

Concussions in Sports: Diagnosis, Treatment, Management, and Perception

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Concussions and head injuries are profound facets of sports and are complicated pathophysiological processes affecting the brain, caused by a traumatic force. Concussions typically involve short-lived impairment of neurologic function and a graded set of clinical symptoms. Diagnosis is difficult because of complexity and usually requires a multidimensional approach. Management of a concussion requires a gradual, multistep process, involving baseline testing, postural stability testing, and neurocognitive examination. Recent research has given some insight into the long term damage of brain trauma in sports and has placed concussions in the forefront of the public's perception. Young athletes as well as athletes with prior history of concussions are at a higher risk for postconcussional syndrome. Research advancements and increased awareness suggest promise for the coming decade in concussion research, prevention, and diagnosis.

Introduction

Postconcussional syndrome is a potential danger of sports and physical activity in general. The gravity of concussions; however, is often severely underestimated. Andre Waters, a football player who suffered multiple concussions, developed severe depression, and committed suicide, is a testament to the true severity of postconcussional syndrome [11]. There are approximately 300,000 reported concussions in the United States that occur while playing sports [19]. The diagnosis and treatment of this condition are subjects of controversy. A basic definition of postconcussional syndrome is a condition that results from a head injury and is characterized by central nervous system problems in the realms of somatic, psychological, and cognitive function [8]. Concussions result from a blow to the head that produces a cascade of neurological events. Following biomechanical injury to the brain, neurotransmitter release and ionic fluctuations result in ionic shifts and increased sodium-potassium pump activity [5]. This excessive activity requires large amounts of adenosine triphosphate (ATP), in which reduced blood flow to the brain creates an inequality between energy requirement and availability for the brain [12]. This lack of energy is one possible mechanism for increased susceptibility following concussion, as the brain is less able to respond to another injury [5]. Subsequently, a time of decreased glucose production occurs, which can last up to one month [12]. Increases in calcium can further

aggravate the energy crisis and damage posttraumatic neural connectivity [5].

Diagnosis

Diagnosis for postconcussional syndrome can be difficult, as many of the symptoms are psychological or subjective. Clinical diagnosis consists of identifying the patient's history of traumatic brain injury and three or more of the following symptoms: headache, dizziness, fatigue, irritability, insomnia, concentration, memory difficulty, and intolerance of stress, alcohol, or emotion [1]. For athletes, on-field assessment involves examination of airway, circulation, neurologic performance, and the ability to perform simple tasks [3]. Previously, concussions were graded on scaling systems [3, 10]. Recently, however, these grading scales have been abandoned [3]. Most concussions (80-90 %) are resolved in seven to ten days, although this period can be longer in children and adolescents [14]. More severe concussions have prolonged or advanced symptoms and often are the result of multiple head insults [3]. The complicated nature of concussions and brain injury, in general, require a coordinated, multifaceted approach to diagnose [18]. The sports concussion assessment tool (SCAT) is the standard use for physician evaluation of a traumatic brain injury and involves symptom assessment, memory testing, and neurological performance testing [13]. Moreover, several computer programs exist to test neurocognitive function of patients [10].

Interestingly, magnetic resonance imaging has been utilized to detect prefrontal dysfunction following mild brain trauma in postconcussional syndrome patients. This could become an important tool for diagnostic purposes in the future [4].

Treatment and Management

Concussions are difficult to manage due to the complexity and relative lack of understanding of the injury. Most authorities recommend resting until all symptoms disappear and then using a graded program to return to full activity [2]. This progression begins with light exercise without resistance training, such as stationary biking and walking. The patient then moves to sport-specific exercises, while slowly adding resistance training. This is followed by non-contact drills, then full-contact practice after medical clearance, and concludes with full return [2]. Complex concussions, however, are more challenging to properly manage and may require neuropsychologic and postural stability testing, as well as a team of physicians to fully assess progression. It is essential that the individual wait until all symptoms are gone before returning to full activity, the individual is not left alone, and one day of rest occurs between each step in the progression [2]. Research also indicates that an individual with a history of a concussion is more likely to sustain another [8]. The period of rest immediately following the concussion is crucial, since athletes engaging in higher levels of activity perform worse in neurocognitive testing [12]. Athletic teams have also begun utilizing baseline neurocognitive testing before an injury occurs as a means of comparison since return to baseline levels is a good indicator of recovery from concussion [7]. An athlete with a concussion should avoid prescription medications except for acetaminophen, avoid complete bed rest, and be awakened periodically throughout the night to monitor symptoms if the athlete suffered from loss of consciousness or amnesia [7]. Ultimately, the key to concussion management is precaution. The increasing level of sensitivity that athletic teams are demonstrating towards players is a major positive step in preventing severe long term injury.

Discussion

Though the frequency of severe symptoms, depression, and/or suicide as a result of a concussion is low, diagnosis and recognition are becoming more prominent, particularly in sports. Furthermore, knowledge of the long term impact of postconcussional syndrome is finally being elucidated. Public awareness of concussion severity has rapidly expanded. Professional sporting organizations, most notably the National Football League (NFL), have begun pushing for greater awareness, better utility of protective equipment, and conservative approaches for players in practices and games. The NFL has even recently requested that players donate their brains to science upon their deaths so that postconcussional syndrome can be more thoroughly studied [17]. Well-known author, Malcolm Gladwell, has taken awareness to a whole new level with his writings, which compared football to dog fighting. This has raised a concern that football will reach a point where anyone who plays professionally is at an unparalleled risk for mental deterioration, dementia, and suicide [6]. His point is well supported, as an exceptionally large percentage of football players (and boxers) have been documented through brain autopsy with chronic traumatic encephalopathy, a chronic neurological disorder that results from head trauma [16]. Chronic traumatic encephalopathy is similar to Alzheimer's disease pathologically, with extensive tau neurofibrillary tangles but no amyloid [16]. Some scientists have also raised the possibility that some presumed Alzheimer's cases are actually the result of progressive brain trauma [6]. It is likely that brain trauma is more widespread than research statistics demonstrate and that young athletes are at risk as well. As athletes continue to augment in terms of size and speed, the frequency and relevance of postconcussional syndrome and head trauma, in general, will grow. It is crucial that sports leagues and science focus on preventative measures and treatment options. It is unlikely that treatments for highly advanced postconcussional syndrome will arise in the short term, so preventative equipment and regulations will play the largest roles. Rule adjustments and equipment renovations have been implemented already. For the latter, research studies have demonstrated a decrease in the prevalence of severe brain injuries but not in concussions [9, 15].

However, the combination of growing public awareness and research advancements offer reason for optimism in the next decade.

Conclusion

With the frequency of diagnosed concussions rising, the significance and understanding of head injuries have never been greater. The complexity of concussions presents a challenge for researchers and physicians. All athletic teams, but especially those involving adolescents or children, should be particularly cautious with players returning from concussions and should work to develop a consistent player management philosophy that involves a multifaceted approach. Due to novel research and technological advancement, concussion diagnosis continues to improve. Hopefully, more effective concussion prevention equipment will soon follow. Concussions are a prominent feature of sports and physical activity. However, with greater awareness and preventative strategies, the frequency of advanced postconcussional syndrome, chronic traumatic encephalopathy, and other chronic brain traumas could decrease.

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