

Neurotrauma & Critical Care NEWS



Fall 2013

AANS/CNS Section on Neurotrauma & Critical Care

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From the Chair

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In This Issue...

2

2013 Congress of
Neurological Surgeons
Annual Meeting

4

Introduction of
Telemedicine in Traumatic
Brain Injury Care

7

The Misnomer and
Muddled Miasma of Mild
Brain Injury



As the chair of the AANS/CNS Section on Neurotrauma and Critical Care, I want to thank all of its members for their ongoing support. In this newsletter, you will find an area listing all the neurotrauma highlights at

the upcoming Congress of Neurological Surgeons meeting in San Francisco.

It is with great excitement that I announce that for the first time in many years, the Joint Section of Neurotrauma and Critical Care (JSNTCC) will have a free-standing meeting in conjunction with the National Neurotrauma Society in San Francisco from June 29 to July 2, 2014. This joint effort was initiated by our former chair David Adelson, MD, FAANS, and continued through contributions from the JSNTCC supported by Michael Fehlings, MD, PhD, FAANS; and Shelly Timmons, MD, PhD, FAANS.

This meeting has been the primary forum for exchanging information in the fields of both traumatic brain injury (TBI) and spinal cord injury (SCI). The meeting focuses on integrating clinical, translational and basic science information on issues in neurotrauma. This year's joint meeting will present an exciting integration of state-of-the-art clinical, translational and basic science information on the consequences of damage to the nervous system through focused clinical sessions and workshops, as well as discussions of translational issues from both the clinical and basic sides of the spectrum. Plenary sessions,

workshops, and poster sessions are being planned to focus on topics of current research and practice issues. A public lecture, patient-perspective talks and networking opportunities will round out the program. The CME-rich clinical program will start on Sunday, June 29, and additional trauma-specific CME credits will be provided for each following day of the meeting.

We have reserved a large block of rooms at the San Francisco Marriott for very reasonable rates (\$229 single/double per night), and have a conference area with a variety of spaces ideal for large lectures, small discussion groups and excellent poster space that will be integrated with the exhibit space. The Marriott is in the heart of the city on public transportation lines (Bay Area Rapid Transit and the trolley lines), close to museums, restaurants, shops, Union Square, Chinatown, the Ferry Building with its farmers market and the beautiful San Francisco Bay. An opening reception and bay cruise are planned for two of the evenings. Time in the middle of the day and most evenings will be open to enjoy the city. Please join us in San Francisco for what is shaping up to be an excellent meeting.

I hope to see you there!
Geoffrey Manley, MD, PhD, FAANS
Chair, AANS/CNS Section on Neurotrauma and
Critical Care

2013 Congress of Neurological Surgeons Annual Meeting

Neurotrauma

Saturday, Oct. 19, 2013

8-11:30 a.m.

PC05: Neurosurgery Board Review

Sunday, Oct. 20, 2013

12:30-4 p.m.

PC25: Neurocritical Care and Neurosurgical Emergencies Update

Multidisciplinary Session I - 2:51-2:58 p.m.

Oral Presentation entation: Evaluation of the Immediate Role of Decompressive Craniectomy in the Treatment of Refractory ICP in Cases of Traumatic Brain Injury. Experience of a Tertiary Care Trauma Center in Alexandria, Egypt

Monday, Oct. 21, 2013

International Neurosurgical Forum - 3:30-5 p.m.

Forum: Role of Decompressive Hemicraniotomy in Severe Traumatic Brain Injury

International Neurosurgical Forum - 3:30-5 p.m.

Forum: Computer-Designed PEEK Implants: A Peek Into The Future of Cranioplasty?

Neurosurgical Forum - 3:30-5 p.m.

Section on Neurotrauma and Critical Care

Section on Neurotrauma and Critical Care Neurosurgical Forum - 3:30-5 p.m.

Forum: Is Surgery Really Beneficial in Compound Skull Fractures? A Multivariate Analysis

Section on Neurotrauma and Critical Care Neurosurgical Forum - 3:30-5 p.m.

Forum: Feasibility, Safety, and Efficacy of Directly Transplanting Autologous Adult Bone Marrow Stem Cells in Patients With Chronic Traumatic Dorsal Cord Injury

Section on Neurotrauma and Critical Care Neurosurgical Forum - 3:30-5 p.m.

Forum: Reliability of CT Angiography as a Confirmatory Test for Brain Death Determination

Section on Neurotrauma and Critical Care Neurosurgical Forum - 3:30-5 p.m.

Forum: The Impact of the Repeal of Pennsylvania's Mandatory Motorcycle Helmet Law on Helmet Use and Head Injury: A Study of Two Urban Trauma Centers On Opposite Sides of the State Line

Section on Neurotrauma and Critical Care Neurosurgical Forum - 3:30-5 p.m.

Forum: The Selective Vulnerability of Foramen Magnum to Blast-TBI

Section on Neurotrauma and Critical Care Neurosurgical Forum - 3:30-5 p.m.

Forum: Probabilistic Tractography in Hemorrhagic Stroke Patients to Map the Default Mode Network: Clarifying Mechanisms of Unresponsiveness

Section on Neurotrauma and Critical Care Neurosurgical Forum - 3:30-5 p.m.

Forum: Frequency, Magnitude, and Distribution of Head Impacts in Pop Warner Football

Section on Neurotrauma and Critical Care Neurosurgical Forum - 3:30-5 p.m.

Forum: The Role of Nitric oxide in Traumatic brain Injury: Insight from a New Transgenic Animal Model

Section on Neurotrauma and Critical Care Neurosurgical Forum - 3:30-5 p.m.

Forum: Management of Simultaneous Traumatic Brain and Aortic Injury

Section on Neurotrauma and Critical Care Neurosurgical Forum - 3:30-5 p.m.

Forum: Image Based Risk Stratification of Elevated Intracranial Presentation sure in Severe Traumatic Brain Injury

Section on Neurotrauma and Critical Care Neurosurgical Forum - 3:30-5 p.m.

Forum: Use of a Cyanoacrylate Skin Adhesive Reduces Ventricular Drain Infection Rates

Section on Neurotrauma and Critical Care Neurosurgical Forum - 3:30-5 p.m.

Forum: Serum Catecholamines as a Predictor of Neurologic Outcome in Primary Intracerebral Hemorrhage

Section on Neurotrauma and Critical Care Neurosurgical Forum - 3:30-5 p.m.

Forum: SLIC and Allen Classification as Predictors of Injury Severity in Teardrop Fractures

Section on Neurotrauma and Critical Care Neurosurgical Forum - 3:30-5 p.m.

Forum: Barbiturates May Falsely Increase Serum Sodium Levels

Section on Neurotrauma and Critical Care Neurosurgical Forum - 3:30-5 p.m.

Forum: A Role for Rapid Thromboelastography in Resuscitation Following Traumatic Brain Injury – Identification of the Coagulopathic Patient.

Section on Neurotrauma and Critical Care Neurosurgical Forum - 3:30-5 p.m.

Forum: Psychiatric History as a Predictor of Outcomes Following Mild Traumatic Brain Injury

Tuesday, Oct. 22, 2013

12:30-2 p.m.

T26: Guidelines for Neurocritical Care Management for Patients with Severe Traumatic Brain Injury

Section on Neurotrauma and Critical Care - 2-2:09 p.m.

Oral Presentation: Clinical Correlates of High Cervical Fractional Anisotropy in Acute Cervical Spinal Cord Injury

CNS Original Science 2 - 2-3:30 p.m.

Section on Trauma and Critical Care

Section on Neurotrauma and Critical Care - 2:09-2:18 p.m.

Oral Presentation: Enhancement of Adult Hippocampal Neurogenesis by a Neurotrophic Peptide in Traumatic Brain Injury

Section on Neurotrauma and Critical Care - 2:18-2:27 p.m.

Oral Presentation: Reversal of Pre-Morbid Oral Anti-Platelet Therapy is Not Associated with a Decrease in Radiographic Progression of Intracranial Injury

Section on Neurotrauma and Critical Care - 2:27-2:36 p.m.

Oral Presentation: A Randomized Placebo Controlled Trial of Progesterone With or Without Hypothermia in Patients with Severe Traumatic Brain Injury - Analysis of Preliminary data

Section on Neurotrauma and Critical Care - 2:36-2:45 p.m.

Oral Presentation: The Role of NgR1 Function in vivo after Spinal Cord Injury

Section on Neurotrauma and Critical Care - 2:45-2:54 p.m.

Oral Presentation: Diffusion Tensor Imaging as a Predictor of Experimental Spinal Cord Injury Severity and Recovery

Section on Neurotrauma and Critical Care - 2:54-3:03 p.m.

Oral Presentation: Predictive Value of Somatosensory Evoked Potentials for Patients with Severe Traumatic Brain Injury

Section on Neurotrauma and Critical Care - 3:03-3:12 p.m.

Oral Presentation: Presentation sure Is Only Part of the Story In Traumatic Brain Injured Patients; Focal Cerebral Blood Flow Goes To Zero In Some Patients With Adequate Cerebral Perfusion Presentation sure

Section on Neurotrauma and Critical Care - 3:12-3:21 p.m.

Oral Presentation: Myelination and Diffusion Tensor Imaging Findings in Mild Traumatic Brain Injury

Section on Neurotrauma and Critical Care - 3:21-3:30 p.m.

Oral Presentation: Application of the CRASH Score When Using Intracranial Multimodality Monitoring

6-8:30 p.m.

DIN5: Placing Sports Under the Microscope: Head Injury and CTE

Wednesday, Oct. 23, 2013

12:30-2 p.m.

W38: Athletic Head Injuries: Return To Play

Section on Neurotrauma and Critical Care - 2-2:23 p.m.

Trauma Section: Novel Translational Research in Head Injury

Section on Neurotrauma and Critical Care - 2-3:30 p.m.

Trauma Section: Evolution of Neurosurgery - Translational Research to Clinical Trial

Section on Neurotrauma and Critical Care - 2:23-2:45 p.m.

Trauma Section: Current Clinical Trials in Head Injury Treatment

Multidisciplinary Session II - 2:27-2:36 p.m.

Oral Presentation: What is the Current Practice of Restarting Oral Anticoagulant in Patients with Subdural Hemorrhage?

Section on Neurotrauma and Critical Care - 2:45-3:08 p.m.

Trauma Section: Novel Translational Research in Spinal Cord Injury

Section on Neurotrauma and Critical Care - 3:08-3:30 p.m.

Trauma Section: Current Clinical Trials of Spinal Cord Injury Trials

Multidisciplinary Session II - 3:15-3:22 p.m.

Oral Presentation: Rapid Assessment of Platelet Dysfunction in the Traumatic Brain Injury Patient: Application of Point of Care Assays

Introduction of Telemedicine in Traumatic Brain Injury Care

Martina Stippler, MD, FAANS; and Howard Yonas, MD, FAANS

On the one hand, traumatic brain injury (TBI) is highly time-dependent for minimizing brain injury. Being able to make rapid decisions is especially important. On the other hand, 80 percent of TBI patients have mild TBI (mTBI), 10 percent have evidence of intracranial bleeding (complicated mTBI), and only 0.3 percent need surgical intervention.¹ Due to a lack of neurological and neurosurgical expertise in rural areas throughout the U.S., there is far too much unnecessary emergent triage toward tertiary referral centers.² This generates transport costs and places undue burden on the patient, the patient's family, and New Mexico's only level I trauma center. The efficacy of ischemic stroke care delivery via telehealth technology has been proven to have equal outcomes for patients cared for in rural hospitals by remote stroke consultants versus care provided at primary stroke centers³. It is time to apply the concept of telemedicine to TBI, especially in rural areas with limited access to neurosurgical care.

In many U.S. hospitals, standards of care for non-operative mTBI consists of transferring all mTBI patients (about 1.7 million) to hospitals that provide neurosurgical care.⁴ However, studies showing that the 1.3 million annual TBI emergency department visits found that neurosurgical intervention was needed in only 0.13 percent to 0.3 percent of these patients.⁴ The practice of transferring all neuro-emergent patients consumes valuable resources with unproven efficacy. In some cases, patients are transported long distances by air only to be discharged soon after arrival, often due to the earlier misinterpretation of radiographs⁵. In the context of limited neurosurgical resources and escalating health-care costs, the negative impact of this practice on health-care costs and patient satisfaction needs to be fully understood.⁶

Non-operative management of mild injury could be managed equally well by providers outside the discipline of neurosurgery. Since the University of New Mexico Hospital (UNMH) is the only level I trauma hospital in the state of New Mexico, and many patients with mTBI are transferred there over long distances only to be discharged on arrival, we introduced a telehealth infrastructure throughout the state as a first step in treating these patients in their local hospitals.

To date, we have developed partnerships with 11 rural and urban New Mexico hospitals to provide teleradiology/telehealth-enhanced neuro-emergent consultations and triage neuro-emergent cases using teleradiology. Our experience shows us that teleradiology alone can prevent unnecessary transfers^{7,8}. The telehealth platform we currently use is Internet-based, HIPPA-protected, and enables the consulting physician to review imaging and generate reports on the spot. The fact that the technology available for information exchange and high-volume data sharing has become more affordable over the past few years makes telehealth an attractive option for even smaller hospitals or physician groups.

Teleradiology and telehealth are relatively new to the U.S., but they have been successfully employed in Europe, resulting in cost savings and appropriate resource management⁹. Neurosurgery cov-

erage is sparse at best in rural areas throughout the U.S., so patients with mTBI do not have ready access to neurosurgical consultation other than by phone. However, phone consultation is limited and inadequate for most neuro-emergent care, and this frequently leads to long-distance transport that is not medically indicated¹⁰.

Telehealth-enhanced neurosurgical consultation is routinely used in Europe. For example, Fabbri et al.¹¹ showed that observation in a neurosurgical unit or in a peripheral hospital after telehealth-enhanced neurosurgical phone consultation is safe and does not result in worse outcomes. In one of our studies by Moya et al.⁸, we showed that telehealth-enhanced consultations in New Mexico resulted in care-management recommendations or avoided transports in 50 percent of cases. We saw similar results with our teleradiology program at the Gallup Indian Medical Center, where 45 percent of transfers could be avoided^{7,12}. Implementing this telehealth system in the state will improve efficiency by achieving wider access to effective neuro-emergent care, reducing health-care costs through appropriate resource management, and improving quality of care at the referral center due to timely expert consultation.



Unnecessary transfers of neuro-emergent conditions are common in the current practice environment. Hesitancy to care for these emergencies locally results from the lack of specialty care and practitioner knowledge — both physician and nurse — of cerebral emergencies. With telehealth and expanded provider education, we can bring neuro-specialty care to the bedside of every patient and enable regional hospitals to provide better service locally. This will save money, provide better health care, and result in better health for urban and particularly rural patients. The emergent transfer of non-operative mTBI can limit access for other patients who would more likely benefit from a neuro-intensive level of care.

The health of populations with limited access to health care is getting increasingly worse. One study assessing the patient's functional status following TBI found that rural TBI patients were more likely to be functionally dependent and report a lower health status than their urban counterparts¹³. This study also showed that financial constraints in accessing the health-care system is associated with this worse outcome. Racial and ethnic differences were also described by Gray et al.¹⁴ who said that post-acute care interventions specifically targeted at minorities should diminish the inequities of current treatment regimens. Post-acute TBI care also is an area where telemedicine could overcome disparity in this geographically and socioeconomically marginalized population and improve outcome.

Cost savings will play a major role in future medical decision-making. Although our study was not designed to evaluate cost-effectiveness, within one year 118 mild TBI patients were evaluated via teleradiology enhanced phone consultation by the on-call neurosurgeon. Because 45 percent of all transports to UNMH were prevented, the cost savings for transport alone totaled \$1,484,700 (based on a fixed wing air transport with an average cost of \$30,300 per transport.)¹⁵

Certain barriers to successful implementation of a teleradiology and telehealth system for TBI triage exists. Challenge number one is the reluctance of rural physicians to care for neuro-emergencies due to fear of poor outcomes. To overcome this barrier, we have addressed health-care providers' concerns and presented evidence-based research and local data mined from our track record with this work in New Mexico. Sometimes this approach is not enough to convince everyone. Because our trauma center provides 24/7 access to specialty consultation, it is important to reassure local physicians that should they later request patient transfer after deciding to observe a patient in a local hospital, there will be a place for that patient at the accepting hospital without delay. We postulate that adding audiovisual consultation with the specialist providing care may also make the local physicians and their patients and families feel more comfortable with local care management.

Challenge number two is medical-legal considerations. All providers involved in the telehealth system should be credentialed with each hospital where they provide telepatient care. Also a memorandum of understanding with every hospital has shown to further help clarify medical-legal concerns. Additionally, the ability to provide a written report of the recommendations to the referring hospital via the telehealth system (within minutes from completing the consults) provides back up for rural physicians, which will negate some of the medical-legal concerns we encountered.

Challenge number three is the lack of provider familiarity with neurological patients. Our experience has shown us that rural health-care providers feel inadequate to monitor and treat patients with neurological disorders due to lack of knowledge. To overcome this barrier, we provided intensive hands-on and Web-based education. Our experience is that nurses can become the strongest proponents when providing better care to patients, so local nurses should be the cornerstones of the educational plan.

Challenge number four is limited hospital resources. Standard of care demands that patients with many acute neurological disorders be admitted to monitored beds. The number of telemetry beds in small rural hospitals is almost nonexistent. Even at the tertiary referral center, it is often difficult to find a monitored bed for every patient needing truly emergent care, let alone for every mTBI patient. This is why we pioneered the observation unit in the UNMH Emergency Department, which has been shown to be safe and effective. Transforming ED beds to temporary observation units is one way to overcome the barrier to limited hospital resources. In addition, timely triage of patients with neurosurgical emergent conditions will free up beds and use limited resources more efficiently and effectively.

In the future telemedicine will be instrumental in overcoming health disparities in underserved areas because patients in rural areas often are triaged unnecessarily to referral centers, creating a financial burden to the health-care system and to patients and their families who often have to travel as many as four hours to be with their loved ones.

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continued on page 6

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The Misnomer and Muddled Miasma of Mild Brain Injury

Uzma Samadani, MD, PhD, FAANS; and Radek Kolecki

Once upon a time in a neurosurgical era not so very long ago, a negative CT after trauma to the head was cause for relief. The patient was deemed lucky, advice was doled by the emergency room doctor and the surgeon (blissfully unaware of the events transpiring in an ER only minutes away) stayed in the operating room with knife poised to treat “real” brain injury.

As the long-term sequelae of concussion are realized gradually, that era appears to have gone the way of the Gigli saw. Our colleagues, our patients, their families, schools sports teams, and other care collaborators are turning increasingly to the trauma neurosurgeon to participate in the care of and discussion about the physiologic impact of brain injury. The significance of non-structural injury was further emphasized by the Aug. 29, 2013, settlement between the National Football League and 4,500 former players and family members for \$765 million.

The 4th international Conference on Concussion in Sport in Zurich, 2012¹ defined several common features of concussion including the following: an impulsive force transmitted to the head that may or may not involve loss of consciousness and typically results in rapid onset of short-lived neurological impairment that resolves spontaneously. Symptoms commonly evolve over a period lasting up to several hours and the majority (80 to 90 percent) subside within a seven- to 10-day period following a sequential course. Concussions may lead to neuropathological changes, however, acute symptoms typically reflect functional rather than structural abnormalities and are therefore not identified in structural neuroimaging studies.^{2,3}

Subconcussion⁴ is used to describe sequelae of repetitive brain injury not necessarily associated with a memorable brain-injury event.

What concussion lacks in definition and diagnostics it compensates for with impact: the condition afflicts as many 3.8 million Americans per year^{5,6}, and thus extends far beyond the professional sports leagues. The numbers may be underestimated; an emergency room survey suggested more than 88 percent of concussions were unrecognized⁷.

Sequelae of concussion range from pure motor disorders to dementia and emotional lability⁸. There is a positive correlation between white matter abnormalities in patients with symptomatic mild traumatic brain injury (TBI) and the distribution of pathological abnormalities in patients with early Alzheimer’s dementia⁹. Damaged axons can serve as a large reservoir of amyloid-beta¹⁰, which has been considered a hallmark pathology for the diagnosis of Alzheimer’s, further implying that concussions may have significant long-term consequences that are not yet understood.

The consequences of concussion are sufficiently elucidated that it may be time to change the name. Mild brain injury, like slight pregnancy, is a condition that simply does not exist. It should be called non-structural brain injury, concussion or subconcussion.

Abnormal symptoms of concussion usually fall into four categories: cognition/memory, physical, emotional and sleep⁶. Hence

diagnostics and assessment batteries of severity are focused on these areas. One such test is SCAT3, which incorporates the Glasgow Coma Scale, Maddocks’ questions and the Standardized Assessment of Concussions (SAC) as well as a balance assessment¹¹. It is suggested that the subsets of the test be followed serially.

The American Academy of Neurology (AAN) and Robert C. Cantu, MD, FAANS(L), of Boston University formulated the two sets of guidelines most commonly followed in the U.S. The AAN recently amended its recommendation to state that athletes suspected of concussion be removed permanently from the game rather than temporarily removed for an on-site evaluation¹². Cantu’s earlier guidelines graded concussion on a scale from I to III of increasing duration for loss of consciousness (LOC) and post-traumatic amnesia¹³.

ImPACT, developed at the University of Pittsburgh, is a computerized neurocognitive assessment test. Despite its widespread use by sporting teams, it has been deemed “reliably unreliable”¹⁴ in a study evaluating whether athletes could attempt to manipulate their baseline cognitive capabilities which generally are assessed with preseason testing.

Another screening measure is the King-Devick Test (K-D Test), originally developed in 1976 as a two-minute “speed of reading” assessment for saccadic visual disorders. The K-D Test also requires a baseline to compare against, and thus is subject to volitional manipulation by the test subject with poor test-retest reliability¹⁵. King-Devick is now available as an iPhone and iPad application.

A hand-eye motor reaction-time test utilizing a hockey puck and dowel has been developed at the University of Michigan¹⁶. The test requires a baseline study to assess reaction time, which is assessed again when concussion is suspected.

Balance assessment is a standard component of the physical examination for concussion testing. A new iPhone application called Sway has been cleared by the FDA for balance assessment (<http://swaymedical.com/products/balance>). It also requires a baseline trial for comparison to post-injury.

Despite the high profile of sports-related concussion, only a tiny fraction of brain-injured patients are participants in organized sports or military personnel who have undergone baseline testing. The vast majority of concussion victims presenting to an emergency room did not anticipate an injury^{7,17}. Thus diagnostics not requiring a baseline pre-morbid assessment are necessary.

HeadSense (<http://head-sense-med.com/>) and Neural Analytics (<http://www.neuralanalytics.com/>) both have devices that measure intracranial pressure (ICP) via non-invasive ultrasound. Testing of these devices against conventional means of assessing ICP will assess their sensitivity and specificity. At least one of these companies is working on studies to determine whether concussion causes elevated ICP.

Silver Medical (<http://silvermedicalinc.com/>) is developing a

continued on page 8

technology that attempts to correlate spikes in nitrous oxide (NO) level with brain injury. Since it is unknown whether NO levels in the blood are altered after concussion, the company is currently in the process of fund-raising for trials with an animal concussion model.

Eye movement tracking for the detection of concussion has been championed by Jamshid Ghajar, MD, PhD, FAANS. His technology is being developed by the company SyncThink (<http://syncthink.com/>), and assesses smooth pursuit eye movements in conjunction with motor activity to assess cognitive integrity.

Eye movement tracking to detect disconjugate gaze associated with structural and non-structural brain injury is being developed by the company Oculogica, based on technology developed at New York University.

Until concussion is detectable and quantifiable it may be difficult to quantitate the success of any potential treatment; nonetheless a clinicaltrials.gov website search revealed that at least 54 proposed treatments for concussion are being explored in human trials (as of Sept. 8, 2013).

Potential therapeutics include hypertonic saline, metoclopramide, progesterone, ondansetron, atorvastatin, sildenafil, citalopram, melatonin, DHA (docosahexanoic acid), selective serotonin reuptake inhibitors (SSRIs), bromocriptine, gabapentin, magnesium sulfate, and the branched chain amino acids (BCAA) leucine, isoleucine and valine. Other treatments being trialed are hyperbaric oxygen therapy, wavelength one bright lights, phototherapy with lasers and mandated rest.

Among the questions going forward are the following: How does one demonstrate that any given person's woes are not the sequelae of their previous brain injury? Young people exhibit emotional lability and rash behavior with greater frequency than their more staid, myelinated and less neuroplastic elders; when is a suicide the consequence of mild TBI, and when is it not?

An anecdotal, informal and completely unscientific survey of neurosurgical colleagues reveals that at least one-third have had a concussion at some point in their lives; some had several; many played and still play ice hockey and football. Yet, again anecdotally, these people all seem highly functional and perhaps even hyper-functional (at least one that I know of performs functional neurosurgery). Thus clearly not all concussions have adverse sequelae in all people. In our own prospective study of concussion currently being conducted in the emergency room of Bellevue Hospital in New York City, we are using SCAT3 to assess concussion severity. While it may or may not be accurate for predicting who will have post-concussive syndrome, we can predict with virtually 100 percent sensitivity who is involved in post-concussive litigation.

Thus the concussion discussion is laden with obfuscating distracters and confounders. Objective measures for detection are needed to obtain clarity in our approach to problem. If the first step in solving a problem is admitting that you have one, the term "mild" hardly begins to encompass the complexities of the condition we are encountering.

Disclosure:

Uzma Samadani, MD, PhD, FAANS, owns intellectual property related to eye tracking diagnostics for brain injury, and equity in the company Oculogica, which is discussed in this article.

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