Biomarkers for Concussion Detection

Jillian Holden, Biomedical Engineering, University of Rhode Island

BME 281 First Presentation, November 3, 2015 <jillian_holden@my.uri.edu>

Abstract—Concussions have become the inevitable, especially for competitive athletes, and can be detrimental to one’s health if not detected early. By using a new experimental method of testing the blood for certain biomarkers, concussions can be detected quickly and more effectively.

I. INTRODUCTION

Concussions (also known as mild traumatic brain injury; mTBI) affect a significant amount of athletes each year, and many times go undiagnosed. [1] If not identified and treated early, mTBI can lead to serious health consequences including headaches, impairment of cognitive ability and more. [1] It has been discovered that during mTBI certain biomarkers, including the protein S100-B, pass through the usually impenetrable blood-brain barrier and leak into the circulation of the blood stream. [1] As a result of this property, new research studies the ability to measure the concentration of these proteins in the blood stream and determine whether or not this level is indication of a concussion.

II. METHODS

Mild traumatic brain injuries occur as a result of a blow to the head, which pushes the brain against the inside of the skull leaving bruising and possible nerve damage. [2] In most cases of mTBI the brain will heal completely within two weeks, however if a player were to return to play after a serious blow, unaware of a concussion, there could be serious long-term nerve damage. [3] To avoid this long lasting damage, a concussion must be detected and treated as soon as possible. New research studies the correlation between a concussion and the concentration of a protein S100-B present in the blood. When elevated concentrations of S100-B, a calcium binding protein, are found in the blood stream this indicates that the brain’s protective barrier has been disrupted and there has been some degree of trauma to the brain. [2] This is due to the fact that trauma results in the damage of astroglial cells, which simultaneously releases the calcium binding protein S100B. [2] When released, these proteins can be found in cerebrospinal fluid (CSF), saliva and blood. [1] The easiest way to test for S100-B is by taking a blood sample and centrifuging it in order to obtain the plasma and extract the protein. [1]

III. RESULTS

One study consisted of forty-seven professional male hockey players on two Swedish hockey teams. [4] Each of the forty-seven players gave a baseline blood sample and thirty-five of these players sustained a concussion during the season, requiring a second blood test evaluation. [4] The blood sampling occurred repeatedly at 1, 12, 36, and 144 hours after the injury and also when they returned to play. [4] The concentration of S-100B as well as other proteins including total tau and NSE were all compared. [4] The results showed that the protein S-100B was significantly elevated in the concussed individuals, and the highest concentrations of the protein was found in the sample taken immediately after the injury. [4] This data verifies that the concentration of these biomarkers can be used as a valuable tool for the detection of sports-related concussions. [4]

IV. DISCUSSION

One challenge with this technology is the difficulty of distinguishing the concentration of S100-B associated with a concussion, as it has been found that S100-B can also be released as a result of vigorous, non-impact, physical activity. [1] However, with continued research and development this method of concussion detection could be revolutionary, especially in the field of competitive sports. While there are current technologies for concussion detection such as CT scan, these are not always readily available and can be costly. [1] A blood test, such as those aforementioned, could be administered on the sidelines by a certified athletic trainer, would only cost about twenty dollars, and could detect a concussion within forty minutes to an hour. [1] This research could change the way concussions are handled in sports and also save many athletes from poor health outcomes as a result of return to play with an undiagnosed concussion.


[4] Shahim, Pashtun, Yelverton Tegner, David H. Wilson, Jeffrey Randall, Tobias Skillbäck, David Pazoski, Birgitta Kallberg, Kaj Blennow,