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Commentary OMICS International

Concussion in Pediatric Sports: Is the Glory of the Game Worth it?

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Commentary

"There is no one tougher than my son. Sometimes players and parents wrongly believe that it shows strength and courage to play injured. Battling pain is glamorized. Zack couldn't swallow or hold his head up. Strength is seeing Zack stand up out of his wheelchair and learning to walk again." Victor Lystedt (Father of 13 year old Zachery Lystedt with severe sports-related disability from premature return to sports play; The Lystedt Law was passed in May of 2009 in the state of Washington seeking to protect young athletes from [potentially] life threating injuries).

Countless millions of children and youth participate in sports every day, many of them in so-called "organized" sports that present potential risks of damage to these youthful athletes. Financial incentives are considerable to a few successful athletes and also to those non-participating groups involved in sports, coaches, school boards, team owners, and media tycoons. Despite this frenzy of money offered in sports, risks of injury to our pediatric athletes must be carefully considered. One of the most significant sports-related squeala is injury to the brain from sports-related concussion (SRC) [1]. An important issue that must be addressed in this early part of the 21st century includes this question: Is the glory of participating in sports worth the risks our children must take to be in the game? Parents may be thrilled to witness their child participating in the glory of a game and may appreciate the bragging rights that this may produce. However, do they realize the risks their child is taking in potentially compromising his/her future? This editorial looks at this phenomenon in contemporary society.

Sports-related concussion (SRC) can be defined as "trauma-induced alteration in mental status that may or may not be associated with loss of consciousness" from participation in sports [2]. The athlete is injured and either immediately or within several minutes develops confusion that may involve loss of memory and reduced speed of information processing [3,4]. SRC is a complex pathophysiologic process that affects the brain and is induced by traumatic biomechanical forces. It can be caused by a direct blow to the head, face, and/or neck but can also result from a blow in other body parts that leads to a force transmitted to the brain [3,4].

Concussion symptomatology

Information about SRC has been accumulating over the past quarter of a century. It is known that most SRCs occur without loss of consciousness and without overt neurological signs [3-5]. The only evidence of this injury may be mild confusion that seems to resolve spontaneously. Cognitive deficit is not necessary for the diagnosis of concussion [3]. However, there can be a wide variety of signs and symptoms in addition to confusion that includes amnesia, disorientation, easy distractibility, excessive drowsiness, feeling foggy ("dinged, stunned"), seeing "stars" or flashing lights, having poor concentration as well as attention, demonstrating inappropriate play behaviors, slurred (incoherent) speech, reduced sports performance or playing ability and providing slow answers to questions or limited following of directions [3-5]. In addition there can be headache (>90%), blurry (double) vision, vacant starring or a "glassy" eye, dizziness, lightheadedness, vertigo, nausea, emesis, ringing in the ears, seizures, ataxia, and loss of balance [3-7]. Various degrees of unconsciousness can be seen.

If there is spontaneous resolution in most cases, one may ask what is the problem? Full resolution does not occur in all athletes who develop sports-related concussion and consideration of the underlying pathophysiology of SRC provides a cause for concern for our young athletes in sports--persons with brains undergoing critical developmental changes of the central nervous system. Traumatic forces to the brain that can include acceleration or deceleration forces even in non-contact sports have been studied in animal and human models [3-9].

Pathophysiology

CNS damage includes increased neuronal cell membrane permeability with membrane leakage, ionic flux, and glutamate release [8,9]. There is axonal injury, breach of the blood brain barrier, loss of microvascular integrity, and a complex inflammatory cascade [10-13]. There is a production of neurotoxic kynurenine metabolites and activation of the sodium-potassium pump to seek restoration of homeostasis [10-13]. A neuronal dysfunction results from the mismatch of a need for increased cerebral blood flow in the reality of a concussion-induced decrease in cerebral blood flow [14-16]. This dynamic discrepancy between metabolic demands and supply results in a neuronal mismatch that lasts 1 to 10 days during which time it takes for the brain to heal and for recovery from the concussion to take place, often with the help of CNS microglia utilized to repair damage to the CNS [14-16]. A major concern is that the developing brains of children, adolescents, and young adults are precariously vulnerable to trauma from SRCs. Research notes that some athletes develop a prolonged post-concussive symptomatology pattern from SRCs [3,17,18].

Concussion epidemiology

Concussions in sports are underreported and thus, various reports reflect the "tip of the iceberg" phenomenon. Some data suggest up to 3.8 million sports and/or recreation-related concussions occur each year in the United States that includes 2.5 million visits to the emergency departments for concussion, 100,000 emergency department visits for school-age children for concussions, and 300,000 head injuries per year in high school athletes [19-23]. Emergency medicine data from 2001 to 2005 reveal 2.4 million sports-related

emergency department visits each year with 6% (135,000) being for concussion evaluation [24]. Though any sports can lead to brain trauma in formal games or practice, sports with the highest incidence of sports-related concussion include rugby, ice hockey, American football, and wrestling [16,20,25-28].

Reports of concussion are increasing though it is not clear if this is due to more reporting of this injury and/or actual increase in this injury [20]. Some research notes that concussion is increasing driven by an increase in concussion in the adolescent population [29]. Sports-related concussion remains an important part of the overall pediatric traumatic brain injury phenomena seen in trauma centers around the United States [30]. Though the exact numbers of sports-related concussions will never be truly known, it is clear that a staggering number of our children, adolescents, and young adults suffer concussions from sports "play" each year [29,30].

Concussion Complications

As one considers the value of the glory of sports participation for our children and youth, one must recognize not only the acute effects of a concussion but that of potential concussion complications. The assumption with a concussion is that spontaneous recovery will occur but some return with decreased reaction time and increased risks for a repeat concussion and prolongation of concussion symptomatology [18,28,31]. How long it takes for the brain to recover from its injury is not clear especially for children and adolescents who have an increased window of cerebral vulnerability due to dramatic developmental changes that are occurring in childhood and adolescence [32,33].

It is not known how long it takes for recovery from a sports-related concussion. The limited research in this area suggests that most college age athletes become free of their concussion symptoms within 7 to 10 days but that resolution is more than 4 weeks in 6.2% and a recurrent concussion is identified in 9% [34]. In this study of SRC in college athletes between 2009 and 2014 there were 5.29 ± 2.94 concussion symptoms per athlete with headache being the most common at 92.2% and dizziness identified at 68.9% [34]. Limited research notes that even when the athlete is asymptomatic, the brain is not 100% normal [35]. In a study of 1953 youth with concussion the median time of symptom recovery was 18 days with a range of 1 to 353 days [36].

What is concerning is that an unknown number of our athletes have a prolonged recovery period that can be worsened by repeat concussions. The precise nature of this dilemma is not known since incidence reports of concussion are too low. Because of the glory of sports athletes do not fully report concussion symptoms for fear of being excluded from the game [1,10,18]. Athletes and coaching staff do not understand, recognize and/or do not worry about the potential negative impact of SRCs [1,10,18].

Long-term risks of SRCs for millions of youth athletes include neurological complications with chronic cognitive (academic) dysfunction, chronic emotional impairment, and chronic psychosocial difficulties [1,18,31]. Some athletes develop posttraumatic migraine characteristics, emotional lability, irritability, low frustration tolerance, anxiety, depression, insomnia, other sleep disturbances, and personality changes [1,7,17,37-41]. Certainly more research is needed but we know that these risks are real for countless numbers of our athletes seeking the glory of the game [39-41]. These risks are complicated and influenced by premorbid medical and psychological factors as well as the impact of known and unknown repeat concussions [5,18,36,42].

Conclusions concerning concussions in children

Data for the incidence of SRC in children and youth is limited because the mechanisms for concussion evaluation and reporting are limited. We need to improve these mechanisms. Clinicians and coaches staff need to be taught how to recognize SRCs, the need for early medical evaluation, and the need for physical as well as cognitive rest during post-concussion recovery period [1,43-45]. Athletes should never return to the game on the same day as their concussion and not until careful evaluations reveal the individual has returned to as close to a pre-concussion state as can be determined [1,18]. The athlete with a SRC should not drive a motor vehicle for at least 24 hours after the injury and perhaps longer [46].

Parents and coaching staff should understand that helmets in American football do not prevent concussions though they may help prevent severe skull fractures; also, mouth guards can reduce oro-facial injury but not the incidence of SRCs [47]. Tensing of neck muscles before concussion impact does not reduce concussion incidence [47]. Parents should not be induced into a false belief that the collision sport their children are playing is "safer" than other collision sports—all sports have potential danger for SRCs [1,47].

Strick rules of the game should be enforced for young athletes such as no heading in soccer until after age 10 (or later if appropriate skills and physical maturity are not present), no body checking in ice hockey until 15 or more years of age, no tackling in American football until at least 16 years of age, and no boxing for any child or adolescent due to the major risk for brain damage [22,48-54].

Youth with SRCs should have a very slow return to school and sports activities and concern for prolonged concussion symptomatology should be paramount in the minds of treating clinicians, coaching staff, and parents [55-60]. All involved in this sports-related dilemma for our youth must understand that we do not have evidence-based guidelines for when young athletes should return to the game after a SRC [35]. Improved state laws are needed to protect our youth in sports such as seen with the Lystedt Law passed in Washington State in 2009 [61].

However, we need to go beyond state laws and directly tell parents to protect their precious children from the tragic impact of sport-induced concussions. SRCs are a silent, incognito epidemic in youth sports that should be silent no more. Unknown thousands of our youth are threatened by the potential risk of prolonged concussion symptomatology which can impact their lives for decades and even a lifetime! We do not have good methods of identifying those at greatest risk of concussion sequelae. The underreporting of SRC by coaching staff and the pressure to play when not ready from many (i.e, coaches, fans, parents) must stop for the sake of the health of our children [62]. We need to address the serious issue of SRC as a common phenomenon in youth sports activities and seek to directly protect our youth from the false glories of the game [1,10,16,62-68]. This is the time to deal with this tragic tide of sports-related concussion in our children and adolescents.

There is a tide in the affairs of men.
Which, taken at the flood, leads on to fortune;
Omitted, all the voyage of their life
Is bound in shallows and in miseries.
On such a full sea are we now afloat,
And we must take the current when it serves,
Or lose our ventures.

(Brutus in Julius Caesar Act 4, scene 3, 218–224).

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