School of Hard Knocks!

Richard Beebe MS RN NRP
MedicThink LLC
Fall of a Teton
PONDER THIS

What REALLY happened inside Johnny’s head?

How Bad is He Hurt?

How common are these types of injuries?

What part of the brain gets injured in a concussion?

How are Concussions Evaluated & Treated?

Why can’t athletes go back in the game if it’s only a minor concussion?
The term, **mild traumatic head injury (MTHI)** has been applied to patients with certain types of head injuries for many years. MTHI is commonly referred to as concussion or mild traumatic brain injury - the terms are used interchangeably.
Common Features of MTHI

Most definitions of MTHI include the following elements:

- Involves an impact to, or forceful motion of, the head
  - Results in a brief alteration of mental status such as:
    - confusion or disorientation
    - memory loss immediately before/after injury
    - brief loss of consciousness (if any) less than 20 minutes

- Glasgow Coma Scale score of 13 – 15
  - If hospitalized, admission is brief (e.g., less than 48 hours)
  - Possible amnesia – while amnesia does not need to be present, it is a good predictor of brain injury
MTHI vs. Traumatic Brain Injury (TBI)

In MTHI, the brain temporarily becomes functionally impaired without structural damage. TBI, there is structural damage to the brain.
Simple and Complex Injury

Brain injury can be classified as simple or complex based on clinical presentation.

- Simple: symptoms resolve in 7-10 days
- Complex:
  - Symptoms persist longer than 10 days
  - Multiple concussions
  - Convulsions, coma or loss of consciousness (LOC) greater than 1 minute
  - Prolonged cognitive impairment

Meehan 2009
Head injury is a leading cause of morbidity during childhood in the U.S.

More than 1.5 million head injuries occur in U.S. children annually, resulting in over 300,000 hospitalizations.

Males are twice as likely as females to sustain a head injury.

Up to 90% of injury-related deaths among U.S. children are associated with traumatic head injury (leading cause of death in traumatically injured infants).

Cost of head injury in children living in the U.S. is $78 million per year (based on 2004 data).

Atabaki 2007; Brener 2004; Berger 2006
# Epidemiology

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<th>Sports</th>
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<td>Ice hockey</td>
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Brain injuries can be classified as focal or diffuse. When an injury occurs at a specific location, it is called a **focal** injury (e.g., being struck on the head with a bat). A focal neurologic deficit is a problem in a nerve function that affects a specific location or function. Examples: Numbness, decrease in sensation, Paralysis, weakness, loss of muscle control.

In **diffuse** injury, the impact is spread over a wide area, such as being tackled in a game of football that results in a general loss of consciousness.
Man Down on the Field

Anatomy of a concussion

Here is what happens to the brain to cause a concussion:

1. Initial impact

2. The force from the impact causes the brain to strike the inner surface of the skull and rebound against the opposite side.

3. In severe concussions as the brain rebounds, it twists.

4. The brain swells. In a severe injury, the swelling puts pressure on the brain stem, which controls breathing and other basic life functions.

Sources: Dr. Jay Rosenberg of Kaiser Permanente Medical Care Neurology; American Academy of Neurology; The Human Body

MARK NOWLIN / THE SEATTLE TIMES
AVPU

AVPU is a quick test used to determine level of consciousness. It measures the reaction of the eyes, voice and motor activity in response to stimuli. In the scale, Alert represents the level of least injury and Unresponsive the most severe.

Alert: fully conscious; may be mildly disoriented
Voice: responds to verbal stimuli
Pain: responds only to pain stimulus
Unresponsive: unconscious

AVPU is not a replacement for the Glasgow Coma Scale.
Glasgow Coma Scale (GCS)

An accurate, commonly used, and easily reproducible tool

- Commonly used neurologic assessment tool for trauma patients since its development by Jennett and Teasdale in the early 1970s
- Is an accurate measure for trauma care practitioners to document level of consciousness over time
- Commonly used in adults - more recently used in children (Pediatric GCS score)

Sternbach 2000
Primary Assessment

- Begin your immediate assessment by following the ABCs:
  - ✓ Airway
  - ✓ Breathing
  - ✓ Circulation

- Always consider the possibility of cervical spinal injury.

- Determine the child’s orientation to people, place, and time.

- Perform a test of recent memory - does the child remember events just before injury?
History

A detailed history is critical in assessing MTHI. Consider:

- Age of child; developmental history/ability
- Medical history:
  - Medications (prescription, OTC, herbal, etc.)
  - Past illnesses
  - Past hospitalizations
  - Previous head injury
- History related to event:
  - Time of injury
  - Emesis
  - Loss of consciousness / Amnesia
- Severity and mechanism of injury
- Was injury witnessed by a reliable person?

Fuchs 2001
Amnesia

Post traumatic amnesia (PTA) is more accurate than loss of consciousness in predicting functional recovery. Patients suffering from MTHI may have amnesia of events occurring immediately after injury.

Classification of the severity of amnesia is measured by length of time it occurs:

- Very mild: Less than 5 minutes
- Mild: Less than 1 hour
- Moderate: 1-24 hours
- Severe: Greater than 24 hours
- Very severe: Greater than 1 week
Loss Of Consciousness (LOC)

- LOC is not a reliable predictor of concussion or length of recovery.
- LOC is not as definitive a predictor of severity as the Pediatric Glasgow Coma Scale.
- Cognitive symptoms such as confusion and disturbance of memory *can* occur without LOC.
- However, when the patient *does* experience LOC, confusion and memory disturbance almost *always* occur.

Gray 2009; Meehan 2009
Sideline evaluation and return to play conscious athlete:

- Athlete should be evaluated for 15 minutes minimum
- If asymptomatic at rest, provocative testing should be performed
- Any symptoms with this testing precludes return to play
Concussion Management: Acute injury

• ANY signs or symptoms of a concussion:
  – Should not be allowed to return to play in the current game or practice
  – Should not be left alone; regular monitoring for deterioration
  – Should be medically evaluated
  – Return to play must follow a medically supervised stepwise process
• “When in doubt, sit them out!”
Return To Play Guidelines

- Simple – an injury that progressively resolves without complication for 7-10 days. Management based on a step-wise approach until all symptoms resolve.

- Complex – persistent symptoms, specific sequelae (e.g., prolonged LOC), or prolonged cognitive impairment. Consider formal neuropsychological testing beyond return to play guidelines.

EMSC - Return To Play Guidelines Brochure

McCrory 2005
Return To Play: A Step Wise Approach

Athletes are **NOT** be returned to play the same day of injury.

Recommended stages of progression:

Step #1. Rest until asymptomatic (physical and mental rest)
Step #2. Light aerobic exercise
Step #3. Sport-specific exercise
Step #4. Non-contact training drills (light resistance training)
Step #5. Full contact training **ONLY AFTER MEDICAL CLEARANCE**
Step #6. Return to competition (game play)

There should be approximately 24 hours (or longer) for each stage and the athlete should return to previous step if symptoms reoccur.

*McCrory 2005*
Sequelae of concussions

- Second impact syndrome
- Post-concussive syndrome
Second impact syndrome

- A second injury to the brain during the vulnerable metabolic cascade
- May be a minor / incidental injury
- Can lead to severe worsening of mental status and even death
Second Impact Syndrome

The effects of multiple injuries to the head are cumulative and potentially more damaging than a single incident. A second blow is more damaging than the “sum” of the two blows.

Second Impact Syndrome should be suspected in all children involved in high-risk situations (i.e., contact sports) and with a history of previous head injuries.

Patients experiencing Second Impact Syndrome are:

- More likely to experience post-traumatic amnesia
- More likely to experience mental status disturbance after each new injury
- Often score lower on memory tests

Second Impact Syndrome can result in fatal brain swelling.
Post Concussive Syndrome

One potential complication of MTHI is **Post Concussive Syndrome**. Clinical indications include:

- Dizziness, trouble concentrating
- Changes in sleep pattern
- Any deviation from normal behavior in the days or even weeks following the injury.

Over time, the symptoms may eventually lessen. However, parents/caregivers must report any new, continuing, or worsening symptoms to their physician immediately.

*It is critical that parents / caregivers are made aware of this complication at time of discharge.*
Emotional

- Irritability
- Sadness
- Increased demonstration of emotions
- Nervousness
- Loss of impulse control
- Difficult to console
- Shows lack of interest in favorite toys/activities
- Any deviation from normal/baseline as per parent/caregiver

CDC: Heads Up: Facts for Physicians
Cognitive

- Feeling mentally “foggy”
- Feeling slowed down
- Difficulty concentrating
- Difficulty remembering
- Forgetful of recent information or conversations
- Confused about recent events
- Answers questions slowly
- Repeats questions
- Any deviation from normal/baseline as per parent/caregiver

CDC Heads Up: Facts for Physicians
Sleep

- Drowsiness
- Sleeping less than usual
- Sleeping more than usual
- Trouble falling asleep
- Any deviation from normal/baseline as per parent/caregiver
I dream of a world where chickens can cross the road without having their motives questioned.