According to the U.S. Department of Defense, traumatic brain injury is one of the signature injuries of troops wounded in Afghanistan and Iraq. Twenty-five percent of all military members evacuated from these conflicts reported head and neck injuries, including severe brain trauma.

TBI is the result of a blow or jolt to the head or a penetrating head injury that disrupts normal brain function. Severity rating is identified upon injury and is defined as mild, moderate or severe. More than 357,000 service members worldwide have been diagnosed with TBI since 2000 with 82.3 percent of cases categorized as mild TBI, also known as a concussion. mTBI is usually not life-threatening; however, the high rate of TBI and blast-related concussion events resulting from recent combat operations directly affects the health and safety of service members and subsequently the level of unit readiness and troop retention.

Current Diagnostic Methods

TBI and mTBI can be difficult to diagnose. Medical assessment usually includes a neurological exam; a typically painless exam that includes an evaluation of thinking, motor function, sensory function, coordination and reflexes. Such tests are widely used but do not definitively diagnose mTBI. MRI and computerized tomography imaging scans are not usually suggested for patients with mTBI because these scans do not typically exhibit structural brain damage, generally coming back normal. However, mTBI occurs when the brain is subjected to forces that are strong enough for axons to fray and sever, resulting in physical symptoms such as trouble remembering things or thinking clearly. Therefore, doctors often diagnose concussion based on commonly demonstrated physical symptoms including headaches, dizziness, changes in vision or balance and problems with attention or memory.

Advances in Diagnostics Research

Tau

Researchers are looking for indicators called biomarkers that help identify concussions. Ideally, the biomarker would be a protein or byproduct of the injury that doctors would be able to detect in a simple test of a patient’s blood or saliva. In January 2017, researchers at the National Institutes of Health determined that the blood protein tau could serve as such a biomarker. In a study of collegiate athletes, a baseline was established in the preseason using blood plasma sampling and cognitive testing. Following a concussion diagnosis, an increased tau concentration was present in the blood of concussed athletes as compared to their respective baseline. Additionally, athletes who took longer to return to play had higher levels of tau in their blood in the hours following the trauma than players who were cleared to return to the field sooner. Likewise, tau protein concentration could also be used to indicate service member concussion recovery time and when the individual could safely return to activity.

Quantitative Electroencephalography Technique

A Maryland-based company developed a new technology for detecting signs of a concussion in a person’s brain waves. The test employs a disposable headset with sensors that record electrical signals that are analyzed by a smartphone application. Referred to as quantitative electroencephalography, this test is based on traditional EEG monitoring methods but employs algorithms in lieu of visual inspection in order to identify irregularities associated with the pathology of brain injury that may have otherwise gone unrecognized.

Blast Load Assessment Sense and Test

The Office of Naval Research is sponsoring the development of a portable, three-part system, called Blast Load Assessment Sense and Test, that measures blast pressure, establishes injury thresholds for the brain and analyzes potential TBI symptoms. The system uses coin-sized sensors that are tough enough to survive an explosion, can be worn on helmets/body armor and are able to record blast pressure. A pressure threshold number can be specified that would identify individuals at risk for TBI and needing to stand down for more advanced testing or medical care, minimizing the chance of someone enduring multiple blasts and suffering more serious brain injury. The system should be tested on field mannequins within the next year and a half and then by Marines completing breacher training.
Rapid Cavitation Bubble Collapse

Researchers from Brown University and the University of Michigan are exploring the mechanics of cavitation-induced injury to gain a better understanding of blast traumatic brain injuries. [13] The team uses a laser, an optical microscope and rat neurons inside a gel-like substance to mimic brain tissue to examine bTBIs. [13] The team aims to begin bridging the gap between the mechanics of blast traumatic brain injury and cell damage. [13]

optical microscope, a high-speed camera captures the laser creating a bubble, the bubble breaking and the damage this causes to the neurons. [13] This method allows them to see the injury history of the cells within cultures.

Quantifying temporal injury history is essential to understanding, diagnosing, and working toward informed treatment of bTBI. This research aims to begin bridging the gap between the mechanics of blast injury and cell damage. [13]

REFERENCES


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