CONCUSSION UPDATE
Bob Derr, M.D.
August 26, 2011

Introduction
1- Definitions
2- History
3- Epidemiology
4- Signs & Symptoms
5- Management
6- Prevention
7- Complications
8- What to Expect

Definitions

1- Closed head injury (CHI)
   A trauma in which the brain is injured as a result of a blow to the head, or a sudden, violent motion that causes the brain to knock against the skull. No object penetrates the skull or causes a skull fracture.
   - Can be diffuse or local.
   - Ranges from mild to severe.

2- Traumatic Brain Injury (TBI)
   Damage to the brain from an external mechanical force. Brain function is temporarily or permanently impaired and structural damage maybe detected.
   Mild: GCS 13-15; LOC 0-30 minutes
   Moderate: GCS 9-12; LOC 30 minutes- 24 hours
   Severe: GCS 3-8; LOC > 24 hours

3- Concussion
   No clear cut definition exists among medical experts. Falls under the classification of mild TBI. The IOC held 3 meetings on concussion in sports (2001, 2004, and 2008). They define it as a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces and must include these 5 features.
   a. Must be caused either by a direct blow to the head, face, or neck or elsewhere on the body with an impulsive force transmitted to the brain.
   b. Results in the rapid onset of short lived neurologic impairment that resolves spontaneously.
   c. Results in a graded set of clinical symptoms that may or may not involve LOC.
   d. May result in neuropathological changes but the acute symptoms reflect a functional disturbance than a structural injury.
   e. No abnormality on standard structural neuroimaging studies is noted.
History
1. Hippocratic Corpus (collection of medical works from ancient Greece) discusses loss of speech, hearing, & sight that results from "commotion of the brain" - commotio cerebri.
2. 10th Century AD
Muhammed ibn Zakariya Razi may have been the 1st use the term concussion.
3. 13th Century AD
Lanfranc differentiated concussions from other brain injuries. Also discussed post-concussive symptoms.
4. 16th Century AD
The term concussion came into use in many forms of medical literature.
5. In 1941, animal experiments showed that no macroscopic damage occurs in concussions.

Epidemiology
1. 1-3/1000 people are treated in a hospital for concussions. Not all people get assessed by a medical professional and the CDC estimates that the rate per year in the general population is over 6/1000 people.
2. Pediatric and adolescent age groups account for the majority of sports related concussions.
3. 59% of all high school athletic injuries are concussions. This data is lacking in grade school and middle school athletes.
4. More common in male athletes but recent studies report a higher rate of concussion in female athletes as compared to males in similar sports.

Signs & Symptoms
- 4 Categories
  1) Physical
     Headache (most common), nausea, vomiting, balance problems, visual problems, fatigue, sensitivity to light and noise, dazed or LOC.
  2) Cognitive
     Mental fogginess, feeling slowed down, amnesia (retro and anterograde), difficulty concentrating, and slow in answering questions.

- Specific Signs
  1. LOC
     Occurs <10% of the time. Usually indicates the need for further intervention and probable imaging.
  2. Along with LOC, amnesia may be an important indicator of more serious injury.
  3. Some of these signs and symptoms are similar to depression, anxiety, and attention deficit disorders.
  4. In patients with pre-existing mental health disorders, concussion may worsen those symptoms, and make them more difficult to control.
Initial Assessment
1) On the Field
   a) ABC’s and c-spine stabilization, if required.
   b) Sideline evaluation should include the athlete’s symptoms, quick neurologic assessment, and evaluation of the athlete’s cognition by using one of several sideline assessment tools.
      1- Maddock questions: brief questions about previous team and game.
      2- SAC: Standardized Assessment of Concussion.
      3- BESS: Balance Error Scoring System.
      4- SCAT2: Sport Concussion Assessment Tool 2.
   c) If concussion is identified
      1. Remove athlete from practice or the game for the remainder of the day.
      2. Monitor for several hours after the injury to evaluate for any deterioration.
      3. Can be referred to the Emergency Department or can follow up with the primary care physician if stable.

2) Office or ED Assessment
   a) Complete history of the events. Be sure to ask about previous concussions or serious head injuries.
   b) Complete exam including a detailed head, neck, and neurologic exams.
   c) Even if the symptoms clear or are cleared and the assessment is normal, the athlete should not be allowed to return to play that day.

Neuroimaging
1) Conventional studies are typically normal.
2) No consensus on criteria on who and when to image.
3) CT is the test of choice if using to evaluate during the first 48 hours after the injury.
4) MRI is more appropriate if imaging is needed after 48 hours.
5) Unclear if the use of functional imaging has a role.
   - positron emission tomography (PET)
   - magnetic resonance spectroscopy (MRS)
   - single photon emission CT (SPECT)

Neuropsychological Testing
1) Has become more commonplace but can still be difficult to obtain or can be expensive.
2) Is a means to provide an objective measure of brain function.
3) Does not independently determine if an athlete has experienced a concussion or if they are safe to return to play.
4) Can be computerized or done with pencil and paper.
5) If available, baseline or pre-injury testing should be obtained. If not done, can use age established norms.
6) Should be performed in a quiet environment and while the athlete is well rested.
7) There are no evidence based guidelines about when to administer the test after a concussion (symptomatic vs asymptomatic). However, a symptomatic person should never be returned to play even with normal testing.
8) Limited by the age of the patient, although standardized tests are being developed for those < 12 years of age.
Management

Cognitive Rest
1) May include a temporary leave of absence from school, shortened school day, reduction in homework, or allowance of more time for to complete work or take tests. More difficult in math, science, or foreign language classes.
2) Need education of teachers, school administrators, and school nurses so they understand these recommendations.

Physical Rest (6 stages)
1) All athletes should be withheld from physical exertion until they are asymptomatic at rest.
2) Light aerobic activity such as walking, swimming, or stationary cycling. No resistance exercises.
3) Basic specific sport-related drills but no head impact.
4) Complex noncontact training drills and can start resistance training.
5) Full contact practice.
6) Return to play.
   ✦ Each stage should be last at least 24 hours.
   ✦ If any symptoms recur, then the athlete should stop immediately. Complete rest for the next 24 hours then can resume previous stage.
   ✦ Any athlete with recurring symptoms should seek medical care, preferably someone who is experienced in concussion care.
   ✦ Someone with multiple concussions may require a longer rehabilitation program.

Medication
1) No evidence based research regarding the use of any medication in treating the pediatric concussed patient.
2) Acetaminophen or NSAID’s do not shorten the course of the concussion.
3) May be considered for those with prolonged symptoms such as difficulty concentrating, sleep disturbances, severe headache, or depression.
4) Any medication used to control symptoms indicates incomplete recovery.
5) Before an athlete can return to play, there must be a period of time where they remain symptom free off the medication.
**Prevention**

**Education**
1) This is the single most important component of improving the care of the athlete with concussions.
2) Should target all individuals involved: athletes, coaches, parents, school administrators, teachers, trainers, athletic directors, physicians, and other health care providers.
3) Studies have shown poor recognition of concussions by players, coaches, and clinicians.

4) "Heads Up" Program
   a. In 2005, the CDC published a series of concussion toolkits for coaches, parents, clinicians, and school personnel.
   b. These toolkits are available free from the CDC via the internet.
   c. These toolkits contain a variety of information in many forms/posters, fact sheets, checklists, evaluation forms, care plans, videos, and online training.
   d. A survey of coaches showed high satisfaction with the toolkit.

**Equipment**
1) Helmets and Headgear
   a. Football helmets do reduce the impact forces to the head but a reduction in concussion incidence has not consistently been seen.
   b. Newer helmet technology has shown some promise but further research is needed to show a reduction in concussion incidence.
   c. Headgear has been demonstrated to reduce concussion incidence in both skiing and snowboarding.

2) Mouth Guards
   a. Proven to reduce the risk of dental trauma.
   b. The role of mouth guards in preventing concussions is controversial. However, most experts agree that they decrease the impact forces to the brain and strongly suggest their use.

**Complications**

**Post-concussion syndrome**
1) No clear cut definition exists.
   a. WHO: Presence of 3 or more post-concussive symptoms after a head injury (does not specify a minimum duration of these symptoms).
   b. DSM4: 3 months duration of 3 or more post-concussive symptoms.
   c. A recently proposed definition seems to make most sense. Presence of cognitive, physical, or emotional symptoms of a concussion lasting longer than expected with a time threshold of at least week and no longer than 6 weeks.
Second Impact Syndrome
1) Occurs when an athlete who has sustained an initial head injury sustains a 2nd head injury before the symptoms associated with the 1st injury have fully cleared.
2) Results in cerebral vascular congestion, which often progresses into diffuse cerebral swelling which can lead to death.
3) All reported cases are of athletes younger than 20 years of age.

Long Term Effects
1) Lack of studies in young athletes to show any long term effects at this time.
2) Adult studies have shown some long term cognitive losses in professional athletes.
3) An autopsy of an 18 year old multi-sport athlete with multiple concussions did report chronic traumatic encephalopathy. This finding was only previously described in professional football players and boxers.

The Future
- Need improved recognition and education of concussions with all involved parties.
- Improved technology and further research.
- Ease of access to testing and concussion centers.

UB Concussion Clinic
Clinic every Wednesday 8:30-11:30.
Research oriented (past and current).

Legislation
1) Many states have laws regarding concussion management in young athletes.
2) Washington was the 1st state to pass such a law in May 2009.
3) New York
   a. On June 13th, 2011, the NY Senate passed the Concussion Management Awareness Act.
      * This bill would direct Health and Education Departments to adopt rules for the treatment and monitoring of students with mild TBI’s.
   b. This bill needs to pass in the Assembly and get approval from the governor.
   c. Some resistance to the bill.
      * Some organizations believe the bill has good intentions but has too many flaws.
      * Fails to require baseline neuropsychological testing.

* If each school district develops its own management teams than there will be many different standards.
* Only applies to school sports. Should also include league and club sports.