

CONCUSSION: NOT SO MINOR AN INJURY

Incidence, Pathophysiology, Risks and Management

JON E. BENTZ, PH.D.

Lancaster General Behavioral Medicine and Neuropsychology



INTRODUCTION

We have previously provided an up-to-date review of the incidence, pathophysiology, risks, and management of mild traumatic brain injury (MTBI) with cerebral concussion and complicated recovery.¹ Across the country there is increasing recognition of the need to be vigilant in facilitating recovery after MTBI. In response to the risk of second impact syndrome, the Washington state legislature recently passed a bill stating that no athlete can return to play until cleared by a licensed health care provider. Pre-play baseline assessment of neuropsychological function for high school, college and professional athletes is becoming the norm rather than the exception. The most widely used neuropsychological screening tool that is focused on concussion is ImPACT (Immediate Post-Concussion Assessment and Cognitive Testing), developed at the University of Pittsburgh School of Medicine. ImPACT is now used by all National Football League, Major League Soccer and Major League Baseball teams; all MLB umpires; the USA Olympic Training Center; USA Hockey and the U.S. Women's Olympic Ice Hockey team; U.S. Soccer Federation; the U.S. Ski Team; Championship Auto Racing Teams and the Indianapolis Racing League; more than 300 colleges and universities, and more than 1,000 high schools nationwide.

MTBI (MILD TRAUMATIC BRAIN INJURY) IN COMBAT VETERANS

In our initial article we briefly mentioned the incidence of MTBI in combat forces returning from Iraq and Afghanistan. The U. S. Department of Defense is engaged in considerable research on the impact of MTBI and has instituted a concussion screening program for returning combat troops. While an estimated 20% of injured combat veterans in past wars sustained traumatic brain injuries, the Defense and Veterans Brain Injury Center at Walter Reed Army Medical Center has estimated that more than 60% of injured troops returning from Iraq may be afflicted. The increased rate of TBI has been attributed to a combination of the prevalence of IEDs, and the development

of body armor that saves lives by protecting the torso but not the brain. Blast injuries, in the absence of personnel being knocked to the ground or sustaining shrapnel wounds, result from atmospheric pressure changes causing organs and tissues of different densities being accelerated at different rates, which creates stretching and shearing forces.² Comparative animal studies have demonstrated inflammation of neuronal cells from milder blasts, which has stimulated research on the possible benefit of using anti-inflammatory medications acutely to attenuate post-concussive sequelae. While military studies generally point to a good prognosis for those who sustain concussions, military medical researchers have also emphasized the need for early detection, neuropsychological assessment, and intervention, to optimize recovery.³ An increased risk of posttraumatic stress disorder (PTSD) has also been observed among soldiers with MTBI. Those who experienced loss of consciousness were significantly more likely than soldiers with other injuries to report poor general health, missed workdays, medical visits, and a high number of somatic and postconcussive symptoms. Of those reporting injuries with associated loss of consciousness, 43.9% met criteria for PTSD. This number contrasts with the 27.3% of those reporting no loss of consciousness but with altered mental status; 16.2% with other injuries; and 9.1% with no injuries.^{4,5}

A SOURCE OF CONTROVERSY

In routine medical evaluations of military veterans, it would seem important to obtain an adequate history of exposure to explosive detonations. After our original article appeared, the *New England Journal of Medicine* published an article authored by military personnel which implied that the estimates by the Department of Veteran Affairs of the prevalence of MTBI in combat veterans may be highly overstated, and that nonspecific symptoms may be due to other psychiatric disturbances, to PTSD, or to substance abuse.⁶ They appropriately pointed to the less than rigorous use of surveys in identifying those who sustained possible MBTI, and they recommended a change in the screening process.

But though the screening currently being performed is less than the gold standard, and has the potential for a high number of false positives, we must be cautious not to throw out the baby with the bathwater. The implications of the NEJM article have been challenged by Army Brig. Gen. Loree Sutton, head of the Pentagon's Centers of Excellence for Psychological Health and Traumatic Brain Injury, as well as by the civilian scientific community. Ibolja Cernak, a brain-injury scientist at Johns Hopkins University Applied Physics Laboratory, referred to the article as offering a "narrow-minded and biased perspective."

THE ROLE OF IMAGING STUDIES

We did not mention the possible relevance of imaging studies in the assessment and treatment of MTBI in our original article. While traditional brain imaging techniques such as MRI and CT scans do not reliably identify subtle anatomical correlates of MTBI and are of no particular value, Functional MRI (fMRI) might have some utility in the evaluation of concussed individuals. A five-year study funded by the National Institutes of Health confirmed prior research which indicated neurophysiological abnormalities after even "mild" concussions. Furthermore, a relationship was observed between fMRI, patients' neuropsychological test performance, and subjective symptoms.⁷

HELMETS

Finally, we would be remiss if we did not comment on the need for increased attention to prevention of TBI. Lancaster General currently participates in the "Think First" program, which provides education to the community on strategies to reduce the risk of injuries to the head and spinal cord. The benefit of wearing proper helmets when engaging in sports should be properly understood and appreciated. The recent death of Natasha Richardson underscores the importance of prevention and proper management of traumatic brain injury. Bicycle helmets have been shown to reduce the risk of head injury by 85%, brain injury by 88%, and severe brain injury by 75%.⁸ The Crash Outcome Data Evaluation System (CODES) study found that motorcycle helmets are 67 percent effective in

preventing brain injuries and that unhelmeted motorcyclists involved in crashes were three times more likely to suffer brain injury than those using helmets.⁹ Unpublished data have revealed similar benefits for helmets in preventing brain injuries in skiers.

PROGRAMS FOR MTBI AT LANCASTER GENERAL

The Lancaster General Healthcare Foundation recently awarded a grant to the Psychology service to develop and establish a MTBI program. Assessment of neurocognitive functioning remains the gold standard for evaluating the presence of postconcussion sequelae and readiness to return to one's usual activities. To that end we will be utilizing instruments that assess higher order attention, memory, brain processing speed, reaction time, and post-concussive physical symptoms. Student athletes from the school districts of Lancaster will be the primary focus of this program. This funding will allow us to:

- a. Provide pre-play baseline and post concussion neuropsychological evaluations for student athletes who are at risk of sustaining cerebral concussions;
- b. Provide assessment and treatment services to individuals who sustain cerebral concussions;
- c. Offer direction and guidance to patients, families and caregivers, schools, coaches, trainers, student athletes and their parents, employers, and medical personnel regarding return to play, school, and work post concussion;
- d. Serve as a resource to the community, offering neuropsychological and case management services regarding mild TBI/concussion.

While the majority of individuals recover quite well from MBTI, there remains a significant percentage that does experience less than complete or protracted recovery. Early and appropriate post-concussion screening of individuals may also lead to avoiding those rare but catastrophic occurrences of second impact syndrome that typically results in permanent neurological deficit or death. Furthermore, appropriate evaluation and treatment might prove to decrease the morbidity that may result later in life from earlier multiple concussions.

REFERENCES

1. Bentz JE, Purzycki EJ. Concussion: Not So Minor an Injury; Incidence, Pathophysiology, Risks, and Management. *J Lanc Gen Hosp*. 2008;3:84-90.
2. Katherine H, Taber KH, Warden DL, Hurley RA. Blast-Related Traumatic Brain Injury: What Is Known? *J Neuropsychiatry Clin Neurosci*. 2006;18:141-145.
3. Ivins BJ, Kane R, Schwab KA. Performance on the Automated Neuropsychological Assessment Metrics in a Nonclinical Sample of Soldiers Screened for Mild TBI After Returning From Iraq and Afghanistan. A Descriptive Analysis. *Journal of Head Trauma Rehabilitation* 2009;24:24-31.
4. Terrio H, Brenner LA, Ivins BJ, Cho JM, Helmick K, Schwab K, Scally K, Bretthauer R, Warden D. Traumatic Brain Injury Screening:

Preliminary Findings in a US Army Brigade Combat Team. *Journal of Head Trauma Rehabilitation* 2009;24:14-23.

5. Hoge CW, McGurk D, Thomas JL, Cox AL, Engel CC, Castro CA. Mild Traumatic Brain Injury in U.S. Soldiers Returning from Iraq. *NEJM* 2008;358:453-463.

6. Hoge CW, Goldberg HM, Castro CA. Care of War Veterans with Mild Traumatic Brain Injury—Flawed Perspectives. *NEJM* 2009;360:1588-1591.

7. Lovell MR, Pardini JE, Welling J, Collins MW, Bakal J, Lazar N, Roush R, Eddy WF, Becker JT. Functional Brain Abnormalities are Related

to Clinical Recovery and Time to Return-to-Play in Athletes. *Neurosurgery* 2007;61:352-360.

8. Thompson DC, Patterson MQ. Cycle Helmets and the Prevention of Injuries. Recommendations for Competitive Sport. *Sports Medicine*. 1998;25(4):213-219.

9. US Department of Transportation. NHTSA. The crash outcome data evaluation system (CODES). Technical Report Number HS 808 338. January 1996.

Neither Dr. Bentz nor any member of his immediate family have any relevant relationships to disclose with any

corporate organizations associated with the manufacture, license, sale, distribution or promotion of a drug or device.

Jon E. Bentz, Ph.D.
Lancaster General NeuroCenter
Lancaster Behavioral Medicine
2100 Harrisburg Pike
Lancaster, PA 17604
717-544-3172
jebentz@lancastergeneral.org