PATIENT PAGE

Can We Measure Brain Injury With a Blood Test?

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Related Article

Association of Plasma Biomarker Levels With Their CSF Concentration and the Number and Severity of Concussions in Professional Athletes

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In their article "Association of Plasma Biomarker Levels With Their CSF Concentration and the Number and Severity of Concussions in Professional Athletes," Dr. Pashtun Shahim and colleagues[1] compared the blood and CSF levels of several biomarkers (or clinical signs) of head injury. Their idea was straightforward. By comparing CSF levels with blood levels, they wanted to determine whether markers of head injury could be reliably measured using a blood test.

Background

The brain and spinal cord (known together as the CNS) are walled off from the rest of the body. This wall is called the blood-brain barrier (BBB). It allows small molecules (such as sugar) to pass through but prevents larger molecules (such as most proteins) from going from the body into the brain (or vice versa). The BBB provides important protection—it prevents infections and foreign substances from getting into the most important organ of our body: the brain.

When a person has experienced a severe brain injury and/or multiple brain injuries, there is greater potential for damage to the BBB. In athletes, there has been increasing attention to head injuries, concussions, and repeated head injuries (RHIs), all of which cause repeated damage to the BBB and to the brain itself. RHIs and more severe brain injuries result in longer lasting neurologic problems. One such problem is called postconcussive syndrome (PCS), which can last for weeks, months, or even years. Common symptoms of this condition include changes in behavior, mood, thinking, and memory.

The undamaged intact BBB is impenetrable to many things. Most bacteria and viruses cannot cross it. In addition, large molecules cannot pass through this barrier. However, if the wall is broken or damaged, the brain becomes more vulnerable to attack by viruses and bacteria. Proteins that normally cannot cross this wall can also leak through a damaged BBB. Because of this, the damage to the BBB that occurs when a person experiences a serious head injury significantly raises their chances of developing conditions or complications because of foreign substances crossing over the BBB. This is a 2-way street: damage to the BBB also allows certain proteins that are primarily found in the brain (which we could call brain proteins) to cross over into the blood.

There are several well-studied brain proteins. T-tau is a protein found in the axons or the cable-shaped part of nerve cells in the brain. Glial fibrillary acidic protein (GFAP) is a protein mainly found in glial cells. Glial cells are not nerve cells, but they are very important: they support and help neurons. Amyloid is an abnormal protein that is found in many CNS illnesses and diseases, such as Alzheimer disease. Regarding serious and RHIs, studies have shown that these proteins are abnormal in the CSF. However, very few studies have looked at the levels of these proteins in blood samples. The goal of the study conducted by Dr. Shahim was to look at the levels of these proteins in the CSF and serum in athletes who had experienced severe brain injury to determine whether such tests can help determine the seriousness of a brain injury.

How Was the Study Performed?

A group of professional athletes were enrolled in the study between September 2014 and June 2016 at the Sahglrenska University Hospital in Sweden. There were 28 athletes who had previous head injuries. These individuals were compared with 19 athletes who had no previous brain injuries. The injured athletes were older than 18 years, otherwise healthy, and had experienced postconcussive symptoms for more than 3 months. The comparison group (uninjured athletes) included those older than 18 years, otherwise healthy, and had experienced no previous head injuries.

Both groups agreed to undergo blood and CSF tests. In the injured athletes, the degree of previous brain injury was assessed using several standard tools. These tools took into account many factors, such as the severity of the concussion, the duration of the postconcussive symptoms, and whether the athlete had needed to retire from play due to their injuries.

Most (19/28) of the injured athletes experienced postconcussive symptoms that persisted for more than 1 year. All these individuals had retired from play. In 9 individuals, the symptoms lasted for less than 1 year, and they returned to playing sports.

What Did They Find?

First, Dr. Shahim and colleagues compared the levels of T-tau, GFAP, and amyloid proteins in the CSF and blood samples taken from the study participants. They found that there was no correlation when measuring T-tau or amyloid proteins. The levels of GFAP in serum did correlate with the levels found in CSF. However, when the researchers compared the injured with uninjured athletes, there was no difference in the serum samples. T-tau, GFAP, and amyloid protein levels in the serum were the same in both groups. Because of this, the researchers concluded that serum concentrations of these proteins would not be helpful in the diagnosis of repetitive head injuries.

Why Is This Important?

In many sports, the assessment of a head injury begins on the field, right after the injury occurs. A brief physical and neurologic examination is conducted on the spot. The injured athlete is asked many questions to determine whether the head injury caused problems such as loss of awareness or confusion. In other words, much of the assessment is subjective. There are few objective measures for determining the severity of a head injury. If a simple and accurate test for the severity of a head injury (such as a blood test) could be developed, it could be performed quickly and easily on any athlete. It could aid in diagnosis and could potentially identify athletes who are at the highest risk for PCS. If such a test was available, it might help reduce the risks associated with RHIs, possibly preventing long-term neurologic consequences of serious head trauma.

About Concussion

What Is a Concussion?

A concussion is a brain injury caused by a blow to the head. Common symptoms of a concussion are headache, loss of memory, nausea, vomiting, and dizziness or vertigo. Ringing in the ears, confusion, slurred speech, and problems with balance and coordination can also occur.[2] Concussion is able to occur because the brain is essentially floating in a layer of fluid in the skull—when a person experiences a blow to the head, the brain moves inside the skull (in this fluid layer), and concussion occurs when the brain moves enough to collide with the inside of the rigid, hard skull.

In most instances, the symptoms of a concussion are temporary. They can resolve in hours or days. In most people, concussion symptoms go away in fewer than 10 days. However, in some people, and with more severe head trauma, the symptoms can persist for weeks, months, or even years. When the symptoms last weeks (or longer), this is called PCS.

Although even a single head injury can cause serious problems, the situation worsens with RHIs. Recent studies have shown how this affects people, especially athletes who have had multiple head traumas. For instance, 1 study of 37 professional soccer players found that 81% of those studied were experiencing problems with attention, concentration, memory, and judgment.[3] In another study using CT scans of 33 former professional soccer players, brain atrophy was found to have occurred in one-third of the players who were studied.[4]

Treatment of Concussion

When a mild concussion occurs, the most common treatment is rest. Over-the-counter pain medication may help with mild headache resulting from a concussion. It is very important for a person who has had a concussion to visit a doctor so the symptoms can be diagnosed, assessed, and reassessed. If the symptoms resolve, the person can often resume all the usual activities.

By contrast, severe head injuries require urgent, immediate attention. Medical testing such as a CT scan or an MRI may be needed. Hospitalization may be required to assess the severity of the injury, to observe the person closely, and to begin necessary treatments. For instance, if seizures occur, they may need to be treated. In addition, bleeding within the brain could occur and may require surgery.

The best treatment of head injury is prevention. Seat belts prevent many types of injury including brain trauma. Helmets prevent bicycling injuries. Wearing a proper athletic protective gear can be the difference between a mild and severe head injury. In older adults, measures that prevent falls are critical in preventing traumatic brain injury.

For More Information

Brain & Life
brainandlife.org

Concussion Legacy Foundation
concussionfoundation.org

Brain Trauma Foundation
braintrauma.org

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