

Sports-Related Recurrent Brain Injuries -- United States

An estimated 300,000 sports-related traumatic brain injuries (TBIs) of mild to moderate severity (1), most of which can be classified as concussions (i.e., conditions of temporarily altered mental status as a result of head trauma), occur in the United States each year. The proportion of these concussions that are repeat injuries is unknown; however, there is an increased risk for subsequent TBI among persons who have had at least one previous TBI (2,3). Repeated mild brain injuries occurring over an extended period (i.e., months or years) can result in cumulative neurologic and cognitive deficits (4,5), but repeated mild brain injuries occurring within a short period (i.e., hours, days, or weeks) can be catastrophic or fatal. The latter phenomenon, termed "second impact syndrome," has been reported more frequently since it was first characterized in 1984 (6-8). This report describes two cases of second impact syndrome and presents recommendations developed by the American Academy of Neurology to prevent recurrent brain injuries in sports and their adverse consequences (9). Case Reports

Case 1. During October 1991, a 17-year-old high school football player was tackled on the last play of the first half of a varsity game and struck his head on the ground. During halftime intermission, he told a teammate that he felt ill and had a headache; he did not tell his coach. He played again during the third quarter and received several routine blows to his helmet during blocks and tackles. He then collapsed on the field and was taken to a local hospital in a coma. A computed tomography (CT) brain scan revealed diffuse swelling of the brain and a small subdural hematoma. He was transferred to a regional trauma center, where attempts to reduce elevated intracranial pressure were unsuccessful, and he was pronounced brain dead 4 days later. Autopsy revealed diffuse brain swelling, focal areas of subcortical ischemia, and a small subdural hematoma.

Case 2. During August 1993, a 19-year-old college football player reported headache to family members after a full-contact practice during summer training. During practice the following day, he collapsed on the field approximately 2 minutes after engaging in a tackle. He was transported to a nearby trauma center, where a CT scan of the head showed diffuse brain swelling and a thin subdural hematoma. Attempts to control the elevated intracranial pressure failed, and he was pronounced brain dead 3 days later. Autopsy revealed the brain to be diffusely swollen with evidence of cerebrovascular congestion and features of temporal lobe herniation.

Summary of Related Data

The true incidence of second impact syndrome is unknown. During 1984-1991, four cases were described, and during 1992-1995, a total of 17 cases were described; most cases have involved male adolescents or young adults and involved participation in boxing, football, ice hockey, and snow skiing (8). Combined data from four states (Colorado, Missouri, Oklahoma, and Utah) during 1990-1993 indicated an annual rate of 2.6 cases per 100,000 population of sports-related TBI that resulted in hospitalization or death; the proportion

attributable to second impact syndrome is unknown.

Reported by: J Kelly, MD, Brain Injury Program, Rehabilitation Institute of Chicago, Illinois. Quality Standards Subcommittee and Task Force on Preventive Neurology, American Academy of Neurology, Minneapolis, Minnesota. Div of Acute Care, Rehabilitation Research, and Disability Prevention, and Div of Unintentional Injury Prevention, National Center for Injury Prevention and Control, CDC.

Editorial Note

Editorial Note: The two cases described in this report involved repeated head trauma with probable concussions that separately might be considered mild but in additive effect were fatal. The risk for catastrophic effects from successive, seemingly mild concussions sustained within a short period is not yet widely recognized. Second impact syndrome results from acute, usually fatal, brain swelling that occurs when a second concussion is sustained before complete recovery from a previous concussion. Brain swelling apparently results from a failure of autoregulation of cerebral circulation that causes vascular congestion and increased intracranial pressure, which may be difficult or impossible to control (7).

Population-based data are needed to define the incidence of this condition, describe causes, and identify populations at highest risk. CDC is developing a multi-state system for TBI surveillance (10). Based on this surveillance system, CDC, in collaboration with participating states, is developing methods to conduct surveillance for sports-related second impact syndrome.

The risk for second impact syndrome should be considered in a variety of sports associated with likelihood of blows to the head, including boxing, football, ice or roller hockey, soccer, baseball, basketball, and snow skiing. The American Academy of Neurology has proposed recommendations for the management of concussion in sports that are designed to prevent second impact syndrome and to reduce the frequency of other cumulative brain injuries related to sports (9) (see box ([Table 1](#))). These recommendations define symptoms and signs of concussion of varying severity and indicate intervals during which athletes should refrain from sports activity following a concussion. Following head impact, athletes with any alteration of mental status, including transient confusion or amnesia with or without loss of consciousness, should not return to activity until examined by a health-care provider familiar with these guidelines.

The popularity of contact sports in the United States exposes a large number of participants to risk for brain injury. Recurrent brain injuries can be serious or fatal and may not respond to medical treatment. However, recurrent brain injuries and second impact syndrome are highly preventable. Physicians, health and physical education instructors, athletic coaches and trainers, parents of children participating in contact sports, and the general public should become familiar with these recommendations.

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Table_1

Note: To print large tables and graphs users may have to change their printer settings to landscape and use a small font size.

Summary of Recommendations for Management of Concussion in Sports

A concussion is defined as head-trauma-induced alteration in mental status that may or may not involve loss of consciousness. Concussions are graded in three categories. Definitions and treatment recommendations for each category are presented below.

Grade 1 Concussion

- Definition: Transient confusion, no loss of consciousness, and a duration of mental status abnormalities of less than 15 minutes.
- Management: The athlete should be removed from sports activity, examined immediately and at 5-minute intervals, and allowed to return that day to the sports activity only if postconcussive symptoms resolve within 15 minutes. Any athlete who incurs a second Grade 1 concussion on the same day should be removed from sports activity until asymptomatic for 1 week.

Grade 2 Concussion

- Definition: Transient confusion, no loss of consciousness, and a duration of mental status abnormalities of greater than or equal to 15 minutes.
- Management: The athlete should be removed from sports activity and examined frequently to assess the evolution of symptoms, with more extensive diagnostic evaluation if the symptoms worsen or persist for greater than 1 week. The athlete should return to sports activity only after asymptomatic for 1 full week. Any athlete who incurs a Grade 2 concussion subsequent to a Grade 1 concussion on the same day should be removed from sports activity until asymptomatic for 2 weeks.

Grade 3 Concussion

- Definition: Loss of consciousness, either brief (seconds) or prolonged (minutes or longer).
- Management: The athlete should be removed from sports activity

for 1 full week without symptoms if the loss of consciousness is brief or 2 full weeks without symptoms if the loss of consciousness is prolonged. If still unconscious or if abnormal neurologic signs are present at the time of initial evaluation, the athlete should be transported by ambulance to the nearest hospital emergency department. An athlete who suffers a second Grade 3 concussion should be removed from sports activity until asymptomatic for 1 month. Any athlete with an abnormality on computed tomography or magnetic resonance imaging brain scan consistent with brain swelling, contusion, or other intracranial pathology should be removed from sports activities for the season and discouraged from future return to participation in contact sports.

Source: Quality Standards Subcommittee, American Academy of Neurology.

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