western blot.

Results/Effects

Expression of PGC-1 α (including Protein and mRNA) and mtTFA (including Protein and mRNA) of $A\beta$ Group were significantly lower than the Control Group in young and senescent neurons ($P < 0.01$). Expression of PGC-1 α (including Protein and mRNA) and mtTFA (including Protein and mRNA) of $A\beta$, plus MEL Group (Group 1 and Group 2), were significantly higher than $A\beta$ Group in young ($P < 0.01$). Expression of PGC-1 α (including Protein and mRNA) and mtTFA (including Protein and mRNA) of $A\beta$, plus MEL Group (Group 1 and Group 2) in senescent neurons, had no significant differences compared with the $A\beta$ Group ($P > 0.05$).

Conclusions/Limitations

These results demonstrate that $A\beta$ 25-35 may induce down-regulation expression of that the PGC-1 α and mtTFA in hippocampal neurons and MEL has a differential effect on $A\beta$ 25-35-induced down-regulation expression of the PGC-1 α and

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mtTFA at different stages of culture. It also suggests that MEL is useful for the prevention of ALZ, rather than treatment.

0062

Age-dependent Upregulation Expression of the APP in SAMP8 Mice With Trigeminal Nerve Damage

Category: Neurotrauma- basic research

Author's preference: Poster

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Introduction/Rationale

Tooth loss is commonly found in patients with Alzheimer's disease (AD) and is considered as one of the risk factors for the disease. The tooth belongs to the trigeminal sensory pathway. Dental damage has been associated with impairments in the central nervous system that may be mediated by injury to the trigeminal nerve. In the present study, we investigated the effects of damage to the inferior alveolar nerve. This is an important peripheral nerve in the trigeminal sensory pathway, an expression of the amyloid precursor protein (APP) and formation of senile plaques in the hippocampus in senescence-accelerated mouse prone 8 (SAMP8) mice.

Method/Approach

24 SAM-P8 mice (4 months old) were divided into middle-aged experimental groups 1, groups 2, and corresponding control groups. 12 mice (7 months old) were divided into an elderly experimental group and control group. An inferior alveolar nerve transection was performed in middle-aged and elderly SAMP8 mice. When the middle-aged mice reached 8 months (middle-aged group 1), or 11 months (middle-aged group 2 and the elderly group), APP and APP mRNA of hippocampal regions were analyzed by reverse transcription polymerase chain reaction (RT-PCR) and Western blot. The hippocampus were then stained by Gomori's methenamine silver nitrate. The area of the methenamine silver stain granules (MSSG) of hippocampus were analyzed by a photograph autoanalyzing system.

Results/Effects

Expression of APP and APPmRNA of the hippocampus in elderly experimental group were significantly higher than in the elderly control group ($P < 0.01$). Expression of APP and APPmRNA of the hippocampus in the middle-aged experimental groups 1 and 2 were not significantly different compared with the corresponding control groups ($P > 0.05$). The area of the MSSG of the hippocampus in the middle-aged and elderly experimental groups were not significantly different compared with the corresponding control groups ($P > 0.05$).

Conclusions/Limitations

The effects of trigeminal nerve damage on the central nervous system (CNS) are age-dependent. Trigeminal nerve damage in old age, but not middle age, can induce upregulation expression of APP in the hippocampus at SAM-P8 mice. This may represent the mechanism underlying the effects of dental damage-induced trigeminal nerve injury on the course of AD.

0063

Rehabilitation Pathways Following Severe Traumatic Brain Injury: Addressing Cognitive Functioning and Self-Awareness One Year After Injury

Category: Neurorehabilitation- Case report/Clinical Research

Author's preference: Oral

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Introduction/Rationale

Most individuals with severe traumatic brain injury (TBI) experience a range of cognitive impairments, as well as behavioural and emotional problems. This suggests that they may need extensive and specialized TBI rehabilitation in promoting recovery. Current research findings show that a direct pathway from acute intensive care to specialized TBI rehabilitation gives the most promising functional outcomes. The twofold aim of this study was 1) to describe the rehabilitation pathways in a national cohort of severe TBI in Norway and 2) to determine whether there are differences in cognitive functioning and self-awareness in patients that receive different pathways.

Method/Approach

In 2009-2011, patients with severe TBI (Glasgow Coma Scale score < 8) were enrolled to a multicentre study when admitted to four trauma centres in Norway. Injury severity was assessed with the Abbreviated Injury Score, the Injury Severity Scale (ISS), Rotterdam computed tomography (CT) scores, and duration of post-traumatic amnesia. 148 individuals participated (aged 16-85 years; median age 35; 76% males) in a study of cognitive functioning 1-year after injury. Cognitive functioning was evaluated with neuropsychological tasks of executive functions, processing speed, memory and reasoning skills. Self-awareness was assessed with the Awareness Questionnaire that was completed by 123 patients and 99 close relatives.

Results/Effects

Four rehabilitation pathways were identified: 1) direct pathway to specialized rehabilitation ($n = 89$, 60%); 2) indirect pathway to specialized rehabilitation ($n = 25$, 17%); 3) non-specialized rehabilitation ($n = 16$, 11%); and 4) no rehabilitation ($n = 18$, 12%). Those who received a direct pathway to specialized rehabilitation had a longer length of stay in rehabilitation (77.3 days) and were younger (34.7 years) ($P_s < .001$). MANCOVA, controlling for injury severity, showed no between-group differences on executive functions

($F_{6,137} = 0.99$, $P = .433$), processing speed ($F_{5,138} = 2.28$, $P = .055$), memory ($F_{4,139} = 1.56$, $P = .190$), and reasoning skills ($F_{2,132} = 0.59$, $P = .553$), or on self-awareness for patients ($F_{3,116} = 0.52$, $P = .671$) and relatives ($F_{3,92} = 0.41$, $P = .748$). There were no differences in cognitive impairments between pathways ($P_s > .05$).

Conclusions/Limitations

Individuals who received specialized TBI rehabilitation were younger and had more severe TBI. Cognitive functioning was similar for patients who received specialized, non-specialized, and no rehabilitation. Findings highlight the importance of addressing rehabilitation needs in this population of persons who have experienced a TBI.

0064

A Comparison of Aggression, Sensation Seeking and Positive and Negative Affect Between Persons With Traumatic Brain Injury (TBI) and Healthy Persons

Category: Neurotrauma – health services and outcomes
Author's preference: Oral

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Introduction/Rationale

The purpose of this study was to compare sensation-seeking, aggression, positive and negative affect in persons with a traumatic brain injury (TBI) and in healthy people.

Method/Approach

The research method was causative-comparative, or post accidental. 30 people with a TBI and 30 healthy people were selected in purposive form using the multi-variable variance analysis (MANOVA) method.

Results/Effects

The results showed that there is more sensation seeking, aggression and negative affect in persons with a TBI than in healthy persons, but positive affect is lower in persons with a TBI than in healthy ones.

Conclusions/Limitations

Damage to brain structure and physiology will be followed by different psychological consequences, including aggression, sensation seeking and changes in affect.

0065

Global Patterns and Outcomes of Patients With Traumatic Brain Injury

Category: Neurotrauma – health services and outcomes
Author's preference: Oral

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Introduction/Rationale

Traumatic brain injuries (TBIs) result in a large number of deaths and many other impairments that lead to permanent disabilities.¹ To optimize care and improve outcomes, studies should be performed to evaluate and benchmark outcomes. In this study, we have compared the demographic patterns and outcomes of patients with TBI in three international Level I trauma centers.

Method/Approach

An international institutional trauma registry based study was used. The registry involved the University Medical Center Utrecht (UMCU), the Netherlands; John Hunter Hospital (JHH), Australia; and Harborview Medical Center (HMC), the United States. Patients ≥ 18 years with TBI Abbreviated Injury Scale (AIS, Head ≥ 1), admitted in 2012, were registered in the institutional trauma registry. A multivariable logistic regression model was used to analyze the difference in outcomes.

Results/Effects

In UMCU, JHH, and HMC, respectively, 457, 690, and 1698 were admitted with TBI, and 196(42.9%), 209(30.3%), 704(41.5%) with severe TBI (AIS head ≥ 4). Mean ISS was significantly higher in HMC = 19.2 compared to UMCU = 16.1 and JHH = 16.6. Unadjusted mortality UMCU = 10.9%, JHH = 5.9%, and HMC = 9.0%. Adjusted for age and ISS odds of death was lower in JHH = 0.412 [0.253-0.672] and HMC = 0.520 [0.355-0.760] compared to UMCU; HMC compared to JHH = 1.261 [0.840-1.892]. Odds of death for patients with severe TBI: JHH = 0.528 [0.303-0.917] and HMC = 0.579 [0.378-0.888] compared to UMCU; HMC = 1.097 [0.689-1.747] compared to JHH. Subgroup analysis showed that the significant difference could be attributed to the patients with severe subdural hemorrhage.

Conclusions/Limitations

This study of patients with severe TBI demonstrates substantial differences across trauma centers in patient characteristics and outcomes. Future studies must reveal whether these differences are attributable to different treatment strategies. Furthermore, future studies need to investigate whether differences across countries remain with non-fatal and long-term outcomes.

0066

Major Limb Loss and Traumatic Brain Injury After Polytrauma

Category: Neurorehabilitation- Case report/Clinical Research
Author's preference: Poster

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Introduction/Rationale

The Polytrauma Rehabilitation Center (PRC) model of care was developed for the rehabilitation of severely injured military personnel including those with concomitant brain injury and amputation. The objectives of this study was to identify the incidence of concomitant diagnosis of amputation and traumatic brain injury (TBI) within the polytrauma population; to describe the characteristics of this population; and to describe functional outcome measures within this population over the course of inpatient rehabilitation.

Method/Approach

This is a prospective cohort study within a PRC at a veterans administration hospital. Participants included military personnel admitted to a PRC with concomitant diagnosis of TBI and major limb amputation between the years of 2006 -2013. We completed an analysis of prospectively gathered data on the demographics and functional outcomes of admitted military personnel by physiatrist and PRC treatment teams. The main outcome measures include functional independence measures (FIM) and FIM efficiency scores.

Results/Effects

This study found 18 patients with concomitant diagnosis of TBI and major limb amputation. The patients were mostly single males, on active duty and injured by a blast or explosion. Half of these patients had severe brain injuries and 56% had multiple limb amputations demonstrating the severity of their injuries. The majority (94%) of these patients were discharged home, or to further rehabilitation facilities for further prosthetic and orthotic training. FIM efficiency scores averaged 0.39 with average rehabilitation admission and discharge FIM scores of 57 and 91, respectively.

Conclusions/Limitations

There is a paucity of data on patients with concomitant diagnosis of major-limb amputation and TBI. These patients have unique needs for both diagnosis and follow up and the PRC structure is successful in rehabilitating these severely injured patients, as assessed by FIM and FIM efficiency scores.

0067

The Community Integration Questionnaire: Comparison of Outcomes of People With TBI and Multiple Matched Controls From Australian Normative Data

Category: Neurorehabilitation – activities and participation
Author's preference: Oral

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Introduction/Rationale

Community integration is often described as the ultimate aim of traumatic brain injury (TBI) rehabilitation. Interpretation of community integration outcomes has, however, been limited, to date, by a lack of normative data against which to

compare findings. The aims of this study were: 1) examine the home, social and economic participation of community living adults with severe and long-term TBI; and 2) to compare findings with multiple matched controls drawn from the Community Integration Questionnaire (CIQ) normative data.

Method/Approach

This study took place in Australia. The participants were adults with severe TBI (n = 61); 70.5% male; age M(SD, R) = 42.9(11.5, 24-69) years, time since injury was M(SD, R) = 17(9, 1-32) years; the participants were living in their own home (26.2%), or group home settings (73.8%). The design was a quantitative matched analysis of people with and without TBI, with matching aimed at reducing variability expected from age, period and cohort effects, gender, metropolitan/rural residence, and co-resident status. Four controls were identified for each TBI participant. Instrumentation for this study was a customized demographic survey, the Care and Needs Scale (CANS) and the Community Integration Questionnaire (CIQ).

Results/Effects

Matched analyses showed medium-large effects favoring the general population – CIQ total M(SD) were 12.3(5.4) and 19.6(4.2) in TBI and non-TBI groups respectively, and significantly different $F(1, 243) = 140, p < 0.0001$. Estimates of the relative risk showed that TBI participants living in the community were 4.4 times more likely to report a poor CIQ total score compared to the general population.

Conclusions/Limitations

People with severe TBI are poorly integrated into the community compared with able-bodied peers. Our understanding of community integration outcomes following TBI is enhanced when we can make meaningful comparisons with the general population to inform and direct rehabilitation practices and resource allocation.

0068

Outcomes of Elementary School Children With A History of TBI Before Age 6

Category: Neurorehabilitation- Case report/Clinical Research
Author's preference: Oral

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Introduction/Rationale

Children under 5 years comprise the largest number of emergency room (ER) visits for Traumatic Brain Injury (TBI). To date, most investigations have examined hospitalized children who have more severe injuries. This presentation will

describe cognitive, language and reading outcomes in elementary school for children who had a TBI before age 6 compared to a control group of children with orthopedic injuries (OI).

Method/Approach

Children ages 6-9 years old with a history of TBI or OI before age 6 years were recruited from community and trauma registries in a large southeastern city. Child assessment and parent report measures were administered in the area of cognitive, language, and reading. Medical record reviews confirmed injuries and injury severity.

Results/Effects

At the initial study visit, the TBI group (n = 40) had a mean age of 7.55 years (SD = 1.29) and was 5.15 (SD = 1.56) years post injury. TBI was classified as mild (80%), moderate (13%), severe (5%) or missing (5%). Children in both groups performed in the average range on cognitive, language, and reading measures. Group differences were observed, however, in executive function skills (F 1,38 = 11.73, p = .001, h = .13), pragmatic language (F 1,20 = 13.63, p = .001, h = .02) and reading comprehension (F1,38 = 5.11, p = .03, h = .06). Medical and school service utilization, after the injury, was low.

Conclusions/Limitations

Young children with mild TBI before age 6 show differences in executive functions, language, and reading during early elementary school when compared to OI controls. Implications for follow-up will be offered.

0069

Using Tele-Rehabilitation to Support People Living With TBI

Category: Neurorehabilitation- Case report/Clinical Research
Author's preference: Oral

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Introduction/Rationale

People living with dysexecutive syndrome often need long term support. This emerging approach will be explored using a single case study.

Method/Approach

A single case study will be used for this approach.

Results/Effects

Tele-rehabilitation has proved to be beneficial.

Conclusions/Limitations

Tele-rehabilitation has allowed for an affordable and effective approach.

0070

Piloting the Use of Accelerometers to Assess the Amount and Intensity of Activity Completed by Inpatients Following TBI

Category: Neurorehabilitation – activities and participation
Author's preference: No preference

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Introduction/Rationale

Repetition and intensity are key components for improved outcomes during inpatient rehabilitation following traumatic brain injury (TBI). Little is known, however, about the intensity and duration of activity completed by patients undergoing rehabilitation post TBI. Evidence from the stroke literature suggests that activity levels are very low and contribute to poor long-term outcomes. Our purpose is, therefore, to report on initial data collected with accelerometers to describe the activity levels of individuals with TBI during acute inpatient rehabilitation

Method/Approach

Actigraph data was collected on 16 individuals (8 females, 8 males), with TBI, participating in acute inpatient rehabilitation (M age = 44.68 years; M GCS = 11.6; M time since injury = 34.2 days). Data was collected for an average of 11.25 consecutive days (1440 min/day) at one minute epochs and included activity counts (AC) and percentage time active or immobile.

Results/Effects

Individuals completed an average of 75.93 AC min/day (range 36-131), spent 741.7 min/day immobile (including sleep) and 572.3 min/day mobile (43.4% of day). The average length of mobile bouts was 6.5 min/day (range 3.46-12.95). Based on population level normative values, 12 participants were considered sedentary (<100 AC/min) and 4 inactive (100-499 AC/min). Results were comparable to stroke studies that reported individuals spent up to 62% of the day inactive.

Conclusions/Limitations

Our results suggest that activity levels are low and that bouts of activity are short during inpatient rehabilitation for individuals during acute recovery following TBI, with the majority considered sedentary (<100 AC/min). Due to the small initial sample, further investigation is warranted to better understand activity levels in the acute brain injury population and to identify safe and effective strategies to facilitate increased participation.

0071

Correlation of Emotional and Neutral Verbal Recall With SCATBI Scores in Traumatic Brain Injury

Category: Neurorehabilitation - basic research
Author's preference: No preference

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Introduction/Rationale

Individuals with traumatic brain injury (TBI) have impairments in identifying emotion in social and pragmatic communication (Ben-David, van Lieshout, & Leszcz, 2011), while individuals without brain injury show increased recall for emotional stimuli compared with neutral stimuli (Hamann, 2001). The purpose of this study was to determine the effects of stimulus emotional content on the ability of individuals with TBI to recall words from lists and content units from paragraphs, and to determine if Scales of Cognitive Ability in Traumatic Brain Injury (SCATBI; Adamovich & Henderson, 1992) scores correlate with performance on emotional, verbal recall tasks.

Method/Approach

Twenty individuals (2 female) with mild to moderate TBI, confirmed from medical history, participated in the study. Participants were monolingual native speakers of English with normal hearing acuity. The participants were administered the SCATBI and a verbal recall task. The verbal task consisted of 6 paragraphs, 3 rated as highly emotional, and 3 rated as neutral and 6 word lists, each 10 words in length with 5 words rated as highly emotional, and 5 rated as neutral. Presentation of word lists and paragraphs was counter-balanced, and word list and paragraph order were randomized.

Results/Effects

Individuals with TBI recalled significantly more emotional words than neutral words from lists, but showed no significant difference between the number of units recalled from emotional and neutral paragraphs. Correlation of overall scores with performance on individual verbal recall task types revealed significant correlations for emotional words (.46), neutral paragraphs (.46) and emotional paragraphs (.53). No significant correlation was found between neutral word recall and the SCATBI score. Emotional paragraph recall had the highest correlation with SCATBI performance.

Conclusions/Limitations

Individuals with TBI do not have increased recall in paragraphs with emotional saliency, though they do show increased recall with emotional words when compared to neutral words. SCATBI scores show the most significant correlation with emotional paragraph recall, where participants did not show increased recall from neutral paragraphs. This correlation reflects that individuals with TBI may present with emotional processing deficits relative to their overall impairment. This domain, however, is not often assessed clinically. Individuals with TBI may benefit from therapy aimed at increasing ability to infer emotional salience at the paragraph level.

0072

Delphi Consensus on Best Practices for Individuals With Traumatic Brain Injury Undergoing Rehabilitation

Category: Neurorehabilitation- Case report/Clinical Research
Author's preference: Poster

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Introduction/Rationale

Attempts at measuring quality of rehabilitation care are hampered by a gap in knowledge translation of evidence-based rehabilitation approaches and a lack of consensus on best practices. There is a critical need, therefore, to adopt evidence-based best practices to minimize variations and improve quality of care. As a result, this presentation will describe the process of identifying and assessing evidence-based clinical practices in traumatic brain injury (TBI) rehabilitative care and provide preliminary results of our work.

Method/Approach

A multidisciplinary team of clinicians (medical, neuropsychological, physical/occupational/speech therapy, therapeutic recreation) was established. The team developed discipline-specific research questions using the PICO process. Next, a systematic review of the literature was conducted for each question using Pubmed, CINAHL, PsychInfo and Allied Health Evidence databases. Team members reconvened to assess the quality of evidence utilizing a modified-Oxford scale and created a draft recommendation for best-practice using a modified-GRADE format. Finally, the draft recommendation was posed to a Delphi panel including clinical representatives and stakeholders. Once consensus was achieved the recommendation was disseminated as best practice.

Results/Effects

A total of 44 PICO questions were created for inpatient TBI rehabilitation. Currently, a systematic review has been completed for 13 questions, with 6 yielding no relevant results of literature. Seven have undergone quality of evidence assessment using modified Oxford and modified GRADE and one has been reviewed by a Delphi panel for consensus.

Conclusions/Limitations

As each disciplinary question undergoes the review and consensus process, a series of evidence-based TBI rehabilitation practice recommendations will be produced. TBI rehabilitation clinicians can adopt these best practices to improve the quality of care that TBI patients receive. To date, one best-practice recommendation in neuropsychology has been finalized, with consensus reached, and includes: weak/conditional support in favor of goal management training to improve goal setting in individuals with TBI undergoing rehabilitation.

0073

Combined Resting-state fMRI and Diffusion Tensor Imaging Study in Mild Traumatic Brain Injury

Category: Neurotrauma - case report/clinical research
Author's preference: No preference

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Introduction/Rationale

To explore whether the functional deficits in mild traumatic brain injury (MTBI) individuals are consistent with

microstructural alterations after acute injury by combined resting-state fMRI (RS-fMRI) and diffusion tensor imaging (DTI).

Method/Approach

Twenty patients with acute MTBI (GCS, 13-15) and seventeen healthy people underwent conventional MRI, RS-fMRI and DTI. We used RS-fMRI to identify areas characterized by regional homogeneity (ReHo) and amplitude of low frequency fluctuation (ALFF) in MTBI patients and controls, and used these abnormal ALFF regions to guide ROI placement for DTI analyses. Modified Mini-Mental State (MMSE) test was administered within 12 hours after functional MRI, and was performed at 6 months again after injury.

Results/Effects

Compared to healthy individuals, MTBI patients had more bilateral frontal lobe and cerebellar posterior lobe activation in the resting state, but less activation in the right thalamus, right hippocampus, brainstem, bilateral occipital lobe, left post-central gyrus, and right corona radiata. In the ROIs identified by RS-fMRI in MTBI patients, we observed overall decreased diffusivity, as evidenced by decreased FA in the bilateral frontal lobe, brainstem, and left occipital gyrus, and by decreased ADC in the left thalamus, bilateral hippocampus and right cerebellar posterior lobe. MMSE scores of MTBI patients were significantly lower than that in the control group for the 6 months after injury.

Conclusions/Limitations

Combining RS-fMRI with DTI not only provides an objective and targeted method for regional DTI analyses, but also provides more useful information for the clinician to make a better explanation for the patient's symptoms.

0074

Transplantation of Galectin-1-Secreting Neural Stem Cells as a Restorative Therapy for Traumatic Brain Injury

Category: Neurotrauma- basic research

Author's preference: Poster

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Introduction/Rationale

Traumatic brain injury (TBI) is a leading cause of death and disability especially in young adults. Neural stem cell (NSC) transplantation has been explored as a potential therapy for brain injuries. The present study investigated whether transplantation of engineered NSCs secreting Galectin-1, a special lectin with high affinity to α -galactosides, could provide protection against TBI, and identified the underlying mechanisms. Moreover, the engineered NSCs were co-administered with a biologic scaffold extracellular matrix (ECM) protein, which could improve the survival of the transplanted cells.

Method/Approach

Secretory galectin-1 was stably overexpressed in neuroepithelial (NE)-4C stem cells. TBI was induced in mice by a controlled cortical impact (CCI). NE-4C stem cells secreting galectin-1 (Gal-NSCs) were mixed with ECM and transplanted into corpus callosum and striatum 1 hour after CCI. Sensorimotor deficits were determined by the Rotorod and Hanging wire tests. Lesion volume was measured using microtubule associated protein-2 (MAP-2) staining. White matter injury was measured by myelin basic protein (MBP), neurofilament SMI32 and Glial Fibrillary Acidic Protein (GFAP) staining. In vitro study, the effect of galectin-1 on AMPA excitotoxicity in primary oligodendrocytes was measured by MTT Assay and LDH Assay.

Results/Effects

Transplantation of Gal-NSCs mixed with ECM treatment (Gal-NSCs+ECM) attenuated sensorimotor deficits up to 35 days after CCI and reduced lesion volume as compared with vehicle-treated mice. White matter injury was also ameliorated in Gal-NSCs-treated TBI mice as revealed by increased MBP staining of myelin and reduced axonal damage (less SMI32 staining). In addition, Gal-NSCs+ECM treatment reduced astrocyte activation. In vitro studies demonstrated that Galectin-1 could protect oligodendrocytes against AMPA-induced cell death in primary oligodendrocyte culture.

Conclusions/Limitations

Our study suggests that engineered neural stem cells, secreting galectin-1, combined with ECM scaffold protein, could improve functional outcomes and reduce tissue loss after a TBI. In particular, the Gal-NSCs+ECM treatment significantly reduced white matter injury after the occurrence of a TBI. Galectin-1 afforded protection on oligodendrocytes.

0075

Concussion in Youth Athletes: Observed Changes in Measures of Heart Rate Variability (HRV) After Concussion

Category: Neurotrauma- basic research

Author's preference: No preference

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Introduction/Rationale

Mild traumatic brain injury (mTBI), otherwise known as a concussion, is of great concern within the pediatric sport population due to its high prevalence and potential impact on neurological development. Currently, there is a lack of data on heart rate variability measures after concussion. This objective marker of physiological stress could assist in the management of recovery in youth athletes after concussion.

Method/Approach

Participants were 29 healthy youth athletes, consisting of 21 females, 8 males (13.03 \pm 1.96 years). Each participant

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completed pre- and post-concussion assessments on post-concussion symptoms, cognition, agility and recordings of heart rate variability (15 minutes or 24 hours). Heart rate variability (HRV) was observed by means of time-domain and frequency domain analysis. All statistical analyses were completed using SPSS v. 19.0 and the threshold for statistical significance was set at $p \leq 0.05$.

Results/Effects

An increase in HRV was observed in youth athletes post-concussion. There was a positive association between HRV and post-concussion symptom scores between days 0 and 21 days post-injury. Additionally, main effects of post-concussion symptoms (increased post-concussion symptoms were associated with higher HRV and concussion status was observed on measures of HRV (having a concussion was associated with increased HRV).

Conclusions/Limitations

These preliminary data may guide future research in determining a physiological marker of stress post-concussion, and can inform improved rehabilitation protocols specific to youth. The results from this study will add to the current knowledge base of concussion management in youth athletes.

0076

The Effects of Higher Order Cognitive Training on Depressive Symptoms in Adults With mTBI

Category: Neurotrauma- basic research

Author's preference: Poster

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Introduction/Rationale

Impaired cognition as a result of mild traumatic brain injury (mTBIs) impacts psychological health, notably depression. Past evidence from adult TBI studies demonstrated that a strategy-based top-down SMART (Strategic Memory Advanced Reasoning Training) program strengthened higher-order abstract reasoning abilities with generalized benefits to frontally mediated cognition, memory, and daily life skills. The current proposal extends these prior findings and examines the benefits of higher order cognitive training and the consequent impact on depression.

Method/Approach

The current data are a subset of an ongoing double-blind randomized trial. Participants were civilians and veterans recruited from the Dallas/Fort-Worth area with at least six months post mTBI and in a chronic phase of recovery. All participants underwent testing (pre and post) and training procedures. Testing included assessments of IQ, gist reasoning, executive functions, depression, and substance use. The SMART training included twelve, 90-minute group sessions over eight weeks. (The manualized SMART program teaches strategies of strategic attention, integrated reasoning, and innovation, all of which are applicable to everyday life, complex thinking and decision-making activities).

Results/Effects

The pre/post performance on cognitive measures and psychological health questionnaires was analyzed by one-way repeated measures ANOVA using a mixed measures procedure in SAS to accommodate missing data. Analysis of participants who received cognitive training demonstrated significant reduction in depressive symptoms ($p < .05$) as exhibited on the Beck Depression Inventory. In addition, the relationship between improved cognition, reduction in depressive symptoms, and substance abuse was explored.

Conclusions/Limitations

These results suggest the importance of cognition in facilitating psychological health. Knowledge gained from this study could help better inform researchers and policy makers who seek to mitigate depressive symptoms in TBI populations.

0077

Training Executive Functions in Traumatic Brain Injury using Motion-based Adaptive Video Games – Pilot Study

Category: Technology – clinical research/applications

Author's preference: Oral

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Introduction/Rationale

Disorders of executive functions are common following traumatic brain injury (TBI). Computerized software and virtual environments are becoming more popular for cognitive rehabilitation. The use of such desktop applications is limited, however, in its' applicability to impaired populations and its transfer to real-life performance. Here we used adaptive cognitive training software that is based on full-body motion games and is designed to train executive functions, including behavioral control, attention, and self-initiation. The goal of this study was to characterize the performance and experience of individuals with moderate to severe TBI in multi-session training using this software for improving executive functions.

Method/Approach

Fifteen participants with TBI and their therapists in the Loewenstein inpatient facility experienced the motion-based software ("Underwater" by Intendu Ltd) and provided user feedback. Changes and adaptations were made to the software, accordingly. Four walking individuals with executive dysfunction, due to moderate-to-severe TBI, then received 4-5 daily training sessions using the motion-based games. Assessments for executive functions were administered pre and post the training sessions. User satisfaction with the games was assessed during the training and the level of the games successfully completed was analyzed.

Results/Effects

Participants were overall satisfied with the training and enjoyed playing the games. Participants were gradually able to

perform games involving higher executive function challenge. The difficulty of the task they were able to successfully complete in the last session, for example, was significantly higher than in the first session and their response time decreased significantly. A trend of improvement on executive assessments was demonstrated for some of the participants.

Conclusions/Limitations

This study provides an initial demonstration for the potential of using motion-based adaptive cognitive training for individuals with TBI. The next step will include a randomized controlled trial (RCT) to assess the effectiveness of this training for improving executive functions in TBI.

0078

Blunted Cortisol Awakening Response of Persons With Mild Head Injury and Moderate Traumatic Brain Injury Relative to Persons Without a History of Head Injury

Category: Neurotrauma - case report/clinical research
Author's preference: Oral

Julie Baker, Dawn Good

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Introduction/Rationale

We have demonstrated (e.g., Baker & Good, 2012; 2014) that persons with self-reported mild head injury (MHI) [e.g. 'altered state of consciousness'] present with flattened affect and corresponding physiological underarousal (e.g., electrodermal activation [EDA]; heart rate [HR]) despite reporting increased environmental stressors. This profile mirrors the moderate-to-severe traumatic brain injury (TBI) population, particularly those with ventromedial prefrontal cortex (VMPFC) disruption (e.g., Tranel & Damasio, 1994). We have also found that persons with MHI are less responsive to laboratory stressors. In this study, we examined a hormonal index of stress responsiveness, as well as autonomic indices of stress dysregulation across the spectrum of injury severity.

Method/Approach

University students across the spectrum of injury severity (MHI [$n = 32$], moderate/severe TBI [$n = 9$]), and age- and education-matched controls [$n = 40$]), provided saliva samples across two days as part of a larger study. Participants completed indices of emotional functioning (i.e., reports of stressors, emotional intelligence); and emotional arousal responses (i.e., EDA; HR) were also recorded (Polygraph Professional Suite, 2008). Salivary cortisol enzyme-linked immunoassays were conducted using a double determination process at Brock's Developmental Neuroendocrinology Laboratory. The cortisol awakening response (CAR) was examined by means of peak concentrations in the first 30 to 40 minutes immediately following awakening.

Results/Effects

Results replicated our earlier findings. Despite increased reports of experiential life stressors, students with head trauma were emotionally underaroused as compared to their no-head trauma cohort and this result followed a gradient of injury

severity. Repeated measure analysis revealed that students with no reported head trauma illustrated the typical increase in cortisol 45 minutes after waking i.e., CAR, $F(1, 39) = 3.85$, $p = .05$. Students with mild head trauma, $F(1, 30) = .03$, $p = .88$, or moderate/severe TBI, $F(1, 8) = .21$, $p = .66$, however, did not produce a typical CAR and illustrated blunted responsiveness.

Conclusions/Limitations

Neuroendocrine dysfunction, after moderate or severe TBI, has been documented in both the acute post-injury (Cernak et al., 1999) and long-term (Krahluk et al., 2010) phase of recovery in terms of abnormal/disrupted pituitary function. Little, if any, research has been conducted with this population examining the CAR. CAR has been proposed to be an index of one's ability to respond to stressors (Clow et al., 2010). The blunted CAR in the current study suggests atypical hormonal function that may be a peripheral indicator of a dysregulated stress system functioning in persons who have a history of reported and/or experienced head trauma.

0080

Investigating Depression Following Mild Head Injury and Moderate Traumatic Brain Injury: Is it Different?

Category: Neurotrauma - case report/clinical research
Author's preference: Oral

Sean Robb, Dawn Good

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Introduction/Rationale

Significant heterogeneity in the clinical presentation, etiology, and treatment response of major depressive disorder (MDD) is well documented. One source of possible heterogeneity is the lack of detection, or under-appreciation, of mild head injury (MHI). In two studies investigating hot cognition symptomatology associated with MDD, it was found that MDD patients illustrated impaired decision-making on the Iowa Gambling Task [IGT]). This suggested that they are hypersensitive to reward and less sensitive to punishment, contrary to much of the MDD literature. We investigated if MHI may be a possible confound given their physiological underarousal and reduced learning rates on the IGT.

Method/Approach

This study investigated depressive symptomatology using the Symptom Assessment - 45 [SA-45]; and Beck's Depression Inventory [BDI] which measured physiological arousal (i.e., EDA, pulse and salivary cortisol), and decision-making (decision making [DM]; i.e., IGT performance) in 75 competing university students with/without mild head injury and a clinical sample with moderate TBI.

Results/Effects

Injury status was found to moderate the relationship between DM (learning rate and propensity to return to punishing selections) on the IGT and depressive symptoms. This relationship was, however, only predictive for those with MHI. Furthermore, MHI illustrated a pattern of underarousal at baseline and in anticipation of making selections on the IGT, which

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was negatively related to somatic depressive symptomatology. Lastly, those who had sustained a neural injury made a slower transition from disadvantageous to advantageous choices leading to less gain. They also had a faster rate of return to disadvantageous selections following punishment, relative to a healthy control cohort.

Conclusions/Limitations

The IGT, a neuropsychological index of orbitofrontal cortex (and related neural substrate) functionality, is predictive of mood symptoms in those with neural injuries only. This exploratory study suggests that MHI may be a variable that may be contributing to the presentational, etiological, and treatment heterogeneity observed in MDD populations. Lastly, perhaps depressive symptomatology following traumatic head injury reflects an underlying neurally-based ‘dampening’ of physiological arousal.

0081

Disinhibition and Physical Aggression as a Function of Physiological Arousal After Mild Head Injury

Category: Neurotrauma - case report/clinical research

Author's preference: Oral

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Introduction/Rationale

Individuals who have sustained a traumatic brain injury (TBI) commonly present with higher levels of aggression as compared to healthy controls. During a head injury, the frontal lobes, including the orbitofrontal cortex (OFC) and the prefrontal cortex (PFC), in general, are commonly disrupted (e.g., Bigler, 1999) and both disruptions have been associated with aggression. The current study sought to investigate aggression in individuals with a history of mild head injury (MHI). It was predicted that aggression in individuals with a history of MHI would present as reactive as opposed to proactive aggression, or consistent anger, and reflective of dampened physiological arousal.

Method/Approach

Seventy-two participants (60% female; 61.4% no MHI), completed a battery of questionnaires: the Buss and Perry Aggression Questionnaire (BPAQ), the Behavioral Inhibition/Behavioral Activation Scales (BIS/BAS Scales), the UPPS-P Impulsive Behavior Scale, the Symptom Checklist-Revised 90 (SCL-R-90), and a demographic questionnaire regarding a history of head injury and a modified version of the Post Concussive Symptom Scale (PCS). Neuropsychological measures were administered, including the Trail Making Test (TMT). Furthermore, indices of physiological arousal were measured, including electrodermal activation (EDA).

Results/Effects

Post-concussive symptoms (PCS), and a history of MHI, significantly predicted sensation-seeking (UPPS-P), disinhibition (BIS/BAS), depression and anxiety (i.e., emotional vulnerability - SCL-R-90). Furthermore, sensation-seeking, MHI, and PCS significantly predicted higher levels of reactive/physical

aggression (BPAQ) and increased reporting of experiencing uncontrollable temper outbursts (SCL-R-90). Persons with a history of reported MHI displayed lower EDA relative to those with no-MHI. In addition, physiological arousal was significantly related to depression, anxiety, interpersonal sensitivity, and physical/reactive aggression. Errors on the TMT were significantly related to disinhibition, as well.

Conclusions/Limitations

Individuals with a history of MHI presented with less inhibition, were more emotionally vulnerable, and acknowledged higher levels of reactive as opposed to character-based (e.g., hostility) aggression compared to individuals with no-MHI. The findings of dampened physiological arousal and lessened interpersonal sensitivity in persons with self-reported MHI may contribute to this emotion dysregulation, via lessening their ability to anticipate the actions of others as readily as their no-MHI cohort. They may act, therefore, in a way that is hypersensitive, or reactive, to unexpected outcomes. Persons with a history of MHI are not simply individuals who are more angry and aggressive.

0082

Understanding Depression in the Context of Persons With Mild Head Injury

Category: Neurotrauma - case report/clinical research

Author's preference: Poster

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Introduction/Rationale

The majority of symptoms resulting from mild head injuries (MHI) resolve within 1 to 3 months. There is, however, a significant minority of persons who suffer from chronic MHI sequelae including heterogeneous cognitive, affective and physical symptoms. Low physiological arousal has been observed in persons who self-report MHI relative to their no-MHI cohorts. This low arousal may potentially result in a diminished ability to appraise stressful experiences and employ effective cognitive self-regulation of emotions (Baker & Good, 2013). Elucidating behavioral symptoms would, aid therefore, in the design of evidence-based rehabilitation strategies for increasing self-regulation capacity.

Method/Approach

A quasi-experimental design (n = 74) investigated self-reported psychological symptoms (e.g., Beck Depression Inventory - BDI) and physiological arousal (e.g., electrodermal activation - EDA) in both MHI and no-MHI cohorts. Variables (e.g. attentional resources, mood) that could be targeted as part of rehabilitation programs were of particular interest.

Results/Effects

Results indicated lower baseline EDA in the MHI group relative to the no-MHI group. While participants who self-reported MHI indicated higher depression scores as measured by the BDI relative to their no-MHI cohort. When the BDI was examined as a function of its cognitive, affective and

somatic symptom subcomponents, the MHI group reported higher somatic-related depressive symptoms relative to non-MHI subjects. There were no differences, however, for the cognitive and affective symptoms. In addition, persons who self-reported loss of consciousness (LOC) had increased somatic depressive symptoms relative to those indicating MHI, but no LOC.

Conclusions/Limitations

Self-acknowledged depression was greater, and physiological arousal less, in persons reporting a history of MHI relative to a no-MHI cohort. Evidence for a relationship between the severity of MHI and the level of acknowledged somatic-related depressive symptoms was also observed. These results have implications for treatment strategies aimed at addressing the persistent mood-based symptoms that can accompany MHI by emphasizing the somatic, as opposed to cognitive, or affect, features of depression.

0083

Seizure Prophylaxis Guidelines Following Traumatic Brain Injury: An Evaluation of Compliance

Category: Neurorehabilitation- Case report/Clinical Research
Author's preference: Poster

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Introduction/Rationale

Best practice for anticonvulsant prophylaxis usage following traumatic brain injury (TBI) recommends that Anti-Epileptic Drugs (AEDs) be used to prevent early posttraumatic seizures (>24 hours and <7 days following injury), but not for preventing late posttraumatic seizures (>7 days following injury). Recent studies have shown an overutilization rate up to 65%. The purpose of this project is to ascertain whether guidelines for starting and stopping seizure prophylaxis, following mild-to-severe TBI, are followed at a Level 1 Trauma Center and affiliated inpatient rehabilitation unit.

Method/Approach

A retrospective chart review was conducted from one local TBI Model Systems data set with subject diagnosis of mild-to-severe TBI, subsequently requiring management in an inpatient rehabilitation unit between the dates of 6/21/2007 through 3/10/2011. Information was captured to calculate the over-utilization rate, under-utilization rate, and predictors (such as age, gender, severity) for over/under-utilization of AEDs.

Results/Effects

Of the 173 subjects included, 123 were male, M age 45.45 ± 19.04. Only 96 subjects (55.49%) started AEDs at the time of injury. Of those subjects, 7 (4.07%) were not treated for the full 7 days. Upon admission to inpatient rehabilitation, 70 subjects (40.46%) were being treated with AEDs, but 12 (6.94%) were deemed inappropriate for the use of AEDs. Of

those 12, only 4 patients were discontinued at inpatient rehabilitation admission. At rehabilitation discharge, 8 out of 10 patients were prescribed AED's without indication. The most common AED was Valproic Acid.

Conclusions/Limitations

Although practice guidelines state that TBI patients should be prescribed AEDs for 7 days upon acute care admission, we found that many of our patients did not receive this treatment. AED treatment is usually resolved before admission to inpatient rehabilitation. AED education for clinicians treating TBI is recommended to improve consistency with practice guidelines.

0084

Ocular and Visual Complications of Head Injury

Category: Neurotrauma - case report/clinical research
Author's preference: No preference

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Introduction/Rationale

The purpose of the study was to evaluate the pattern of ocular and visual complications of head injury.

Method/Approach

A prospective 225 head-injured patients were part of the study. For the purpose of extracting visual complications, a neurosurgeon and an ophthalmologist examined each patient and conducted appropriate investigations. Patients with ocular morbidity were analysed for age, sex, cause of injury, Glasgow Coma Score (GCS) at admission, and associated injuries, in addition to findings from the neurosurgical and ophthalmic evaluations.

Results/Effects

Two major types of ocular and visual complications were observed in 57 (25.3%) of 225 head-injured patients studied. Soft-tissue injury to the globe and adnexae included periorbital ecchymosis, subconjunctival haemorrhage, lid laceration, or globe rupture in 29 patients. Neuro-ophthalmic ocular cranial nerve palsies occurred in 28 patients, while orbital fracture was encountered in two patients. Ocular injuries were present multiple in 60% of the cases. The patients (aged 9 months to 57 years), and were comprised of 37 male and 20 female subjects. The leading cause of head injuries (84.2%) was traffic accidents. Other causes included falls from heights, assaults and gunshots.

Conclusions/Limitations

Injury to the globe and adnexae and ocular cranial nerve palsies constitute the most common oculo-visual complications following head injury in our center.

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0086**Heart Rate Variability: A Normative Exploration of the Youth Athlete**

Category: Neurorehabilitation – activities and participation
 Author's preference: Poster

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Introduction/Rationale

Concussion, also known as mild traumatic brain injury (mTBI), is a common injury among Canadian youth with an estimated prevalence of 597 per 100,000¹. Youth athletes are engaged in a multitude, and intensity, of sports while also achieving major developmental milestones. Current return-to-activity decisions, post-concussion, rely heavily on subjective youth self-reporting, which is problematic as youth have a high incentive to return to activity². Heart rate variability (HRV) is a non-invasive, neurophysiological marker of autonomic nervous system (ANS) stress. The objective of this study was to describe age, gender and sport exposure influences on resting state HRV in healthy youth athletes.

Method/Approach

This cross-sectional cohort study examined data obtained from healthy youth hockey players between 10-18 years of age (N = 850) across various sports in the Greater Toronto Area. Baseline demographics on sport exposure (e.g. sport played, position played, level of play), post-concussion symptoms, and HRV (over a 24-hour period) were collected. To capture HRV, participants wore a chest strap and watch. Data was analyzed with multi-factor ANOVAs. Multiple regressions were used to explore the dynamic influence of sport exposure on HRVs. The statistical threshold was set at $p \leq 0.05$.

Results/Effects

A main effect of age and sex, as well as significant interactions, was found on both time-domain and frequency domain measures of HRV ($p \leq 0.05$). Older youth athletes were shown to have lower HRV than younger children. Male participants were shown to have higher HRV than females. Finally, sport exposure was also found to have a main effect on HRV ($p \leq 0.05$).

Conclusions/Limitations

The findings of this indicate a differential effect of physiological stress at baseline that is unique to youth athletes. Exploring the effect of age, sex and sport exposure on HRV measures to gauge baseline physiological stress in youth athletes provides a conceptual framework to: (1) investigate the effects of pediatric concussion using an objective marker, and (2) to provide age-specific recommendations for appropriate levels of cognitive and physical activity post-concussion. These benefits will ultimately mitigate the risk of further neurological injury and promote optimal and safe return to activity.

0087**Seat Belts and Airbags in Motor Vehicle Crashes: How Protective are These Devices in Preventing or Reducing the Severity of a Traumatic Brain Injury?**

Category: Neurotrauma – prevention and public health
 Author's preference: Oral

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Introduction/Rationale

Motor vehicle crashes were the second leading cause of traumatic brain injury (TBI) related deaths (26%) during 2006-2010. Airbags and seat belts are an effective way to reduce injuries in a crash. Their association with TBI occurrence and severity, however, is understudied. This project examined the effectiveness of seat belts and airbags in preventing and reducing the severity of TBI by age group of motor vehicle crash occupants.

Method/Approach

Hospital records (n = 227,862) from 773 trauma centers were analyzed using the 2012 National Trauma Data Bank. TBI severity was classified using the Glasgow Coma Scale (GCS). Medical chart reviews captured seat belt and airbag information. Two logistic regression models were used to measure the effects of seat belts, airbags, and combinations. Automobile and crash characteristics were not available.

Results/Effects

Among injuries treated at a trauma center, combinations of protective devices decreased the odds of a TBI. Compared to no protection, when a seat belt was used with an airbag deployment, the odds of a TBI were significantly lower {adjusted odds ratios (AOR):0.69}. An airbag alone, without belt(s), provided little protection against a TBI (AOR:0.95). The odds of receiving a TBI in a crash increased, however, with age when all protective devices were used (age group 19-29 vs. 30-39, 40-49, 50-59, >60, respective AOR:1.18,1.35,1.53,1.77). Similarly, TBI severity in a crash increased with age when all protective devices were used.

Conclusions/Limitations

Seat belts and airbags effectively reduced TBI and TBI severity in a crash. Such devices, whether used alone or in combination, however, appear to result in less protection from a TBI as people age, especially among those in older age groups.

0088**Virtual SMART: Tele-Cognitive Rehabilitation in Youth & Adults With Chronic TBI**

Category: Technology – clinical research/applications
 Author's preference: Oral

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Introduction/Rationale

Increasingly, clinicians are adopting telehealth approaches to improve access to cognitive rehabilitation for traumatic

brain injury (TBI) survivors. Existing approaches include the use of a telephone and two-way messaging, which have demonstrated marginal to moderate gains in cognitive outcomes. This study extends these by leveraging an interactive telehealth communication platform (e.g., Skype) to maximize the impact of cognitive training delivery to individuals with TBI. The training implemented, Strategic Memory Advanced Reasoning Training (SMART), aims to equip strategies of strategic attention, integrated reasoning, and innovation to improve functionally and salient higher-order abilities. Prior evidence demonstrated significant cognitive/functional gains following SMART in adolescents/adults with TBI in face-to-face contexts.

Method/Approach

Twelve adolescents (ages 14-19) and ten adults (ages 23-65, including civilians and veterans), who were at least six months post-TBI, participated in the study. Pre- and post-training assessments were conducted face to face, whereas individual training sessions were conducted using Skype. Each participant received 8-10 hours of training over 4-6 weeks.

Results/Effects

Preliminary results from the adolescent group revealed significantly improved higher-order reasoning performance after tele-SMART training as compared to pre-training performance ($p < .01$). Additionally, significant gains were seen in untrained measures, including recall from texts ($p < .001$) and working memory ($p < .05$). Functional gains were also observed in real-life executive function behaviors, per parent report ($p = .05$). In the adult group, gains in delayed memory were evident ($p < .05$). Furthermore, improvements in immediate memory and depressive symptoms showed a positive trend ($p < .07$). Trending gains in executive functions of inhibition and cognitive flexibility were also promising.

Conclusions/Limitations

The current findings of cognitive and functional gains, in both adolescents and adults with TBI, hold promise in addressing access barriers to cognitive rehabilitation. The implication is that SMART training is as effective via Skype as in person, and with lower costs and time demands. These comparable results between on-site and on-Skype training lead us to consider the additional benefits of environmental salience to adoption of cognition training in daily life. Online training could have substantial economic and health policy implications, but more studies are needed to validate this approach.

0089

Caregiver Psychological Outcomes of ICU Patients With Traumatic Brain Injury: Understanding of ICU Experience

Category: Neurotrauma - case report/clinical research
Author's preference: Poster

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Introduction/Rationale

Of the individuals sustaining a traumatic brain injury (TBI) annually, more than 20% are hospitalized with a moderate-to-severe TBI, and an intensive care unit (ICU) stays are common. Although research has identified that the ICU is a stressful environment for patients, few studies have examined the psychological impact on caregivers. The primary objective of this study was to examine the relationship between the caregivers' understanding of the patient's illness and treatment, their symptoms of depression, and objective data from the patient's medical record.

Method/Approach

After providing consent, caregivers of TBI patients in the ICU were enrolled between March 2013 and November 2014 in an urban Level I trauma center. Eligibility included caregivers' ≥ 18 years with patients' ≥ 18 years admitted to the trauma/critical care ICU for ≥ 48 hours, and expected survival of ≥ 96 hours. Outcome measures included the Patient Health Questionnaire 8 (PHQ-8), the Caregiver Experiences and Understanding of the ICU questionnaire, and objective data from the patient's medical record (e.g., on a vent; receiving antibiotics).

Results/Effects

55 caregivers of patients (M age = 49) with TBI were included of which 51% were Caucasian, 75% female, 33% parent(s) of the patient, and 64% were employed. The caregivers' mean rating of their understanding of the patient's illness and treatment was 8.7 (0-10 scale) and 8.3, respectively (10 = completely understand), yet only 58% were able to correctly answer at least 9 of the 11 questions about the patient's care in the ICU (when compared to the medical record). 44% of the caregivers reported symptoms of depression although there was no statistically significant association between depression and their understanding of the patient's illness and treatment.

Conclusions/Limitations

Results suggest a discrepancy between the patients actual illness and treatment and the caregivers understanding of them, highlighting the importance of improved communication and education between the ICU staff and patients' caregivers.

0090

Cortical Thinning Following Sports-Related mTBI: The Relationship Between MRI Findings and Dual-Task Performance in Youth

Category: Neurorehabilitation – activities and participation
Author's preference: Poster

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Introduction/Rationale

Mild traumatic brain injury (mTBI) is a common injury in youth athletes. Much of what is known about the sequelae of mTBI is, however, yielded from adult literature. A child's brain is especially vulnerable to insult due to various physiological and biomechanical sensitivities not present in adults, yet few functional magnetic resonance imaging (fMRI) studies have been conducted on youth with mTBI. Most studies have employed single-task paradigms which may not be challenging enough to uncover subtle deficits in youth brains. This study explored dual-task performance and fMRI correlates in youth athletes with a history of mTBI.

Method/Approach

Thirteen youth with a history of mTBI 3-6 months prior to testing and thirteen typically developing controls were administered neuropsychological tests and completed an fMRI session. The behavioral analysis consisted of performance (accuracy as measured by hits-false alarms and median reaction time (RT)) on both single and dual task versions of an n-back working memory paradigm and a motor task, as well as results from neuropsychological tests assessing general intellectual ability, visuospatial memory, inhibitory control and behavioral flexibility, fine motor skills and processing speed. The imaging analysis consisted of whole brain cortical thickness values.

Results/Effects

Behaviorally, none of the participants exhibited impairment on any neuropsychological test and there were no significant differences between groups. Cortical thickness analysis revealed that, compared to controls, youth with mTBI had significantly thinner cortex in the left dorsolateral prefrontal cortex and in the right inferior parietal cortex. Regression analyses showed significant negative correlation between cortical thickness and median reaction time during the dual task condition in these areas, such that thinner cortex was associated with slower response speed.

Conclusions/Limitations

Children with mTBI demonstrated thinner cortex compared to healthy controls in key areas involved in executive functions. This reduced cortical thickness was associated with slower performance on a dual task condition. Results of this study highlight the importance for early identification of children with mTBI who are at risk for persistent executive functioning problems, and for the development of interventions to address these issues.

0091

Effect of Skull Deformation Under Blunt Impact on the Level of Brain Injury

Category: Neurotrauma- basic research

Author's preference: Oral

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Introduction/Rationale

Upon the exertion of a mechanical load on the head, due to road accidents, falls, or physical assaults, the portion of the load that is transferred to the brain creates stresses, strains and intracranial pressure (ICP) variations that may lead to traumatic brain injuries (TBIs). Mechanisms of injuries, however, are not well understood. One hypothesis considers the deformation and vibration of the skull as a mechanism of injury. This study elucidates the effect of skull deformation on the level of ICP.

Method/Approach

A validated finite element head model (FEHM) was employed and impacted by a cylindrical impactor while the skull was considered as an elastic material. The simulation was repeated with the skull as a rigid body without any deformation and vibration. The variation of ICPs was compared.

Results/Effects

ICPs were recorded at the coup and contrecoup sites of the brain. The results showed no significant difference between the two cases of deformable and rigid skulls. The pressures at the coup site for both models were around 150 kPa.

Conclusions/Limitations

Skull deformation didn't show any adverse effect on the variation of ICPs on the brain and, at least for this case study, cannot be considered as a mechanism of injury.

0092

NMDA Receptors are Sensitive to Shear Stress

Category: Neurotrauma- basic research

Author's preference: Oral

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Introduction/Rationale

N-Methyl-D-aspartic acid (NMDA) receptor is one of the predominant pathways of synaptically activated Ca^{2+} influx in brain cells (neurons and glia). Traditionally, NMDA receptors are thought to be ligand-gated. They mediate Ca^{2+} flux in response to the synaptic release of neurotransmitters such as glutamate. The sensitivity of NMDA receptors to mechanical stretch has only been explored recently.

Method/Approach

Using a high speed pressure servo driven microfluidic chamber, we measured Ca^{2+} response in GluN1A, 2A expressing cells in response to mechanical stimuli. We showed that in the absence of channel agonists, fluid shear stress elicits NMDA receptor mediated Ca^{2+} entry in cells. In this study, we expressed mCherry tagged GluN1 and GluN2A subunits in Chinese hamster ovary (CHO) cells. The transfected cells were identified by fluorescence.

Results/Effects

Shear pulses caused an acute Ca^{2+} rise in GluN1, 2A expressing cells, and this Ca^{2+} flux was completely blocked by

MK-801. A similar Ca^{2+} elevation was shown when the receptors were activated using glutamate and glycine. CHO cells have endogenous mechanosensitive channels. We blocked these channels using GsMTx4. Application of $5 \mu\text{M}$ GsMTx4 to GluN1,2A expressing cells did not alter the Ca^{2+} response, and didn't affect the response to glutamate. We applied the same shear stimuli to non-transfected cells and the Ca^{2+} rise showed a consistent latency of $\sim 10\text{s}$. The Ca^{2+} peak in non-transfected cells blocked by GsMTx4.

Conclusions/Limitations

The result suggests that recombinant NMDA receptors are sensitive to mechanical force. This study expands our understanding of NMDA receptor activation mechanisms and triggering mechanisms of mechanical induced neurotoxicity of cells in traumatic brain injury (TBI).

0093

Sensitivity and Specificity of Brain MRI Diffusion Tensor Imaging (DTI) With Brain Injury

Category: Neurotrauma - case report/clinical research

Author's preference: Oral

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Introduction/Rationale

Brain injuries are a leading cause of disability and death. Clinically significant differences in neurological functioning can be assessed with diffusion tensor imaging (DTI) scans. Sensitivity and specificity were calculated in a blind study where raters were asked to distinguish between DTI, overlaid with SPM contrasts called Z-maps, between a cohort of controls, and that of clinically referred patients with brain injury, normalized by the same method. Results showed a sensitivity of 0.75 and specificity of 0.875 in distinguishing between scans of controls and those of the referrals. This suggested beneficial usage of this technique in brain injury diagnosis.

Method/Approach

32 control subjects (mean = 34.2 years, SD = 11.2, 19M, 13F) had been screened using function biomedical informatic research network (FBIRN) criteria. 14 clinically referred patients (mean = 34.2 yrs, SD = 15.9, 8M, 6F) that included mTBI (n = 10) and carbon monoxide poisoning (n = 4) were studied. DTI was obtained on Siemens 3T magnetic resonance imaging (MRI) scanner with 30 directions and 2mm slice thickness. Controls and brain injury patients were normalized and contrasts with significantly different fractional anisotropy (FA) values ($p = 0.01$, voxel threshold = 30) were obtained after scans were statistically adjusted for age and gender. Two blind raters randomly labeled mixed DTI z maps as either patient or control.

Results/Effects

The average sensitivity calculated was 75% (stdev \pm 7.1%) and specificity was 87.5% (stdev \pm 2.5%). The false positive rate was 12.5% (stdev \pm 2.5%). The false negative rate was 25% (stdev \pm 7.1%). The true positive rate was 75% (stdev = 7.1%). The true negative was 87.5% (stdev \pm 2.5%).

Conclusions/Limitations

DTI FA z-maps have a sensitivity and specificity comparable to other medically accepted imaging tests. For example, Silverman et al., 2004, noted that fludeox glucose (FDG) position emission tomography (PET) imaging for senile dementia Alzheimer type (SDAT), clinically accepted, has a false positive rate of 14% which is comparable to the false positive rate that we have found. Assuming that half of the patients referred for DTI are normal and the other half have brain injury, the positive predictive value would be 0.85 and the negative one would be 0.78.

0094

Intrinsic Functional Brain Connectivity in Retired Professional Hockey Players

Category: Neurotrauma - case report/clinical research

Author's preference: No preference

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Introduction/Rationale

Traumatic brain injury (TBI) is associated with neurodegenerative disease, even seemingly mild TBIs (mTBIs) sustained in sports, can be associated with accelerated cognitive impairments during aging and the earlier onset of dementia. Previous studies on the long-term effects of mTBI in athletes have shown alterations in functional brain activity in response to specific tasks. Few studies, however, have assessed intrinsic resting-state (RS) functional connectivity in athletes with a history of concussion. Given that many professional hockey players experience TBI during their careers, and that their TBI characteristics are well documented, they provide an excellent model for this line of research.

Method/Approach

Twenty-one (mean age = 51; SD = 10) retired professional hockey players and age-matched control participants (N = 14; mean age = 51; SD = 9) with no significant history of TBI, were scanned with functional magnetic resonance imaging (fMRI), including a 6-minute RS scan. We assessed functional connectivity between nodes of the default mode network (DMN) to the rest of the brain. We hypothesized that the alumni athletes would show altered functional connectivity in the DMN when compared to the non-athlete controls.

Results/Effects

As compared to the control participants the athletes demonstrated reduced connectivity in the medial temporal lobe (MTL) sub-system. In particular, athletes showed reduced connectivity from the parahippocampal cortex to the medial prefrontal cortex (mPFC) and posterior cingulate, as well as from the hippocampal formation to the mPFC and the superior temporal gyrus.

Conclusions/Limitations

Our results indicate that a history of sports concussion is associated with alterations in functional connectivity. Furthermore, our results suggest that regions in the MTL may be more

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vulnerable to the long-term effects of remote TBI. This is consistent with declines in episodic memory function shown in past studies.

0095

Investigating the Language Effect on the Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) Results in Baseline Evaluation

Category: Neurorehabilitation - basic research

Author's preference: No preference

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Introduction/Rationale

Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) is a computerized neurocognitive test battery that allows the large-scale baseline evaluation for athletes and post-concussion assessment. The ImPACT test is available in 17 languages. While the ImPACT test demonstrates adequate reliability and validity (Lovell, 2006), the consistency across different language versions has never been examined. The purpose of this study is to identify if there are consistent results in the ImPACT test between English and Spanish test takers. The study will also ascertain whether taking the ImPACT test in a second language would cause a difference on performance.

Method/Approach

The data was obtained from the athletes, in El Paso, TX, who received baseline evaluation on ImPACT from 2007 to February 2014. Subjects were excluded if they had a history of concussion, or other neurocognitive and/or psychiatric diagnoses. In this pool, group one contained 39 native Spanish speakers who took the test in Spanish. Group two included 94 native Spanish speakers who took the test in English. Group three included 134 native English speakers who were randomly selected and who took the test in English. The five composite scores of ImPACT were compared among the three groups by using MANOVA.

Results/Effects

MANOVA revealed a significant multivariate effect, $F(10, 518) = 3.839$, $p < .001$. Significant univariate effects were processing speed, $F(2, 260) = 15.456$, $p < .001$ and impulse control, $F(2, 260) = 4.821$, $p = .009$. Native English speakers who took the test in English had higher scores on processing speed than native Spanish speaker who took the test in either Spanish or English. Native Spanish speakers who took the test in Spanish made more mistakes than native English speakers. There were no significant differences on ImPACT scores for native Spanish speakers who took the test in English or Spanish.

Conclusions/Limitations

The impact of a second language was not found in this study. Native Spanish speakers' performance showed no difference when they took the test in a second or first language. When compared to native English speakers, native Spanish speakers processing speed performance was lower, whether they took the test in English or in Spanish. When Native Spanish speakers took the test in Spanish, they made more

errors (impulse control) in completing the test, than native English speakers. The results implied the differences of ImPACT scores between native Spanish and English speakers, but not the inconsistency of different language versions.

0096

A Study of Visual Field Loss: Right Inferior Quadrantanopia, Bilateral and Unilateral Left Hemianopsias

Category: Neurotrauma - case report/clinical research

Author's preference: No preference

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Introduction/Rationale

Hemianopsia is a form of blindness in one half of the visual field while quadrantanopias is a loss of one quarter of a visual field. Both forms are typically right or left and split along the midlines. The most common underlying cause is a cerebral vascular accident (CVA), infection, brain tumor, or some form of trauma, especially involvement in a motor vehicle accident. The term Homonymous is added if the visual loss is bilateral and on the same side of each eye. As the brain is contralateral for vision, the visual loss is opposite to the impaired area. Insult to the right side of the brain or the right visual tract will, therefore, cause a left field and vice versa. Homonymous hemianopsias are more common than unilateral hemianopsias. This presentation will compare, and contrast, a bilateral and unilateral left hemianopsia along with an inferior quadrantanopia and the subsequent sequelae.

Method/Approach

Client One: A 53-year-old female who was injured in a motor vehicle accident and later diagnosed with cognitive disorder secondary to traumatic brain injury (TBI). She demonstrated a left homonymous hemianopsia, loss of global cognitive ability, mild impairment in attention, deficiency in recent visual and auditory memory, and motor apraxia. Preserved skills centered on tactile and auditory sensory abilities, expressive and receptive language, and higher order executive functions. Secondary issues revolved around depression and anxiety. The patient's pre-morbid history was unremarkable.

Client Two: An 80-year-old female who suffered a CVA at the age of 79. She demonstrated a left hemianopsia in her right eye with the left eye being unencumbered. Her neuropsychological evaluation was significant for global cognitive decline, impairment in attention, deficiency in immediate and recent visual memory, poor visual analysis, and color blindness (post CVA only). Her most significant loss was reading as she suffered word blindness (visual anomia) in this realm. Preserved abilities centered on auditory memory, expressive speech and left fine motor ability. The patient denied depression and anxiety and measures were negative. Her pre-morbid history was significant for a CVA occurring 20 years earlier.

Client Three: A 34-year-old male who suffered a TBI while riding a motorcycle in the forest. There was a loss of consciousness, an extensive hospitalization with a chemically induced coma, and two-months of posttraumatic amnesia. Significant losses were right inferior quadrantanopia, word-finding difficulty, impairment of attention, and limitations in judgment, insight and reasoning.

Results/Effects

All three clients were evaluated on an outpatient basis. Each was evaluated, by a licensed neuropsychologist and a certified assistant, in two four-hour sessions in a cool, quiet room. Tests were administered and scored according to the publisher's instructions. Protocols of administration were similar but not identical. No unusual circumstances occurred to contaminate the findings. The protocols and results were reviewed with each client.

Results: Several of the individual tests are of particular interest in delineating differences between the presentations:

Assessment/Test Client #1 and Client #2
 Speech Stammer Slow but clear
 Medical History Unremarkable CVA 20 years pre
 Education Masters 3 years college
 Mental Status Depression/Anxiety Poor working memory
 WAIS-IV VCI 110 91
 PRI NA 69
 WMI 100 92
 PS NA 65
 FSIQ NA 75
 Trails A and B A-WNL, B-Moderate A and B-Severe
 Clock Test Pass Fail
 Visual Memory Low average Moderate
 Verbal Memory Low average Low average
 Animal Naming 18-WNL 6-Fail
 RIAST 1 error-WNL 8 errors-significant
 Adaptive Behavior 64 SS-Mild <20 SS-Profound
 Neitz Color Vision Pass Fail
 Visual Fields Left Homonymous hemianopsia Left
 Hemianopsia- Right eye
 Beck Depression Mild WNL
 Beck Anxiety Mild WNL

Client one experienced many more visual problems and was unable to complete a number of standardized tests. Her overall level of functioning, however, was judged to be better than client two. Client three was unavailable for a complete neuropsychological assessment and was administered the Memory Module of the Neuropsychological Assessment Battery with a Memory Index Score of 73 suggesting general memory functioning in the borderline range.

Conclusions/Limitations

In considering the totality of the test data it should be recognized that the level of impairment of client two was greater than the impairment of client one with the exception of vision. It should also be evident that the array of impaired skills, versus preserved skills in explaining overall presentation, was more complex than simply noting that the left hemisphere manages right vision and motor abilities and vice versa. Multiple variables were in play to construct the ultimate sequelae. An analysis of vision revealed that client one had more visual impairment than just field deficits. There was clear evidence of color loss in client two suggesting more occipital involvement than parietal. It is likely that client one had a more localized lesion to the anterior parietal and right optic tract while client two experienced a more complex and evolving CVA encompassing a greater volume of tissue which affected more structures and functions. Client one enjoyed a better prognosis. Client three had numerous limitations, but his overall skills were better persevered than the others. Much of his success as a client was due to cognitive reserve and a younger age. The limitations of this study stem from the differences in the ages of the participants and the underlying etiology TBI vs. CVA.

Future research might focus on combining neuropsychological assessment with MRI data.

0097

Speech Development in a Boy With Moyamoya Disease - Case Study

Category: Neurorehabilitation- Case report/Clinical Research

Author's preference: Poster

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Introduction/Rationale

This research examined analysis of speech and language development of a patient with Moyamoya disease (MMD). Our hypothesis was that intensive speech therapy with a patient who has MMD contributes to overall progress in speech and language development.

Method/Approach

Case study of M.J., born 1998, with MMD and who is on long-term habilitation treatment in a special hospital for cerebral palsy and developmental neurology in Belgrade. In this study, we have used a retrospective method, of following up for a period of four years. Speech and language development tests were used as instruments for data collecting. The study shows a comparative statistical analysis based on the frequency of answers on speech and language development tests. An analytical statistical analysis was, however, not done. The results are presented in charts and tables.

Results/Effects

The oral praxis test indicated that the boy had achieved a higher possibility of voluntary movements of orofacial musculature. In qualitative terms, his highest achievement was determined by his tongue range of motion (e.g. licking of lips, touching upper and lower lip with tip of tongue). Speech intelligibility was higher than it was at the beginning of therapy. The number of correctly articulated sounds was higher and sounds, previously omitted, were now emitted in distorted form. When speech development was examined, the boy answered on 4 of 5 given questions – a significant difference compared with the test results after his arrival.

Conclusions/Limitations

Intensive speech therapy stimulates speech and language development in patients with MMD, and early diagnosis and active intervention, before the establishment of irreversible hemodynamic change, are essential for achieving a favorable clinical outcome in children with MMD.

0098

Improved Sleep and Cognition After Transcranial or Intranasal, Red/Near-Infrared LED Treatment in Chronic TBI: Pilot Case Series

Category: Neurorehabilitation- Case report/Clinical Research

Author's preference: Poster

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Introduction/Rationale

This pilot case series investigated the efficacy of non-invasive, red/near-infrared (NIR), transcranial or intranasal light-emitting diode (LED) treatment on sleep and cognitive functions in chronic traumatic brain injury (TBI) patients with persistent cognitive and neuropsychiatric problems. LED is a noninvasive, painless, non-thermal neuromodulation treatment that targets cellular function of injured/hypoxic brain cells. The red/NIR photons promote increased adenosine triphosphate (ATP) production and release of nitric oxide, stimulating focal vasodilation.

Method/Approach

The participants in the study were three patients (2 female) with mild/moderate TBI, determined through medical records and clinical evaluation, who had persistent cognitive dysfunction and sleep complaints. There were 18 sessions (3x/Wk for 6 Wks) of transcranial LED (n = 2), or intranasal LED (n = 1). Standardized neuropsychological (executive function, memory), neuropsychiatric (depression, post traumatic stress disorder [PTSD]) and sleep measures (the Pittsburgh Sleep Quality Index [PSQI], actigraphy) were administered to all participants at (T1) baseline, (T2) 1 Wk post-LED treatment, and (T3) 2 to 3 Mo post-LED treatment.

Results/Effects

All cases showed an average increase of 1 hour of sleep per night (actigraphy, 1Wk) post-treatment (T2). In 2/3 of the cases sleep, improvement remained at T3. One case was able to discontinue sleep medication, with continued improved sleep efficiency at T3. P1 (transcranial LED) and P3 (intranasal LED) improved by at least 1SD on executive function (Stroop), and by 2SD on verbal memory (California Verbal Learning Test [CVLT], alternating versions) and verbal fluency (FAS) at T2 and T3. P2 significantly improved on PTSD measure (PCL-M): from raw score > 50 (T1), dropping by 12 (T2) to 19 (T3) points post-transcranial LED. No adverse events were reported.

Conclusions/Limitations

Our pilot results demonstrate that this novel noninvasive therapeutic approach (red/near-infrared LED) is safe to use within the TBI population. The study results suggest that sleep and cognition can be improved by transcranial or intranasal LED treatments in chronic mild/moderate TBI. Our findings also indicate that transcranial LED treatment can reduce PTSD symptoms in patients with chronic TBI and co-occurring PTSD. Further controlled studies are warranted.

0099

Head Impact Exposure in Youth Football Athletes Over Three Seasons

Category: Neurotrauma- basic research
Author's preference: Oral

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Introduction/Rationale

Approximately 5 million athletes play organized football in the United States (U.S.); 2,000 NFL, 100,000 college, 1.3 million high school, and 3.5 million youth athletes. Head impacts have been studied at the high school, collegiate, and professional levels. Investigations of head impact exposure in youth (ages 8-13) football, however, has been limited.

Method/Approach

An ongoing study has collected head impact data from youth football athletes using the Head Impact Telemetry (HIT) system for three seasons to better understand the exposure of head impacts in youth football. A total of 30,651 impacts from 98 individual player seasons have been collected and verified.

Results/Effects

The median linear accelerations for the 2012, 2013, and 2014 seasons were 19 g-force (g), 21.5 g, and 21.4 g, respectively. The 95th percentile linear accelerations for 2012, 2013, and 2014 were 46.4 g, 49.8 g, and 52.8 g, respectively. A comparison between the lowest (8-9 years old) and highest (12-13 years old) age groups for the 2014 season demonstrated differences in the magnitude of head impacts between the two age groups. The medians and 95th percentile linear accelerations of the 12-13 year olds were 21.8 g and 53.8 g, respectively. Whereas the median and 95th percentile linear acceleration of the 8-9 year olds were 19.5 g and 46 g, respectively.

Conclusions/Limitations

Although lower magnitude impacts were seen in younger athletes, the distribution of observed impacts was comparable to high school and collegiate levels. The head impact exposure data from three consecutive seasons provided insight into differences in exposure between age groups and other factors (i.e. exposure in practices vs. games). The resulting repository of head impact data from youth football athletes will provide a better understanding of head impact exposure and may be used to inform helmet manufacturers, youth football safety regulators, and, ultimately, keep youth athletes safer.

0100

Relationship of GOS-E Peds to Functional and Cognitive Outcome Measures After Pediatric TBI

Category: Neurotrauma - case report/clinical research
Author's preference: Poster

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Introduction/Rationale

The Glasgow Outcome Scale (GOS) is well established as an efficient measure of functional outcome following brain injury in adults. A more recent pediatric extension of the

GOS- (GOS-Extended Pediatric Revision (GOS-E Peds) is designed to assess outcome after traumatic brain injury (TBI) in children. A recent study established the concurrent, predictive, and discriminant validity of the GOS-E Peds at 3 and 6 months post-TBI comparing GOS-E Peds to functional behavioral and cognitive outcome measures (Beers et al., 2012). The goal of this study was to examine the relationship between the GOS-E Peds and functional and cognitive outcome measures at 12 and 24 month post-injury to assess the ability of the GOS-E Peds in order to characterize children more long-term.

Method/Approach

The GOS-E Peds and the Vineland Adaptive Behavior Scales (VABS), a parent rating scale measuring daily function and behavior, were administered at 12 and 24 months post-TBI. Age appropriate IQ tests were administered at the same time points. Out of 121 children and adolescents with TBI enrolled in a long term TBI study (69% males), assessments were completed for 98 subjects at 12 months and for 63 subjects at 24 months. Severity of injury was distributed as 70% severe and 30% moderate.

Results/Effects

Regression analysis of the GOS-E Peds with the VABS composite score at 12 and 24 months revealed significant negative correlations (respectively, $r = -0.791$ and $r = -0.722$; $p < 0.001$). Regression analysis of the GOS-E Peds, with measures of IQ at 12 and 24 months, also revealed significant negative correlations (respectively, $r = -0.768$ and $r = -0.739$; $p < 0.001$). When the relationship of GOS-E Peds within injury severity was examined, the moderate TBI group demonstrated a significant correlation for IQ at 12 months ($r = -0.510$, $p = 0.004$), though correlations at 24 months were not significant. The relationship of the GOS-E Peds and VABS was strong at 12 months ($r = -0.820$, $p = 0.001$) and moderate at 24 months ($r = -0.587$, $p = 0.029$) within the moderate group. A strong, significant correlation (> 0.7 , $p < 0.001$) was observed for the severe injury group between the GOS-E Peds and the VABS, and IQ at both the 12 and 24 month time point.

Conclusions/Limitations

As research increasingly focuses on finding novel therapeutic interventions to improve pediatric TBI outcomes, a need exists for tools to assess functional outcomes efficiently and validly. Overall, results demonstrate a strong association between the GOS-E Peds and the VABS, and measures of IQ at 12 and 24 months post-injury, overall. While this study is limited by the lack of a mild injury group, these results lend support for the use of the GOS-E Peds as a measure of long-term outcomes in children with moderate to severe TBI.

0101

A Novel Clinical Neurorehabilitation Program for Veterans With TBI, PTSD and Other Complex Post-Deployment Treatment Needs

Category: Neurorehabilitation – activities and participation
Author's preference: No preference

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Introduction/Rationale

A proportion of veterans returning from recent military service have complex medical and mental health needs including mild to moderate TBI with post concussive symptoms, post traumatic stress disorder (PTSD), chronic pain, sleep disorders, and problematic use of substances. They often use acute psychiatric inpatient services and/or medical emergency room (ER) services, which are resource-intensive strategies that are also less effective at stabilizing symptoms over time. In this paper we describe an inpatient programmatic approach for this constellation of conditions, present illustrative case examples, and discuss preliminary outcome data from a sample of past participants.

Method/Approach

This VA inpatient program at the Center for Rehabilitation and Extended Care addresses six key cognitive rehabilitation themes in individual and group therapies: 1) cognitive skills, 2) communication, 3) pain management, 4) sleep, 5) mood, and 6) stress management. Veterans attend daily individual and group sessions and participate in recreational and community integration activities led by individual providers and in interdisciplinary co-treatment sessions. The program was conceived to assess and treat those veterans whose complex needs have not been adequately served in our system by fixed-length, or more brief programs, focusing on just one or two of these areas.

Results/Effects

We surveyed a sample of past participants 24-36 months following inpatient stay for their perception of improvement in each of the six program domains. The average length of stay was 4.8 months. Of those staying longer than 1 week, and thus, experienced all treatment activities, 100% reported significant benefit from the program ("very helpful" or "extremely helpful"), and 100% percent would highly, or extremely, recommend it to other veterans with similar needs. The most consistent improvement was reported in the memory, communication and stress domains.

Conclusions/Limitations

These outcome data are further described along with program activities and illustrative case examples. These results are descriptive and rely on self-report measures with some collateral input when available. These appear, however, to represent positive and stable changes given the length of time since discharge. Formalized pre/post batteries of neuropsychological function, mental health, community integration, and family ratings are underway to further characterize program benefits.

0102

Neurotherapy of Traumatic Brain Injury/Posttraumatic Stress Syndromes: Benefits During Active Treatment and at Follow-up

Category: Neurorehabilitation- Case report/Clinical Research
Author's preference: No preference

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Introduction/Rationale

We have previously demonstrated the potential of a novel form of neurotherapy that involves minute pulsed electromagnetic (EM) stimulation of brainwave activity for the amelioration of mixed syndromes of traumatic brain injury (TBI) and posttraumatic stress symptoms in a small clinical sample of military service personnel from the Afghanistan and Iraq wars. The purpose of this paper is to expand on this sample to provide further information on the benefits of active treatment and to provide follow-up data on the sustained effects of this intervention in a subset of individuals who have completed assessments at 3- and 6-months post-treatment.

Method/Approach

Thirteen veterans with persistent TBI/posttraumatic stress symptoms dating from their involvement in the Afghanistan/Iraq Wars were seen in 20 individual treatment sessions. Each was treated with an adaptation of the Flexyx Neurotherapy System (FNS). The FNS uses very tiny, subliminal pulses of EM energy to stimulate changes in brainwave activity by adding a fixed amount of EM stimulation to the momentary peak electroencephalogram (EEG) frequency using a 2-channel electrode configuration in a predetermined order. Symptom questionnaires and rating scales were completed at pre- and post-treatment and as follow-up sessions, as well as individual symptom rating scales at each treatment and follow-up sessions.

Results/Effects

Linear trend analyses indicated significant slopes (betas with all $p < .001$) in evidence for decreases in all current symptom ratings and increased activity levels across the duration of active treatment. Statistically significant ($p < .05$) pre- to post-treatment and pre-treatment to follow-up time points paired t test comparisons were in evidence for decreased bothersome symptom and increased activity ratings, as well as for PTSD Checklist-Military version total scores.

Conclusions/Limitations

Findings from an expanded sample of veterans continue to suggest FNS may be a potentially effective treatment for mixed TBI/PTSD. Further, effects in evidence across the duration of active treatment appear largely sustained at extended follow-up. Given that some additional veterans (not reported above) have also responded to fewer sessions and that some have not seemed suitable for treatment (e.g., due to excessive alcohol use, logistical issues interfering with regular attendance, etc.), it remains to better determine which personal and clinical characteristics are associated with those individuals most likely to respond and experience enduring benefits.

0103

Increases in Pre-hospital Systolic Blood Pressure After Its Nadir in Major Traumatic Brain Injury: Association With Mortality

Category: Neurotrauma - case report/clinical research
Author's preference: Oral

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Introduction/Rationale

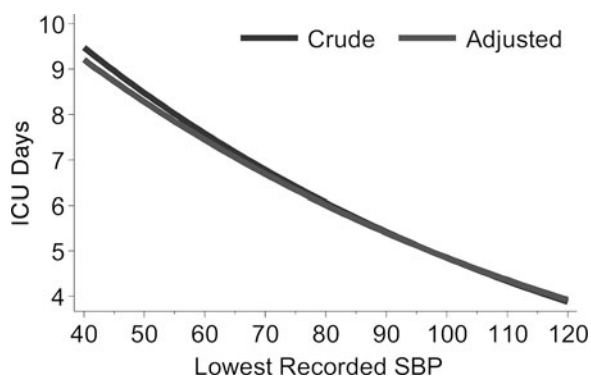
Little is known about pre-hospital emergency medical services (EMS) blood pressure (BP) patterns in cases of traumatic brain injury (TBI) because linkage of EMS data to trauma center outcomes is so challenging. Even when EMS data are available, previous studies only have a single measurement. The absence of serial BP measurements means that the effect of trends in BP during EMS care remains unknown. Utilizing the comprehensive, linked EMS data in the Excellence in Pre-hospital Injury Care (EPIC) TBI Study database, we evaluated the association between mortality and increases in EMS systolic BP after the lowest recorded measurement in major TBI patients.

Method/Approach

All moderate/severe TBI cases (CDC-Barell Matrix-Type-1) in the statewide, EPIC Study (NIH/NINDS: 1R01NS071049; ClinicalTrials.gov/NCT01339702) from 1/1/08-12/31/11 were evaluated [exclusions: age < 10, death before emergency department (ED) arrival, systolic blood pressure (SBP) < 40mmHg/> 300mmHg, missing SBP (3.0%)]. Logistic regression was used to determine an association between the increase in EMS SPB after the lowest SBP and probability of death. The final model incorporated co-variables with $p \leq 0.2$.

Results/Effects

6,409 subjects met the inclusion criteria (Male-68.4%; median age-44). 5353 (83.5%) had an equal or higher SBP recorded subsequent to the lowest measurement. The figures show the probability of death vs. the increase after the nadir in the hypotensive (40-89mmHg), normotensive (90-139mmHg) and hypertensive (140-159; 160-300mmHg) cohorts.



Conclusions/Limitations

Increases in EMS SBP after the nadir revealed distinct, and previously unreported, patterns: hypotension-mortality drops significantly if SBP increases after the nadir. Improvement is dramatic with large increases. Normotension-SBP increases are associated with slight mortality reductions and even large SBP increases do not appear to be detrimental. Mild hypertension-Large SBP increases (>50mmHg) are associated with higher mortality. Severe hypertension there is a higher mortality with any subsequent increase. Given the pathophysiology of TBI-associated hypertension, these results have unclear treatment implications in patients with high SBP. The findings in the hypotensive and normotensive cohorts, however, support the concept of restoring/optimizing cerebral perfusion in TBI.

0104

Socioeconomic Status: A Confounder for Computerized Neuropsychological Test Scores in Adolescent Athletes?

Category: Neurotrauma – prevention and public health

Author's preference: No preference

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Introduction/Rationale

While co-morbidities, such as learning disabilities and previous history of concussion, have been identified as gross factors that result in poor performance on cognitive assessment, socioeconomic status (SES) has been neglected in concussion research. Low socioeconomic environments pose an additional problem as a growing population that is historically medically underserved and researched. Consequently, a thorough understanding of SES on neuropsychological test scores is necessary to ensure appropriate test score interpretations and assessment of diverse populations. The aim of this study is, therefore, to determine the effect of SES on neuropsychological test scores.

Method/Approach

Study Design: Prospective between-groups design.
Methods: High school athletes (N = 1180) were administered a computerized neuropsychological test (ImpACT) battery during baseline assessment. Participants were divided into groups based upon SES (high n = 581 and low n = 599). ImpACT composite scores served as dependent variables. Comparisons of groups were calculated using a One Way ANOVA. All statistical analyses were conducted utilizing SPSS 21.0. Significance levels were set a priori at 0.05.

Results/Effects

Statistically significant differences existed between SES groups on composite verbal memory (F = 96.25, p > 0.001); composite visual memory (F = 64.22, p > 0.001); composite visual motor speed (F = 282.8, p > 0.001); composite reaction time (F = 66.74, p > 0.001); and total symptoms (F = 7.09, p = 0.008). Those athletes in the higher SES group performed better and reported fewer symptoms.

Conclusions/Limitations

Results suggest that despite a similar physical environment, participants in the higher SES group performed better on

neuropsychological concussion assessment and reported fewer symptoms at baseline. It is essential for clinicians to understand the significance of SES on test scores to determine the need for population specific assessment to ensure safe management practices in diverse populations. Future research should investigate comprehensive clinical models that take into account individualized (personal) differences through baseline testing. Additional investigations should focus on a multimodal approach to management that would include, but not be limited to, SES risk factors.

0105

Using Universal Design for Learning as a Framework for Teaching Students With Traumatic Brain Injury

Category: Neurorehabilitation – activities and participation

Author's preference: Oral

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Introduction/Rationale

Many children who sustain a traumatic brain injury (TBI) return to their school and experience difficulties in executive functions. As a result, teachers and students face a set of challenges that are unique to this population. Understanding the executive functions of this population is critical for students with TBI. Over recent years, there have been many suggestions as to the best way to educate students with TBI. The results have been mixed. The one framework that identifies specific strategies for teaching students with TBI, and that addresses various brain networks, is the Universal Design for Learning (UDL).

Method/Approach

Children and adolescents sustain TBI more frequently than people in any other age group (Centers for Disease Control and Prevention [CDC], 2006; Langlois, Rutland-Brown, & Thomas, 2006; Rosso et al., 2007). Because of this, attention to the reintegration of students with TBI into general educational settings is important. Teachers need to have an understanding of the nature of the injury and of the impact of the injury on cognition, language, and emotional functioning. Teachers also need to have the professional training that includes knowledge of brain function as well as knowledge of effective pedagogy.

Results/Effects

Students with TBI face a complex array of barriers as they re-enter inclusive settings. These barriers can be minimized through the use of the UDL. The UDL is a theoretical framework that incorporates evidence-based practices described to best support the delivery of the standard curriculum to all students (UDL; CAST, 2011a). It is an educational framework based on research in the learning sciences that guides the development of flexible learning environments (CAST, 2011a).

Conclusions/Limitations

Students with TBI learn more efficiently when material is presented in a variety of ways that address the networks of the brain, and when the instruction offers multiple means of representation, means of engagement, and means of expression. They can experience even more success when they have the opportunity to interact with the material in such ways that appeal to their brain networks. Ensuring that teaching students

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with TBI by implementing the principles of UDL framework can, therefore, provide an effective means for educating this unique population of learners.

0106

Circular Visual Tracking (CVT) Metrics in Neurocognitive States

Category: Neurotrauma- basic research

Author's preference: Poster

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Introduction/Rationale

Attention is a core function for cognition and it is impaired following a concussion or mild Traumatic Brain Injury (mTBI). Since there is a large overlap in the neural networks subserving attention and eye movement control, it is possible that eye movement-based markers of attention impairments are useful when screening for mTBI. Our particular interest, for this study, was to characterize a key role of attention in generating time-based expectancies of specific sensory information because it is postulated that post-concussion cognitive impairments and symptoms may stem from a primary deficit in this predictive timing mechanism.

Method/Approach

We utilized continuous predictive visual tracking paradigms to assess individuals' attentional capacities. The capacity for predictive timing was quantified with indices of dynamic gaze-target synchronization. Indices for binocular coordination were also evaluated.

Results/Effects

Preliminary results of data collected from subjects with varied neurocognitive conditions are as follows: normal, acute and chronic mTBI, ADHD, and sleep deprivation.

Conclusions/Limitations

We demonstrated that the visual tracking indices provided fast and objective measures that allowed comparison of abnormal attentional states to a normative standard and allowed for monitoring within-individual changes.

0107

Risk for Burnout, Compassion Fatigue, and Vicarious Trauma Among Staff Working With Brain Injury Patients

Category: Neurorehabilitation - basic research

Author's preference: Poster

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Introduction/Rational

The aim of this study was to determine whether staff, working directly with brain injury patients, were more prone to, or more at risk for burnout, compassion fatigue, or vicarious trauma.

Method/Approach

A sample of 25 direct care brain injury staff completed the Burnout, Compassion Fatigue, and Vicarious Trauma Assessment questionnaire.

Results/Effects

Twenty-one questions were completed with seven questions each divided between burnout, compassion fatigue, and vicarious trauma. Scores were compiled for each category. The majority of participants' highest score was for compassion fatigue. Burnout was the second highest score.

Conclusions/Limitations

Direct care staff caring for patients with brain injuries is more at risk for compassion fatigue than burnout and vicarious trauma.

0108

Multiple Linear Regression Model of Quantitative Volumetrics Reveal Abnormalities in the Inferior Lateral Ventricles, Amygdala, and Pallidum of Brain Injury Patients Compared to Normal Controls

Category: Technology – clinical research/applications

Author's preference: Poster

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Introduction/Rationale

Until recently, imaging techniques did not have the ability to reliably delineate structural abnormalities in patients showing signs and symptoms of brain injury. This added to the complication of differentiating between normal controls (NC) and brain injury patients (BI). Advances in technology, however, now allow MRI-based brain volumetrics to suggest potential structural abnormalities that can be coupled with other clinical correlates resulting in a diagnosis. Using a multiple regression model controlling for age and gender, we looked to find any trends in the quantitative volumetrics of NC and BI.

Method/Approach

The study included 51 NC (31 = males, 20 = females, average age = 49, standard deviation = 14.5) and 55 BI (35 = males, 20 = females, average age = 36.74, standard deviation = 15.33). The prediction model, along with the volumetric software program, NeuroQuant, isolated the specific brain regions in which the actual volume represented a statistically significant structural abnormality. We then looked at each brain region to see which ones were indicative of BI when statistically abnormal.

Results/Effects

The left inferior lateral ventricles showed the highest difference, 38.18% (BI) to 5.88% (NC), in percent of patients who show an abnormality, while the left amygdala and the left pallidum showed a difference of 10.91% (BI) to 1.96% (NC) and 10.91% (BI) to 3.92% respectively. The right side showed similar structural abnormalities; inferior lateral ventricle 20.00% (BI) to 3.92% (NV), amygdala 12.73% (BI) to 1.96% (NC), and the pallidum 16.36% to 1.96%. The data also showed that abnormalities in cortical grey matter and left lateral ventricles tend to lead to false positives.

Conclusions/Limitations

This study revealed that the three brain structures that seemed to show the most differentiation, using this methodology, were the inferior lateral ventricles, amygdala, and pallidum. Future data collection and modeling can lead to structural models for specific BIs that will assist the diagnostic physician in helping BI patients.

0109

Examining Language Preference and Acculturation and Implications for the Continuum of Care of Patients With Traumatic Brain Injury (TBI)

Category: Neurorehabilitation - basic research

Author's preference: No preference

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Introduction/Rationale

Minorities are at a disproportionate risk for traumatic brain injury (TBI) (Jager, 2000), accounting for over half of the hospitalizations for TBI (Shafi, 2007; Shafi, 2007). This indicates a need to better identify factors contributing to health disparities, including years spent living in the United States (US), first language spoken, and primary language spoken at home. This can all provide valid measures of acculturation, which likely have a great impact on health outcomes. Studies demonstrate that language barriers between patients and providers can have a negative effect on patient outcomes due to misunderstandings surrounding discharge and follow-up instructions (Hasnian-Wynia 2006; Jacobs, 2006; Fernandez, 2011; Garrett, 2008; Gardam, 2009).

Method/Approach

Data was collected through medical record abstraction and patient self-reports, producing a sample of $n = 38$ participants diagnosed with moderate to severe TBI and receiving inpatient rehabilitation services in a public city hospital in New York City (NYC). Variables included patient report of culture, race/ethnicity, acculturation, family support, trust in healthcare providers, and health and language literacy.

Results/Effects

Patients were more likely to indicate distrust towards healthcare providers if they were not comfortable speaking in English, and preferred using their native language when communicating about their healthcare with their providers.

Forty-seven percent of those interviewed indicated they would prefer to use interpreter services if their healthcare provider was unable to speak their native language. Of particular note, 75% of Hispanic patients interviewed said they mostly speak their native language when at home, indicating that in addition to ensuring patient understanding of health information it is imperative to include families in order to improve patient outcomes.

Conclusions/Limitations

While our sample size is small, these descriptive results indicate that providing health information in a patient's native language supports the likelihood of a successful transition from inpatient to outpatient services in the TBI population. These data further highlight the need for the rehabilitation field to develop tools that can better address patients with limited English proficiency (LEP). In addition, the data appear to reflect research recommendations to make use of appropriate, and timely, interpreter services, which has been shown to increase patient use of, and satisfaction with, medical care, as well as increase adherence to care instructions (Garrett, 2008).

0110

Pre-season Vestibular Function in Division I Male Lacrosse Players and History of Concussion

Category: Neurorehabilitation- Case report/Clinical Research

Author's preference: Oral

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Introduction/Rationale

Concussion incidence in sports is estimated at approximately 3.6 million cases per year in the United States (US). Currently, the establishment of optimal care, prevention, and diagnostic assessments of concussion is crucial. Identification of susceptible neural structures in recovering concussed athletes may, therefore, provide beneficial insight in this area. The vestibular system functions to maintain gaze stability during rapid head movements. Anatomical location of this system is vulnerable to injury during an impact to the head, resulting in impaired vestibular-ocular reflex (VOR). We proposed that the VOR might be susceptible to impairment following concussive blows and should, therefore, be documented.

Method/Approach

Participants included 41 National Collegiate Athletic Association (NCAA) Division I male lacrosse players, average age 20.6 (+/-1.3). Participants received pre-season assessments including the VOR exam using the inVision™ system by NeuroCom®, and a questionnaire on their previous medical history. Vestibular function measures were assessed by gaze stability (GST), and dynamic visual acuity (DVA), in horizontal and vertical planes of head motion. Participants were divided into groups depending on their position, as well as whether, or not, they had a previous history of concussion. Those with previous history of concussion were divided into 4 groups depending on the number of concussions, (0, 1, 2, and 3 or more).

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Results/Effects

Descriptive statistical analysis revealed that a history of concussion was seen in 82.9% of participants with 39% of participants reporting 3 or more concussions. This represented the largest percentage within the group. Spearman Rho's correlation showed a significance relationship between number of concussions and symptom presentation during the horizontal DVA exam ($p = 0.048$), as well as team position and previous history of concussion ($p = 0.049$). Vestibular function symmetry, as expressed in horizontal and vertical DVA scores, were significantly related to a positive history of concussion ($p < .05$).

Conclusions/Limitations

Our preliminary results indicate a significant number of participants with symptoms associated with vestibular deficits as related to previous history of concussion. The results suggest that vestibular health should be considered in athletic pre-season assessments. We will follow-up these findings with post-season testing of vestibular function in response to head impacts throughout actual season play.

0111

Going Beyond Person-Centered Services for Increased Well-being

Category: Neurorehabilitation – activities and participation

Author's preference: No preference

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Introduction/Rationale

What could be beyond person centered services? Some helpful insights about creating an environment of wellbeing, while also understanding some aspects of the socio-economic challenges the individuals with brain injury, and our staff have defined. We will examine how professionals create the context of care that dynamically influences the healing process. Context establishes unwritten operating agreements with people and it defines the environment and our relationships. What we call "Intentional Context" gives us the opportunity to positively and dynamically influence the health, well-being and healing process for the people we serve, as well as for our staff's well-being.

Method/Approach

This is part of a training program that is based on concepts from *The Eden Alternative*, *Bridges Out of Poverty* by Ruby Payne, and *Scarcity* by Sendhil Mullainathan. These resources support the concept that levels of situational poverty are not comparable to generational poverty. Instead, they are viewed separately and in relation to the cultural issues of rehabilitation and return to a high quality of life. These concepts will be addressed through the methods of wellbeing and services taken to a new level of person directed care approaches.

Results/Effects

Participants will be able: 1) to describe attributes of person-directed care as compared to other contexts of care; and 2) to explain how the instability created by few, or reduced, resources creates an increased need for relationship.

Conclusions/Limitations

Professionals create the context of care that dynamically influences the healing process and wellbeing. Context establishes all of our unwritten operating agreements with people, and it defines the environment and our relationships. What we call "Intentional Context" gives us the opportunity to positively and dynamically influence the health, well-being and healing process for the people we serve, as well as for our staff's well-being. The success of this context takes commitment to, and focus on, person directed care.

0112

Combining Clinical Neuroimaging and Real-World Mechanical Impact Data to Investigate Motor Vehicle Crash-Related Subarachnoid Hemorrhage

Category: Neurotrauma- basic research

Author's preference: Oral

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Introduction/Rationale

Traumatic subarachnoid hemorrhage (SAH) is a common motor vehicle crash (MVC)- related traumatic brain injury (TBI). Little is known about the relationship between crash parameters and resulting SAH. SAH volume and location was analyzed to better understand occupant injury. The hypothesis was that neuroimaging findings would correlate with crash parameters, particularly contact location (CL) and impactor stiffness. Head computed tomographs (CTs), demonstrating SAH ($n = 94$), were selected from the Crash Injury Research Engineering Network (CIREN) database (Figure 1B).

Method/Approach

Semi-automated methods were used to quantify volume of SAH and approximate CL identified from a soft tissue scalp contusion. Label maps representing the injury and scalp contusion were converted to three-dimensional (3D) point clouds and aligned to a global spherical coordinate system using bony landmarks on the skull (Figure 1A, C). Injury location was quantified as theta (around the head, nose to ear) and phi (measured from ear to crown of head) in relation to the CL. Orthodromic distance (OD) was used to assess the 3D spherical distance between the centroid of the CL and the highest percentage of injury.

Results/Effects

Stepwise regression was performed to determine which crash characteristics had the largest effect on SAH volume.

Occupants most frequently contacted compliant structures within the vehicle (a-pillar, b-pillar, etc) (n = 48), followed by external structures (hood of impacting vehicle, pole, etc.) (n = 21). OD was right skewed with a median (95%) value of 25.61 (80.85) degrees.

Conclusions/Limitations

Left to right CL (theta) and maximum crush of the vehicle were important factors in the stepwise regression for anterior CLs ($p = 0.0140$ and $p = 0.0242$, respectively). Medial to superior CL (phi) was the only variable correlated to injury volume for left sided CLs ($p = 0.0212$, $r^2 = 0.1949$). Decreasing impactor stiffness was the most significant factor in the stepwise regression for right sided CLs ($p = 0.0205$). These data will be used to understand the biomechanical bases of head injury.

0113

Tinnitus: Prevalence and Co-morbidities in a Cohort of Iraq and Afghanistan Veterans

Category: Neurotrauma – health services and outcomes
Author's preference: Poster

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Introduction/Rationale

Tinnitus, or the perception of ringing in the absence of acoustic stimuli, is the most prevalent service-connected disability for veterans of Iraq and Afghanistan. Estimations of prevalence vary, but previous work suggests that upwards of 30% of Iraq and Afghanistan veterans (IAVs) suffer from tinnitus. Further, little is known about the association of tinnitus with other co-morbidities such as traumatic brain injury (TBI) in IAV coping with tinnitus. The purpose of this study was to describe the prevalence of tinnitus and its associated conditions in a cohort of IAVs.

Method/Approach

This retrospective observational study used data from the national Veterans Health Administration (VHA) data repository. After identifying IAVs, we used ICD-9-CM codes to identify those who received care for tinnitus (2010-2011). We also identified co-morbidities that may be associated with tinnitus using algorithms validated for use with ICD-9-CM codes. Co-morbidities included TBI, post traumatic stress disorder (PTSD), and/or depression, as well as conditions associated with these diagnoses (headache, anxiety, memory/attention/cognition, neck pain, photosensitivity/photo blurring, insomnia, malaise/fatigue, vertigo/dizziness). Multivariable logistic regression analysis was used to examine conditions associated with tinnitus.

Results/Effects

Among all of the IAVs, 311,400 received VHA care in 2010 and 2011. 4.8% of these were diagnosed with tinnitus. Veterans diagnosed with tinnitus in 2010-2011 were more likely to have a diagnosis of TBI alone (AOR 2.25; 99% CI 1.99-2.54), PTSD alone (AOR 1.79; 99% CI 1.67-1.92), TBI+PTSD (AOR 3.20; 99% CI 2.94-3.49), TBI+depression (AOR 1.78; 99% CI 1.42-2.22), PTSD+depression (AOR 1.82; 99% CI 1.70-1.95),

TBI+PTSD+depression (AOR 3.30; 99% CI 3.05-3.57), memory loss (AOR 1.69; 99% CI 1.51-1.89), and vertigo (AOR 2.40; 99% CI 2.17-2.66).

Conclusions/Limitations

Our results indicate that both TBI alone and PTSD alone are significantly associated with tinnitus among veterans. When TBI and PTSD are combined, however, their effects are additive. Indeed, individuals with co-morbid TBI and PTSD demonstrated significantly higher rates of tinnitus than those with either TBI or PTSD alone. These findings indicate that a complex relationship may exist among these conditions and may need to be considered in future research.

0114

The Impact of Scheduled Telephone Follow-up on Decreasing Head Computed Tomography use in Children with Mild Traumatic Brain Injury

Category: Neurotrauma - case report/clinical research
Author's preference: Oral

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Introduction/Rational

Unnecessary head computed tomographies (CTs) in children with mild traumatic brain injury (mTBI) has been common in China. We examined the impact of scheduled telephone follow-up on head CT utilization in pediatric mTBI emergency department (ED) visits.

Method/Approach

A two-year cohort study was conducted in an emergency department (ED) of a tertiary academic teaching hospital from 2013 to 2014. All pediatric patients discharged from the ED with mTBI-associated diagnoses were included. All cases were evaluated, with a scoring system, on their arrival and during their one month of scheduled telephone follow-up period. The intensity of head CT use in pediatric mTBI ED visits, the rates of delayed imaging, and delays in diagnosing radiologically significant findings were analyzed.

Results/Effects

During the non-follow up period, the rate of cranial CTs was 57.3%. With the scheduled telephone follow-up strategy, the rate of cranial CT reduced significantly (47.3% relative decrease, $P = .005$). There was no difference on the rates of delayed imaging (5.3% vs 5.8%, $P = .371$). The rates of delayed imaging and delays in diagnosis of radiologically significant findings were analyzed and found to be unchanged (0% vs 0%).

Conclusions/Limitations

The scheduled telephone follow-up can reduce head CT use in children with mTBI.

0116

Vestibular Dysfunction and Traumatic Brain Injury in Veterans of the Wars in Iraq and Afghanistan

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Category: Neurotrauma – health services and outcomes
 Author's preference: No preference

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Introduction/Rationale

Vestibular dysfunction, most commonly characterized by vertigo and dizziness, has many causes and etiologies including medical and mental health conditions. The prevalence of vestibular dysfunction diagnoses among Iraq and Afghanistan veterans (IAVs) is not known. It has, however, been associated with traumatic brain injury (TBI) a commonly occurring condition among this group. The purpose of this study was to describe the prevalence of vestibular dysfunction and associated conditions in a cohort of IAVs.

Method/Approach

This retrospective chart review study used data from the national Veterans Health Administration (VHA) data repository for IAVs. Using ICD-9-CM codes, we identified those who received care for vestibular dysfunction (438.85, 780.4, 386) during 2010-2011. We also identified co-morbidities that may be associated with vestibular dysfunction using algorithms validated for use with ICD-9-CM codes. Co-morbidities included TBI, post traumatic stress disorder (PTSD), and/or depression, as well as conditions associated with these diagnoses (headache, anxiety, memory/attention/cognition, neck pain, photosensitivity/photo blurring, insomnia, malaise/fatigue, and tinnitus). A multivariable logistic regression analysis was used to examine conditions associated with vestibular dysfunction.

Results/Effects

Among all IAVs, 311,400 received VA care in 2010 and 2011 and 0.8% of these were diagnosed with vertigo/dizziness. Veterans diagnosed with vertigo/dizziness in 2010-2011 were more likely to have a diagnosis of TBI alone (Adjusted Odds Ratio (AOR) 3.79.75; 99% CI 3.13–4.60), TBI+depression (AOR 5.36; 99% CI 4.18–6.87), TBI+PTSD (AOR 5.48; 99% CI 4.79–6.28), TBI+PTSD+depression (AOR 6.40; 99% CI 5.68 – 7.22), malaise/fatigue (AOR 2.87; 99% CI 2.43–3.40) and neck pain (AOR 2.47; 99% CI 2.23–2.73).

Conclusions/Limitations

Our results indicate that TBI alone is associated with vestibular dysfunction among veterans and that psychiatric co-morbidities (i.e., PTSD and depression) further increase the likelihood of vestibular dysfunction among individuals with TBI. The diagnosis of vertigo/dizziness was also associated with an increased likelihood of co-morbid malaise/fatigue and neck pain. These results suggest that additional studies are needed to fully understand how vestibular dysfunction and co-morbid conditions are related.

0117

The Independent Living Status (ILS) Assessment Tool: A Prescriptive and Descriptive Outcome Measure to Determine Effectiveness of Residential, Transitional Rehabilitation

Category: Neurorehabilitation – activities and participation
 Author's preference: Oral

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Introduction/Rationale

It has become increasingly important to demonstrate superior treatment outcomes as length of stay decreases and pressure from payers to demonstrate cost efficiency increases. Valid and reliable treatment tools and outcome measures can be helpful in a pay-for-performance environment. The Independent Living Status (ILS) scale is a tool that provides detailed treatment guidance and real time, proximal skill, repeated measurement of hierarchically task-analyzed performance for use with patients with brain injury in the post acute phase of treatment.

Method/Approach

The ILS was developed in post-acute residential rehabilitation settings to address performance measurement of activities of daily living (ADLs), behavior and initiation. The ILS is a 100-point treatment tool used for daily treatment guidance and performance documentation by paraprofessional staff. Diagnostic and prognostic information regarding assistance required to facilitate performance of ADLs, initiation and behavioral compliance are assessed on a daily basis in real time simultaneously with task performance. This tool enables quantification of learning generalization from the clinical environment to the living environment. The ILS has predictive capabilities in determining staff coverage and supervision requirements for each individual patient.

Results/Effects

The ILS uses 300 repetitively measured data points weekly to provide quantitative and qualitative analysis of 17 ADLs (61 points), 11 distinct behaviors (30 points), and initiation (9 points). The ILS has inter-rater reliability ($R^2 = 0.85$), good test-retest reliability ($R^2 = 0.72$), and good validity with other commonly used rating scales ($R^2 = -0.75$ with the Disability Rating Scale). Psychometric properties of the ILS are good and weekly changes in scores can be observed. This makes the ILS useful in a transitional, residential post-acute brain injury program. Studies of efficiency (rates of change per day), effectiveness and growth curve trajectories utilizing the ILS are possible.

Conclusions/Limitations

The ILS is a valid and reliable functional skill acquisition tool for continuous, real time, proximal skill and behavior assessment for patients with brain injury. The ILS can help determine patient progress, staff effectiveness, program efficacy and efficiency, caregiving requirements, behavioral status, staffing level requirements, and staff accountability. It can also enable distinction of ability from willingness to perform tasks. This presentation will illustrate these features of the ILS, and will provide demonstration of data collection and presentation for use in residential, transitional rehabilitation settings.

0118**Speed and Social Thinking: A comparison of adults With and Without Traumatic Brain Injury on the Video Social Inference Test (VSIT)**

Category: Neurorehabilitation- Case report/Clinical Research

Author's preference: Oral

Rocio Norman, Lyn Turkstra

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Research has shown that individuals with traumatic brain injury (TBI) are at risk for social isolation, depression and employment difficulties (Spatt et al., 1997). These individuals may also experience deficits with both expression and comprehension in social communication exchanges (Turkstra et al, 2001). The purpose of this study was to determine the relationship between speed of information processing and social inference using a video-based social communication task.

Method/Approach

Participants included eighteen adults with moderate-to-severe TBI recruited from a community based setting in the Midwest and 18 uninjured adults matched for sex, age and education. Participants completed the Video Social Inference Test (VSIT), a task used to assess social inference abilities in individuals with TBI. Dependent variables were VSIT accuracy scores, reaction times in (msecs) and speed/accuracy tradeoff. Paired t-tests were used to compare means between groups.

Results/Effects

Accuracy scores were significantly higher ($p = .015$) in the control group (mean: 84% standard deviation (SD):12) than in the TBI group (mean: 72%, SD: 17). Reaction times were slower for the TBI group (mean: 188065 msec., SD: 58996) vs control group (mean: 170084 msec. SD: 52228), but the difference was not statistically significant ($p = .353$). The groups differed significantly ($p = .012$) in speed/accuracy tradeoff, which was larger for the TBI group (mean: 2822 SD:1220) vs control group (mean: 2066 SD:707).

Conclusions/Limitations

Speed of information processing is worth examining in individuals with social problems after TBI. In the present study, adults with TBI differed significantly from matched controls on measures of accuracy and speed/accuracy tradeoff. The results of this study contribute to the literature on speed of information processing after a TBI by characterizing speed effects in a social communication context.

0119**Syndrome of the Trephined: Improvement in Neurolinguistic Deficits and Global Aphasia After Cranioplasty**

Category: Neurotrauma - case report/clinical research

Author's preference: Poster

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Introduction/Rationale

A 32 year-old male veteran suffered a severe traumatic brain injury (TBI) post assault, resulting in a subdural hematoma with midline shift. He required an emergent left-sided decompressive craniectomy. A non-contrast head computed tomography (CT) obtained one month after insult showed left frontal, parietal, and occipital lobe encephalomalacia with expected surgical changes from the left frontal craniectomy. On admission to the acute brain injury rehabilitation unit, this veteran presented with severe functional and neurocognitive deficits with global aphasia. These deficits are consistent with syndrome of the trephined; a disorder of delayed neurological deterioration after removal of a large cranial bone flap.

Method/Approach

The Western Aphasia Battery (WAB) is a comprehensive assessment of language function for adults with acquired neurological disorders. The WAB is designed to assess linguistic modalities including verbal expression, auditory comprehension, written expression, reading comprehension, and gestural communication. This assessment provides a differential diagnosis of an individual's language function, as well as current performance in specified linguistic areas.

Results/Effects

The WAB was administered to the patient one month before and one month after cranioplasty. His results demonstrated dramatic improvement in word fluency, verbal repetition, object naming and comprehension of sequential commands after the cranioplasty. Smaller improvements were noted in the patient's spontaneous speech and auditory word recognition.

Conclusions/Limitations

Early cranioplasty improves symptoms of the syndrome of the trephined with qualitative improvement of neurolinguistic deficits. One limitation to this study was the patient's low tolerance level to standardized testing immediately following the cranioplasty, and thus limited data was able to be collected at that time.

0120**White Matter Integrity and its Relationship to PTSD Symptoms and Sleep Quality in OEF/OIF Veterans**

Category: Neurotrauma- basic research

Author's preference: Poster

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Introduction/Rationale

Studies utilizing diffusion tensor imaging (DTI) in Veterans with post traumatic stress disorder (PTSD) and sleep disturbances are limited, but previous reports have implicated decreased fractional anisotropy (FA) in the cingulum bundles and superior longitudinal fasciculus in PTSD. Extending our previous research on sleep disturbance in returning Operation Iraqi Freedom/Operation Enduring Freedom (OIF/OEF) Veterans with posttraumatic stress disorder (PTSD), this exploratory study examined PTSD symptoms and level of sleep disturbance in relation to white matter integrity.

Method/Approach

Seventeen previously-deployed OEF/OIF Veterans aged 18-54 years with PTSD diagnosed via clinical diagnosis and verified using the Clinician-Administered PTSD Scale (CAPS) and without comorbid mild traumatic brain injury (mTBI), or substance abuse, underwent diffusion tensor imaging (DTI). Sixteen veterans of comparable age and sex, and without PTSD, mTBI, or substance abuse issues, were used as a control group. Sleep quality was assessed with the Pittsburgh Sleep Quality Index (PSQI), and PTSD symptom level was assessed with the PTSD Checklist-Civilian Version (PCL-C).

Results/Effects

Group comparisons yielded significant differences in FA in the genu ($p = .054$) and splenium of the corpus callosum ($p = .040$) and left uncinate fasciculus ($p = .007$). Whereby, the PTSD group demonstrated lower FA in all regions. There were no significant correlations between FA values in these regions and PCL-C, though significant negative correlations were observed between PSQI Total Sleep and right ($r = -0.736$, $p = 0.003$) and left ($r = -.501$, $p = 0.030$) centrum semiovale and left ventral striatum ($r = -0.570$, $p = 0.042$), indicating that higher levels of disrupted sleep were associated with lower FA in the participants with PTSD.

Conclusions/Limitations

PTSD is known to be associated with significant sleep disturbance, particularly in veteran populations. These problems with sleep may be associated with decreased white matter integrity and warrant further investigation and a need for treatment.

0121

Cognitive Performance in MCI Patients With and Without a History of Concussion

Category: Neurorehabilitation- Case report/Clinical Research
Author's preference: No preference

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Introduction/Rationale

Increased attention has been devoted to the link between a history of traumatic brain injury (TBI) and the later development of cognitive impairment or dementia. Mild cognitive impairment (MCI), a transitional state between normal cognition and dementia, has been noted to occur at a higher frequency among former National Football League (NFL) players with a history of concussion. The current study sought to examine whether neuropsychological differences exist between MCI subjects with and without a remote history of concussion.

Method/Approach

Subjects included 13 retired professional athletes diagnosed with MCI (11 NFL players, one National Hockey League [NHL] player, and one boxer) and 13 MCI patients without a history of TBI selected for approximate age and education match. Retired players had an average of 7.2 concussions (range = 2-18). Cognitive performance was assessed across five domains: (1) attention and cognitive flexibility (Digit span and Trail Making Test), (2) processing speed (Digit symbol), (3) language (category fluency, F-A-S, and Boston Naming Test [BNT]), (4) visuospatial skills (Block design), and (5) verbal episodic memory (California Verbal Learning Test [CVLT]).

Results/Effects

Independent two-tailed t-tests indicated athletes and controls were not significantly different in terms of age, gender, race, or education. Groups were compared on each cognitive measure using either Student's t-tests or Welch's t-tests if the variance ratio was significant. Retired athletes with MCI performed significantly worse than MCI subjects without a history of concussion on the following measures: Trail Making Test B ($p = .041$), Boston Naming Test ($p = .001$), Block Design ($p = .005$), and CVLT total T-score ($p < .001$).

Conclusions/Limitations

Comparison of retired athletes with MCI and a history of concussion and MCI controls revealed lower performance among retired athletes on measures of attention and cognitive flexibility, language, visuospatial skills, and verbal episodic memory. Findings suggest that a diagnosis of MCI in combination with a history of concussion (or multiple concussions) may be associated with greater neuropsychological impairment. Results also suggest that concussion(s) may represent a risk factor for later cognitive decline, although additional exploration of other risk factors—such as age, genetics, and vascular factors—is warranted before firm conclusions can be drawn.

0122

Preliminary Development and Validation of a Finite Element Brain Model

Category: Neurorehabilitation - basic research
Author's preference: Oral

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Introduction/Rationale

Each year, approximately 1.7 million people in the United States (US) suffer from traumatic brain injury (TBI). TBI is a leading cause of disability and injury-related death, accounting for nearly one third of all injury-related deaths.¹ Finite element (FE) models are a powerful method employed to study and understand the underlying mechanisms in brain injury. The objective of the current study is to create a high resolution, anatomically accurate brain FE model to analyze brain injury.

Method/Approach

An FE element model was developed from the International Consortium for Brain Mapping (ICBM) brain atlas by converting each voxel into an element of the same size using a custom code developed in MATLAB. As initial validation, the atlas-based brain model (ABM) was subjected to impact conditions investigated in the cadaveric studies conducted by Hardy et al². In these experiments, 10 neutral density targets (NDTs) were implanted in the brain to track relative brain displacement. Nodes in the ABM closest to the physical location of each NDT were identified and their relative displacement-time histories were compared to experimental data.

Results/Effects

The results presented in this study are those from the C755-T2 Hardy experiment. The x- and z-displacements for all 10 NDTs are computed for the ABM and compared to the experimental data reported by Hardy et al².

Conclusions/Limitations

The results show good agreement with experimental data for many of the NDTs, as well as competitive results when compared with brain response from other currently used FE models.

0123

Development of a Long-Term Integrated Rehabilitation Psychotherapy Model for Adolescents With Moderate to Severe Brain Injury and Co-morbidities.

Category: Neurorehabilitation- Case report/Clinical Research
Author's preference: No preference

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Introduction/Rationale

Recovery from moderate to severe brain injury takes a long time and requires multi-modal treatment. There is limited access to treat substance abuse, alcohol abuse, suicidality, and psychiatric co-morbidities for adolescents with brain injury. Integrating what is known about brain plasticity, cognitive rehabilitation, substance and alcohol abuse, suicidality, and psychiatric conditions into rehabilitation psychotherapy for the treatment needs of this population was the challenge posed in this study. The integrative rehabilitation psychotherapy model was applied to several cases for up to 6 years and four phases of therapy emerged to guide assessment and treatment.

Method/Approach

Adolescents with moderate to severe brain injury in a south-west medical center, who were discharged from acute care, and were treated by multiple health professionals over various time periods ranging from several months to six years. The treating rehabilitation psychologist engaged in a range of activities across treatment (e.g., psychological assessment, cognitive rehabilitation, psychotherapy, substance abuse treatment, and family therapy). The modalities of interventions, ongoing assessments, and outcomes were described and four stages of therapy were proposed.

Results/Effects

Our hypothesis was that integrating cognitive rehabilitation, substance abuse therapy, and psychotherapy that includes treatment of suicide and psychiatric disorders into rehabilitation psychotherapy, maximizes engagement and outcomes of therapy over the long term. A developmental metacognitive approach to cognitive rehabilitation, a relapse prevention approach to substance abuse, and an integrative psychotherapy approach to psychiatric co-morbidities concomitant with projective and neuropsychological testing allowed for uninterrupted access to care as needed. The approach also allowed for significant adjustments to treatment planning as needed, and positive outcomes. The four phases of treatment were: preparation – surviving; active – healing; transforming – thriving; and tapering – ending.

Conclusions/Limitations

Recovery from moderate to severe brain injury in adolescents requires a broad theoretical and practical approach in developing effective treatment models. Traditional models of care result in less than maximum outcomes and research rarely focuses on long-term care, or a comparison of different models of care. There is great need for more discussion and models of integrative long-term care that tap into what is known about brain plasticity, brain imaging, assessment, and treatment of the whole person to inform evidence-based research. The proposed integrative rehabilitation psychotherapy is one such model that needs to be developed in research.

0124

Sleep Disorders Following Traumatic Brain Injury (TBI)

Category: Neurotrauma- basic research
Author's preference: Poster

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Introduction/Rationale

Common sequelae of traumatic brain injury (TBI) are poor sleep patterns, significantly impaired overall function and a sense of wellbeing. Despite the high occurrence of sleep disorders in post brain trauma, its overall management continues to need major levels of research.

Method/Approach

An extensive literature search was done using Pub-Med. Our review was limited to studies in humans published in English, and significant findings synthesized.

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Results/Effects

Sleep disorders in TBI include insomnia, hypersomnia, and abnormal sleep phenomena such as somnambulism, nightmares, excessive daytime sleepiness and pleiosomnia. The extent, and severity, of sleep problems depends on patient age, and correlates positively with brain injury severity (mild, moderate, and severe). Disturbances in sleep patterns and/or circadian rhythm, reflect imbalances in melatonin production and metabolism, deleterious effects of oxidative stress and physiological damage imposed by TBI. Compared to the general population, melatonin levels in TBI patients are significantly lower, and sleep quality and efficiency greatly impaired. Levels of hypocretin-1, a neuropeptide promoting vigilance, are decreased, as well as this contributes to hyper-somnolence.

Conclusions/Limitations

There is a need for greater awareness among clinicians about sleep disorders in TBI patients, so that they screen for it and manage accordingly. More rigorous studies are needed to identify underlying pathologic mechanisms and advance evidence-based treatments. Identifying which patients may be more at risk for specific forms of impairment, and those that may benefit from currently available therapies, informs therapeutic decisions and guides management.

0125

Increased Postural Sway in Veterans With Mild Traumatic Brain Injury Measured With a Force Platform

Category: Neurotrauma - case report/clinical research

Author's preference: Poster

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Introduction/Rationale

Balance is the ability to remain upright and steady with minimal postural sway, or horizontal movement of the center of gravity and is critical to the performance of most daily living activities. Postural sway problems can indicate neurological dysfunction in sensory integration and motor coordination. Prior studies have found increased postural sway in persons with traumatic brain injury (TBI). Assessment of postural sway has been performed primarily using subjective observations of performance during balance tasks. This study uses an inexpensive force platform, the Nintendo Wii Balance Board, to perform quantitative assessment of postural sway in veterans with mild TBI (mTBI).

Method/Approach

Fifty-six veterans receiving services from the Minneapolis VA, 46 with mTBI (mean age = 53.9, 3 women); and 10 without TBI (mean age = 45.6, 5 women), were assessed. Postural sway was assessed while subjects stood motionless with feet together on the board for 60 seconds with eyes: 1) closed 2) open and fixating on a paper attached to the wall - inspection task, or 3) open searching a paragraph of text on a paper, counting occurrences of a particular letter - search task. The

outcome variable was: displacement - which measures the average absolute distance traveled in the anterior-posterior and medial-lateral directions.

Results/Effects

A group (TBI, non-TBI) x task (eyes closed, inspection, search) mixed model ANOVA showed a significant group, by task interaction, for the AP direction. Between group t-tests for each task revealed that TBI subjects had significantly reduced postural stability (greater displacement) than controls in the eyes closed condition ($p < .001$), but not for the inspection or search tasks. For the ML direction, there was a significant effect of task (more displacement in the eyes closed task compared to the other tasks), but none involving the groups.

Conclusions/Limitations

Veterans with a history of mTBI have increased postural sway in the anterior-posterior direction in the eyes closed condition. Postural sway is increased when visual input is restricted (eyes closed). Vestibular and/or proprioceptive system disruption in mTBI may contribute to increased postural sway. Teasing apart these systems' contributions is an avenue for future study. Current findings indicate that objective assessment of postural sway in mTBI may be helpful in identifying individuals at increased risk of fall. In addition, this balance assessment may be an important tool in assessing current performance as well as guiding rehabilitation of patients with mTBI.

0126

Pre-hospital Systolic Blood Pressure and Non-Mortality Outcomes in Major Traumatic Brain Injury: Is There a "Hypotension Threshold"?

Category: Neurotrauma - case report/clinical research

Author's preference: Oral

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Introduction/Rational

The current Pre-hospital Traumatic Brain Injury (TBI) Guidelines utilize a systolic blood pressure (SBP) threshold <90 mmHg for treating hypotension in patients ≥ 10 years. This is, however, based primarily upon the general population's distribution of SBP rather than experimental/clinical data. Our previous work failed to identify a treatment "threshold" for SBP related to the risk of mortality. To our knowledge, this question has never been evaluated for non-mortality outcomes.

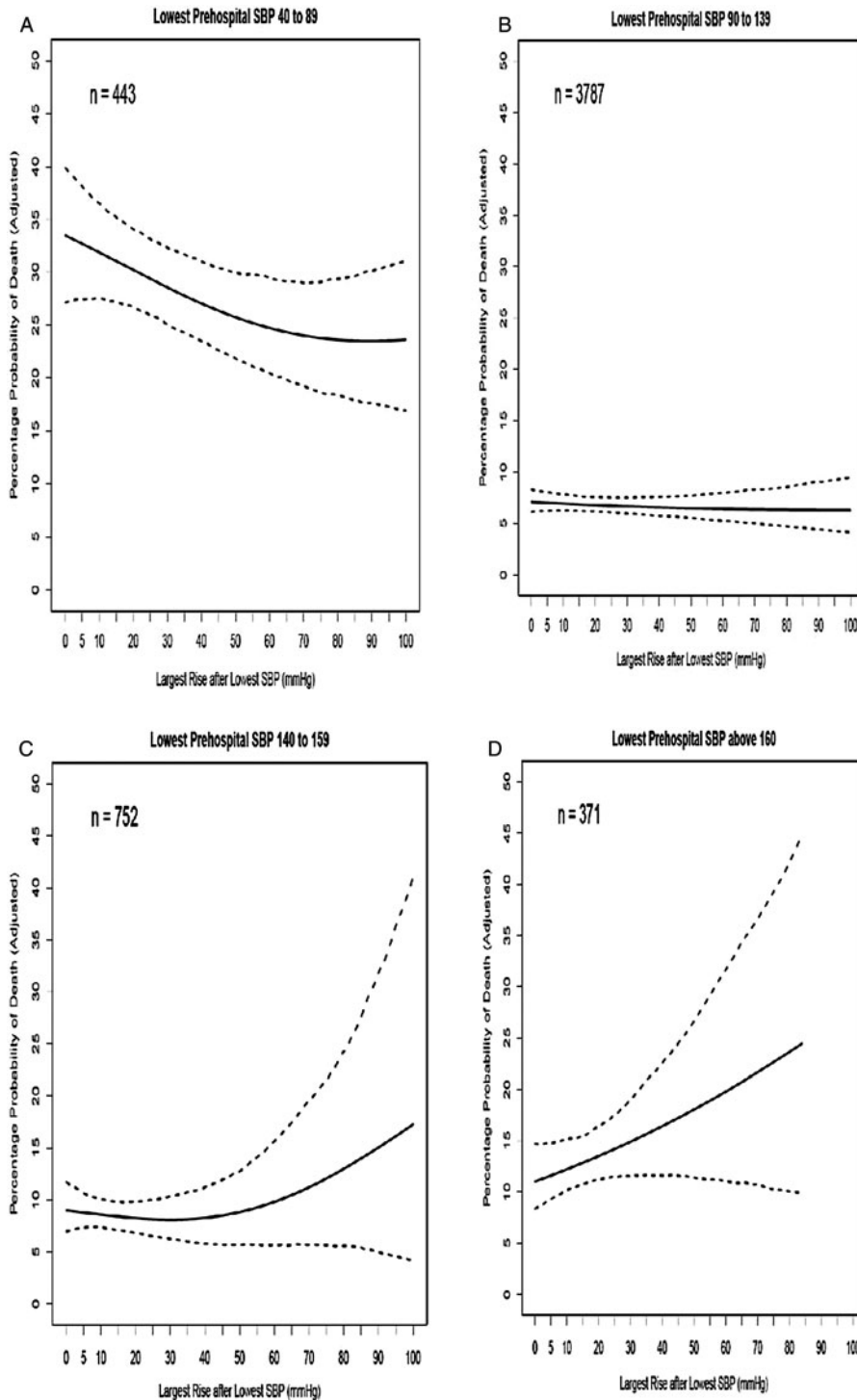
Method/Approach

All moderate/severe TBI cases (CDC-Barell Matrix-Type-1) in the statewide Excellence in Prehospital Injury Care (EPIC) TBI Study (NIH/NINDS-1R01NS071049; ClinicalTrials.gov-NCT01339702) from 1/1/08-12/31/12 with a lowest recorded pre-hospital emergency medical systems (EMS) SBP between 40 and 120 mmHg were included (exclusions: age < 10, death). Fractional polynomials (FP) with logistic regression [Intensive

Care Unit (ICU) admission, inpatient disposition home (vs. rehab/skilled nursing facility)] and negative binomial regression (ICU days) were used to analyze associations with outcomes.

Results/Effects

4,390 patients met inclusion criteria. SBP was linearly associated with all outcomes in the log scale. No FP transformation



improved any model fit compared to non-transformed (linear) SBP. Each five-point increase of SBP: decreased odds of ICU admission by 5.1% (adjusted OR = 0.949, 95% CI: 0.907-0.993); increased odds of disposition home by 11.1% (aOR = 1.111; 1.078-1.145), and decreased ICU days by 5.2% (incidence rate ratio = 0.9481; 0.938-0.958; see Figure) across the range of SBP from 40 to 120mmHg. This was after controlling for ISS, SpO₂, AIS-head, age, sex, payor, race, ethnicity, trauma type, interfacility transfer, and clustering by a trauma center.

Conclusions/Limitations

In major TBI, we found a linear relationship between lowest pre-hospital SBP and three important non-mortality outcomes across a wide range of SBP (40-120mmHg). The concept that 90mmHg represents a unique, or important, "cut-point" is not supported by these data. For the injured brain, clinically meaningful "hypotension" may be higher than current guidelines suggest and further work is needed to identify an optimal target for fluid resuscitation in TBI.

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An Open Label Randomized Control Pilot Study Examining the Use of Ibuprofen and Acetaminophen for Acute Headache in Post-Concussive Youth.

Category: Neurotrauma - case report/clinical research
Author's preference: No preference

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Introduction/Rationale

Post injury concussion and headache are problematic for children after mild traumatic brain injuries (mTBIs).

The objectives of this pilot study were: (i) to assess the feasibility for a full randomized control trial (RCT), (ii) to assess the efficacy of routine administration of analgesia on concussion headaches and (iii) to classify acute headaches using the International Headache Society (IHS) criteria.

Method/Approach

A 4 arm open label pilot RCT study was conducted. The treatment arms (n = 20) were: (i) acetaminophen, (ii) ibuprofen, (iii) acetaminophen and ibuprofen and (iv) a standard control group. Eight to eighteen year olds presenting to emergency department (ED) with a headache 24-48 hours after their first concussion, were recruited consecutively and sequentially randomized. Demographic data was collected, the headache survey was administered and standard concussion education was provided. Headaches were diarized over one week capturing the (i) number of headaches, (ii) headache days and (iii) intensity. The follow up for return to school was at one week.

Results/Effects

Patients on acetaminophen (p = <0.001), ibuprofen (p = <0.001) or both (p = <0.001) had significantly fewer (i) episodes of headaches and (ii) less headache intensity (acetaminophen (p = <.001), ibuprofen (p = <.001) or both (p = <.001) than the standard care group. Patients on ibuprofen and acetaminophen (79.0%) and on ibuprofen alone (61.0%) returned to school one week post injury significantly earlier than the acetaminophen group (33.3%) and the standard care group (21.1%) (<.001). Headaches were not classifiable using the IHS Criteria.

Conclusions/Limitations

The routine administration of analgesia has been shown to be effective in the management of post concussive headache. An RCT is needed for incorporating children with multiple concussions, and premorbid factors and following up longer to investigate the efficacy and generalization of these treatment regimens.