NCAA, GUIDELINE 2i Concussion or Mild Traumatic Brain Injury (mTBI) in the Athlete

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Estimates suggest that 1.6 to 3.8 million concussions occur from participation in sports- and recreation-related activities every year (see reference No. 18). These injuries are often difficult to detect, with athletes often underreporting their injury, minimizing their importance or not recognizing that an injury has occurred. At the college level, these injuries are more common in certain sports, such as football, ice hockey, men's and women's soccer, and men's lacrosse. However, they also account for a significant percentage of injuries in men's and women's basketball, women's lacrosse, and other sports traditionally considered "noncontact."

The incidence in helmeted versus nonhelmeted sports is also similar. In the years 2004 to 2009, the rate of concussion during games per 1,000 athlete exposures for football was 3.1, for men's lacrosse 2.6, for men's ice hockey 2.4, for women's ice hockey 2.2, for women's soccer 2.2, for wrestling 1.4, for men's soccer 1.4, for women's lacrosse 1.2, for field hockey 1.2, for women's basketball 1.2, and for men's basketball 0.6, accounting for between 4 and 16.2 percent of the injuries for these sports as reported by the NCAA Injury Surveillance Program by the Datalys Center.

Assessment and management of concussive injuries, and return-toplay decisions remain some of the most difficult responsibilities facing the sports medicine team. There are potentially serious complications of multiple or severe concussions, including second impact syndrome, postconcussive syndrome, or post-traumatic encephalopathy. Though there is some controversy as to the existence of second impact syndrome, in which a second impact with potentially catastrophic consequences occurs before the full recovery after a first insult, the risks include severe cognitive compromise and death. Other associated injuries that can occur in the setting of concussion include seizures, cervical spine injuries, skull fractures and/or intracranial bleed. Due to the serious nature of mild traumatic brain injury, and these serious potential complications, it is



imperative that the health care professionals taking care of athletes are able to recognize, evaluate and treat these injuries in a complete and progressive fashion. In April 2010, the NCAA Executive Committee adopted a policy that requires NCAA institutions to have a concussion management plan on file. (See information box on page 56.)

Concussion or mild traumatic brain injury (mTBI) has been defined as "a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces." Although concussion most commonly occurs after a direct blow to the head, it can occur after a blow elsewhere that is transmitted to the head. Concussions can be defined by the clinical features, pathophysiological changes and/or biomechanical forces that occur. and these have been described in the literature. The neurochemical and neurometabolic changes that occur in concussive injury have been elucidated, and exciting research is underway describing the genetic factors that may play a role in determining which individuals are at an increased risk for sustaining brain injury.

Most commonly, concussion is characterized by the rapid onset of cognitive impairment that is self limited and spontaneously resolves. The acute symptoms of concussion, listed below, are felt to reflect a functional disturbance in cognitive function instead of structural abnormalities, which is why diagnostic tests such as magnetic resonance imaging (MRI) and computerized tomography (CT) scans are most often normal. These studies may have their role in assessing and evaluating the head-injured athlete whenever there is concern for the associated

injuries of skull fracture, intracranial bleeding and seizures, when there is concern for structural abnormalities or when the symptoms of an athlete persist or deteriorate.

Concussion is associated with clinical scenarios that often clear spontaneously, and may or may not be associated with loss of consciousness (LOC).

The sideline evaluation of the brain-injured athlete should include an assessment of airway, breathing and circulation (ABCs), followed by an assessment of the cervical spine and skull for associated injury. The sideline evaluation should also include a neurological and mental status examination and some form of brief neurocognitive testing to assess memory function and attention. This can be in the form of questions regarding the particular practice or competition, previous game results, and remote and recent memory, and questions to test the athlete's recall of words, months of the year backwards and calculations. Special note should be made regarding the presence and duration of retrograde or anterograde amnesia, and the presence and duration of confusion. A timeline of injury and the presence of symptoms should be

noted. These sideline tests should be performed and repeated as necessary, but do not take the place of other comprehensive neuropsychological tests.

Once an injury occurs and an initial assessment has been made, it is important to determine an initial plan of action, which includes deciding on whether additional referral to a physician and/or emergency department should take place, and determining the followup care. The medical staff should also determine whether additional observation or hospital admission should be considered.

Follow-up care and instructions should be given to the athlete, and ensuring that they are not left alone for an initial period of time should be considered. Athletes should avoid alcohol or other substances that will impair their cognitive function, and also avoid aspirin and other medications that can increase their risk of bleeding.

As mentioned previously, conventional imaging studies such as MRI and CT scans are usually normal in mTBI. However, these studies are considered an adjunct when any structural lesion, such as an intracranial bleed or fracture, is suspected. If an athlete

Table 1 SIGNS AND SYMPTOMS OF mTBI

Loss of consciousness (LOC) Confusion Post-traumatic amnesia (PTA) Retrograde amnesia (RGA) Disorientation Delayed verbal and motor responses Inability to focus Headache Nausea/Vomiting Excessive drowsiness Visual Disturbances (Photophobia, blurry Phono/ photophobia vision, double vision) Disequilibrium Feeling "in a fog," "zoned out" Vacant stare Emotional lability Dizziness Slurred/incoherent speech

experiences prolonged loss of consciousness, confusion, seizure activity, focal neurologic deficits or persistent clinical or cognitive symptoms, then additional testing may be indicated.

There are several grading systems and return-to-play guidelines in the literature regarding concussion in sport (AAN, Torg, Cantu). However, there may be limitations because they presume that LOC is associated with more severe injuries. It has been demonstrated that LOC does not correlate with severity of injury in patients presenting to an emergency department with closed head injury, and has also been demonstrated in athletes with concussion (Lovell '99). It has been further demonstrated that retrograde amnesia (RGA), post-traumatic amnesia (PTA), and the duration of confusion and mental status changes are more sensitive indicators of injury severity (Collins '03), thus an athlete with these symptoms should not be allowed to return to play during the same day. These athletes should not return to any participation until cleared by a physician. More recent grading systems have been published that attempt to take into account the expanding research in the field of mTBI in athletes. Though it is useful to become familiar with these guidelines, it is important to remember that many of these injuries are best treated in an

1. NCAA Concussion Fact Sheets and Video for Coaches and Student-Athletes

Available at www.NCAA.org/health-safety. **2. Heads Up: Concussion Tool Kit** CDC. Available at www.cdc.gov/ncipc/tbi/coaches_tool_kit.htm. **3. Heads Up Video** NATA. Streaming online at www.nata.org/consumer/headsup.htm.

individual fashion (Cantu '01, Zurich Conference, NATA '04).

Several recent publications have endorsed the use of neurocognitive or neuropsychological testing as the cornerstone of concussion evaluation. These tests provide a reliable assessment and quantification of brain function by examining brain-behavior relationships. These tests are designed to measure a broad range of cognitive function, including speed of information processing, memory recall, attention and concentration, reaction time. scanning and visual tracking ability, and problem solving ability. Several computerized versions of these tests have also been designed to improve the availability of these tests, and make them easier to distribute and use. Ideally, these tests are performed before the season as a "baseline" with which post-injury tests can be compared. Despite the utility of neuropsychological test batteries in the assessment and treatment of concussion in athletes, several questions remain unanswered. Further research is

Table 2 SYMPTOMS OF POST-CONCUSSION SYNDROME

Loss of intellectual capacity Poor recent memory Personality changes Headaches Dizziness Lack of concentration Poor attention Fatigue Irritability Phono/photophobia Sleep disturbances Sleep disturbances Depressed mood Anxiety needed to understand the complete role of neuropsychological testing.

Given these limitations, it is essential that the medical care team treating athletes continue to rely on its clinical skills in evaluating the head-injured athlete to the best of its ability. It is essential that no athlete be allowed to return to participation when any symptoms persist, either at rest or during exertion. Any athlete exhibiting an injury that involves significant symptoms, long duration of symptoms or difficulties with memory function should not be allowed to return to play during the same day of competition. The duration of time that an athlete should be kept out of physical activity is unclear, and in most instances, individualized return-toplay decisions should be made. These decisions will often depend on the clinical symptoms, previous history of concussion and severity of previous concussions. Additional factors include the sport, position. age, support system for the athlete and the overall "readiness" of the athlete to return to sport.

Once an athlete is completely asymptomatic, the return-to-play progression should occur in a stepwise fashion with gradual increments in physical exertion and risk of contact. After a period of remaining asymptomatic, the first step is an "exertional challenge" in which the athlete exercises for 15 to 20 minutes in an activity such as biking or running in which he/she increases his/her heart rate and

breaks a sweat. If he/she does not experience any symptoms, this can be followed by a steady increase in exertion, followed by return-tosport-specific activities that do not put the athlete at risk for contact. Examples include dribbling a ball or shooting, stickwork or passing, or other agilities. This allows the athlete to return to the practice setting, albeit in a limited role. Finally, the athlete can be progressed to practice activities with limited contact and finally full contact. How quickly one moves through this progression remains controversial.

The NCAA Executive Committee adopted (April 2010) the following policy for institutions in all three divisions.

"Institutions shall have a concussion management plan on file such that a student-athlete who exhibits signs, symptoms or behaviors consistent with a concussion shall be removed from practice or competition and evaluated by an athletics healthcare provider with experience in the evaluation and management of concussions. Student-athletes diagnosed with a concussion shall not return to activity for the remainder of that day. Medical clearance shall be determined by the team physician or his or her designee according to the concussion management plan.

"In addition, student-athletes must sign a statement in which they accept the responsibility for reporting their injuries and illnesses to the institutional medical staff, including signs and symptoms of concussions. During the review and signing process, student-athletes should be presented with educational material on concussions."

NCAA Adopted Concussion Management Plan Legislation.

Concussion Management Plan. An active member institution shall have a concussion management plan for its student-athletes. The plan shall include, but is not limited to, the following:

- (a) An annual process that ensures student-athletes are educated about the signs and symptoms of concussions. Student-athletes must acknowledge that they have received information about the signs and symptoms of concussions and that they have a responsibility to report concussion-related injuries and illnesses to a medical staff member;
- (b) A process that ensures a student-athlete who exhibits signs, symptoms or behaviors consistent with a concussion shall be removed from athletics activities (e.g., competition, practice, conditioning sessions) and evaluated by a medical staff member (e.g., sports medicine staff, team physician) with experience in the evaluation and management of concussions;
- (c) A policy that precludes a student-athlete diagnosed with a concussion from returning to athletic activity (e.g., competition, practice, conditioning sessions) for at least the remainder of that calendar day; and
- (d) A policy that requires medical clearance for a student-athlete diagnosed with a concussion to return to athletics activity (for example, competition, practice, conditioning sessions) as determined by a physician (e.g., team physician) or the physician's designee.

3.2.4.16.1 Effect of Violation. A violation of Constitution 3.2.4.16 shall be considered an institutional violation per Constitution 2.8.1; however, the violation shall not affect the student-athlete's eligibility.

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