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ScienceDirect
Journal of Sport and Health Science 3 (2014) 307–313
www.jshs.org.cn

Review

Concussion management in soccer

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Received 20 April 2014; revised 3 June 2014; accepted 3 July 2014
Available online 7 August 2014

Abstract

Brain injuries in sports drew more and more public attentions in recent years. Brain injuries vary by name, type, and severity in the athletic setting. It should be noted, however, that these injuries are not isolated to only the athletic arena, as non-athletic mechanisms (e.g., motor vehicle accidents) are more common causes of traumatic brain injuries (TBI) among teenagers. Notwithstanding, as many as 1.6 to 3.8 million TBI result from sports and recreation each year in the United States alone. These injuries are extremely costly to the global health care system, and make TBI among the most expensive conditions to treat in children. This article serves to define common brain injuries in sport; describe their prevalence, what happens to the brain following injury, how to recognize and manage these injuries, and what you can expect as the athlete recovers. Some return-to-activity considerations for the brain-injured athlete will also be discussed.

Keywords: Concussion; Football; Futbol; Injury management; Mild traumatic brain injury; Soccer

1. Introduction

Soccer is the most popular sport in the world, with participation exceeding 265 million people.[1] Although not considered a full contact sport like American football or ice hockey, collisions frequently occur in soccer between players. It is not uncommon for ball and object (goalposts) to collide with players. These collisions often lead to injuries including concussions. The general epidemiology of soccer-related concussions is unknown. In the American collegiate setting, men's and women's soccer trails only American football with regard to concussion injury rates,[2] and concussions in soccer accounts for approximately 5% of total injuries in any given collegiate season.[3] It is reported over 50,000 concussions occur annually in men's and women's high school soccer alone in the United States.[2] Concussion in high school women's soccer has been reported at a rate of 3.4 injuries per 10,000 athlete exposures, trailing only high school football, men's ice hockey, and men's and women's lacrosse.[4]

It has traditionally been thought concussions in soccer occur from player to player collisions involving the upper body of the involved players.[5] This has led to the adoption of stricter enforcement policies amongst soccer governing bodies in regards to elbow, arm, and head to head contact. It should be noted, however, more recent research has suggested almost one third of soccer related concussions occur after a player deliberately strikes the ball with their head.[6] This is alarming as heading is an important soccer skill and is employed up to 800 times in a single season at the professional level.[7] Due to the prevalence of concussion and

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Peer review under responsibility of Shanghai University of Sport.

http://dx.doi.org/10.1016/j.jshs.2014.07.005

collision nature of soccer, it is imperative for coaches at all age levels to understand the basic principles of proper concussion recognition and management.

2. Definition of concussion

The most common type of sports-related traumatic brain injury (TBI) is cerebral concussion. Although the term concussion is widely used, there is no universally agreed upon definition of concussion. Despite this, concussions are often defined as a brain injury, induced by biomechanical forces, which results in a complex pathophysiological process affecting the brain. Additionally, the resulting clinical, pathological, and biomechanical features of the injury are often used to define concussion. Concussions are the result of forces transmitted to the head, through direct contact with the head, face, chest or elsewhere on the body. In soccer, another player, the ground, the goal post or the soccer ball itself can create these concussive forces. Concussions often result in rapid, but short-lived, impairment of neurological function. These clinical symptoms are often the result of functional disturbances and not structural injury. Thus, traditional imaging modalities (e.g., magnetic resonance imaging (MRI) or computed tomography (CT) scans) often result in negative findings when diagnosing a soccer player with concussion.[8]

Concussions are a form of diffuse brain injury, such that concussive injuries result in widespread disruption of neurologic functioning. A severe type of diffuse brain injury involves damage to the neuronal axons, which may lead to deficits in cognitive functioning such as difficulty remembering or concentrating. In its most severe form, diffuse axonal injury can result in the disruption of brainstem centers responsible for heart rate, breathing, and consciousness.[9,10] However, even with this information in mind, it is important to understand that concussive injuries rarely result in sudden death. Additionally, the overwhelming numbers of concussions do not result in a loss of consciousness (LOC). More typically, concussive injuries catalyze a neurometabolic cascade in the brain. It is through this combination of axonal injury and neurometabolic dysfunction that gives rise to the common signs and symptoms associated with concussion.

3. Signs and symptoms of concussion

There are many signs and symptoms associated with concussive injuries. Signs of concussion are those deficits that can be observed by other individuals, specifically medical personnel. Concussive symptoms are deficits that we rely on the athlete to report to us. A non-exhaustive list of common concussion signs and symptoms are as follows: headache, nausea, dizziness, vision problems, difficulty concentrating, changes in sleep patterns/drowsiness, emotional changes (irritability, sadness), sensitivity to light/noise, LOC, amnesia (retrograde and/or anterograde), unstable walking/balance problems, general confusion/disorientation, difficulty remembering, vomiting, combativeness, and/or changes in behavior/personality. While these signs and symptoms are some of the more common deficits post-concussion, it is important to understand that these signs and symptoms 1) are not specific to only concussion, 2) do not all have to be present in order for a concussion diagnosis to be made, and 3) should prompt immediate removal of an athlete from play until such time as they can be evaluated by a medical professional.

LOC and amnesia are often thought to be common indicators of concussive injuries, but in reality do not adequately represent the complexity of concussion. LOC occurs in less than 10% of all concussive injuries.[11] Amnesia, along with confusion, is considered to be a hallmark of concussion and may appear directly after the trauma or have a delayed onset.[12] While LOC and amnesia are relatively rare, these signs may be indicative of more serious brain injury,[13] and athletes experiencing these signs should be further evaluated to rule out more severe and potentially catastrophic brain injuries. Headache, balance problems, and slow mental processing are the most frequently reported concussion symptoms.[14,15] Approximately 85% of concussed athletes report a headache after injury, while 77% report symptoms of dizziness and balance problems.[15]

Concussive symptoms are an individualized phenomenon, meaning that the number and severity vary greatly between individuals and are influenced by many factors. While most athletes report symptoms at the time of injury, it can take several hours after injury for some athletes to feel the onset of symptoms.[8,13,15] Therefore, athletes should be monitored carefully during the acute stages of injury in order to properly identify and manage delayed symptoms. While there have been no obvious differences in pre-injury symptom reporting between males and females,[16] women typically report a higher frequency and overall symptom severity post-concussion.[17] Lastly, many concussive symptoms are similar to those of attention deficits disorders, anxiety, or depression. Individuals with pre-existing mental health disorders should be monitored carefully because concussions may exacerbate those symptoms. All of these factors relating to concussive symptoms are important and may play a role into predicting recovery. While complex, referring the players you suspect of having sustained a concussion to the appropriately trained medical professionals in your jurisdiction will help you better care for your athletes.

4. Concussion recognition

The first step in caring for athletes suffering a concussion is recognizing the injury has occurred. Unless the athlete experienced LOC, recognizing a concussion may be a challenging task. It is likely that the athlete will appear dazed, dizzy, and disoriented following a concussion. In more obvious injuries, coaches and other personnel may recognize that the athlete is having difficulty standing on his or her own, or that they are unable to properly follow instructions (e.g., what play to run, or what position to be in). In cases where there are no obvious signs of concussion and the athlete does not immediately report or recognize symptoms, it is possible for concussions to go undiagnosed at the time of injury. To minimize this risk, it is imperative for coaches to be well educated about concussion signs and symptoms, in hopes of being able to recognize them