A blood test for concussion?

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Concussion, pervasive in most sports, epidemic in contact contests, affects millions of individuals ranging from youth sports through professional athletes. Those who routinely see patients with sports concussion rely predominately on patient-reported symptoms and a thorough neurologic examination to ascertain the extent of injury and prognosis. Although neuropsychological assessments are helpful, no other routine testing, including conventional neuroimaging, is useful in answering many basic questions regarding the clinical evaluation and management of concussion, let alone determining the severity of CNS damage.

The neurometabolic and pathophysiological changes following concussion, a subset of traumatic brain injury, have been summarized and include axonal damage due to linear and rotational forces. However, there is still more to understand regarding cellular and biochemical change to the brain over time, whether it is one or more concussions or repeated subconcussive trauma. Why do some individuals rapidly recover after a concussion while others have more prolonged neurologic or psychologic issues? When is the ideal time to let an individual increase activity and return to play? After concussion, it would be clinically important to have a marker to predict severity and recovery.

There are several biomarkers that are elevated in CSF after traumatic brain injury, including neurofilament light polypeptide (NFL), which is abundant in large-caliber myelinated axons. This is the main breakdown product when axons are injured and may be the most sensitive biomarker of axonal injury. Studies of amateur boxers have shown a positive correlation between the number and intensity of head blows and CSF NFL levels. Although NFL seems to correlate well with the extent and severity of an injury to the brain, obtaining CSF samples in athletes is difficult, especially if done serially. To date, no serum biomarker reflecting sports-related traumatic brain injury has been accepted for routine clinical use. Serum NFL is a promising candidate, as demonstrated recently.

In this issue of Neurology®, Shahim et al. have produced interesting findings. They measured CSF and serum NFL in 14 amateur boxers. Serum and CSF levels correlated and were elevated after the bout, lowering by 3 months, but not returning to control levels. Boxers who had a greater number of hits generally had higher levels of NFL than those who had fewer hits to the head. In addition, serum NFL in 35 professional ice hockey players measured 1, 12, 36, and 144 hours after the diagnosis of concussion were elevated and then returned to normal by resumption of play. Those athletes with rapidly resolving postconcussive symptoms had lower levels than those with persistent symptoms.

These findings suggest that NFL is a sensitive serum biomarker for concussion, correlating somewhat with level of injury, symptoms, and recovery. Admittedly, the number of athletes in this study was small and correlation with larger numbers of athletes in different sports, of differing age, race, and sex, will be interesting to study. Video correlation of the number of hits that a boxer took to the head might be more accurate than only a post-bout interview, since athletes notoriously over or under call symptomatic history. In addition, embedding an accelerometer or similar head impact measurement device into an amateur boxer’s or icer’s headgear might provide correlative data regarding the forces involved with any hit to the head. Correlating serum NFL levels with changes on advanced imaging techniques, such as diffusion tensor imaging, should provide additional information regarding axonal injury. It will be important to map out the typical serum rise and degradation of NFL in order to fully optimize when levels should be drawn for diagnosis or prognosis.

Although the clinical importance of NFL can be debated at this time, this study represents an important step in developing a useful serum biomarker for brain injury. Anyone who routinely evaluates and treats individuals with sports (and other) concussion would welcome a simple, cost-effective serum test that could ascertain if clinically significant head trauma occurred as well as help with prognosis and recovery.

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REFERENCES