Comprehensive Evaluation, Management and Treatment of Mild Traumatic Brain Injury

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Definition of MTBI

• A complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces including:
  • Direct blow to body or head
  • Rapid onset of short lived impairment of neurological function that usually resolves spontaneously
  • Traditional imaging (CT and MRI 1.5T) tests usually normal
  • May or may not involve LOC
Definition of MTBI

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
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</thead>
<tbody>
<tr>
<td>Structural imaging</td>
<td>Normal</td>
<td>Normal or abnormal</td>
<td>Normal or abnormal</td>
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<tr>
<td>Loss of Consciousness (LOC)</td>
<td>0–30 min</td>
<td>&gt; 30 min and &lt; 24 hrs</td>
<td>&gt; 24 hrs</td>
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<tr>
<td>Alteration of consciousness/mental state (AOC)</td>
<td>Transient up to 24 hrs</td>
<td>&gt; 24 hours. Severity based on other criteria</td>
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<tr>
<td>Post-traumatic amnesia (PTA)</td>
<td>0–1 day</td>
<td>&gt; 1 and &lt; 7 days</td>
<td>&gt; 7 days</td>
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<tr>
<td>Glasgow Coma Scale (best available score in first 24 hours)</td>
<td>13-15</td>
<td>9-12</td>
<td>&lt; 9</td>
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</tbody>
</table>
Mild Traumatic Brain Injury

- Pediatrics
- Neurology
- Physical Therapy
- Emergency Medicine
- Athletic Training
- Family Medicine
- Neuroradiology
- Neurosurgery
- Neuropsychology
- Psychology
- Internal Medicine
- Occupational Therapy
- Sports Medicine
Neurometabolic Cascade Following Cerebral Concussion

(UCLA Brain Injury Research Center, Giza & Hovda, 2001)

- **Calcium**
- **K+**
- **Glucose**
- **Glutamate**
- **Cerebral Blood Flow**
Incidence of Sports Related MTBI

- Estimated 3.8 million sports and recreational related concussions per year
- Collegiate football
  - Players 34% with one concussion, 20% with multiple concussions
  - Individual Risk 19%/year of play in contact sports
  - One concussion per team per three games
- High risk with soccer and cheerleading
Return to Play after MTBI

• Athletes should not be returned to play until their ALL of their neurologic function has returned to their usual state of health!
• “Get your mind right!!”
Symptoms of MTBI

- Headache, pressure in head
- Neck pain
- Nausea, Vomiting
- Dizziness
- Balance problems
- Vision changes, double, blurry
- Photosensitivity
- Phonosensitivity
- Feeling slowed down or in just “not right”
- Feeling sluggish or fatigued
- Confusion
- Feeling foggy
- Difficulty remembering
- Difficulty concentrating
- Irritability
- More emotional, nervous or sadness than usual
- Tinnitus
History and Physical

- Essential to perform a complete history and physical which identifies ALL of the deficits
- Don’t just asked the concussed individual if their symptoms are gone and they are back to themselves
Vestibular Ocular Reflex

• The vestibulo-ocular reflex (VOR) is a brainstem level eye movement reflex which is triggered during head movement and produces eye movement in the direction opposite to head movement, thus preserving the image on the center of the visual field.
Balance Testing for Vestibular Dysfunction

- Balance Error Scoring System (BESS)
- Bertec Essential force plate technology
Is the Diagnosis Correct and Complete?

- Mild Traumatic Brain Injury
- Subdural Hematoma
- Epidural Hematoma
- Anxiety/Conversion Disorder
- Tension Headache
- Migraine Headache
- Occipital Neuralgia
- Post concussive seizures vs. epilepsy
- Stroke
- Cranial Nerve Palsy
Indications for CT

- Age < 2 or > 65
- LOC or Amnesia with
  - Severe Headache
  - Nausea, Vomiting
  - Progressing symptoms
  - On anticoagulants
  - Post Traumatic Seizure
  - Dangerous mechanism of injury
  - Drug / Alcohol Intoxication
  - Memory Deficits
  - Physical evidence of trauma above the clavicle
  - GCS less than 15
  - Focal neurologic deficit
  - Coagulopathy
Indications for imaging in MTBI?

- CT Scan to rule out bleed?
- MRI (3T) may reveal subtle abnormalities
- Generally imaging is not indicated and will not assist in the management except to rule out other pathology
Cornerstone of MTBI Management

• Brain rest
  • No class
  • No physical exertion
  • No reading
  • No internet
  • No texting
  • No video games
  • Increase fluids / increase rest
  • TV?
Initial Treatment of MTBI

• Treatment of Headaches
• Treatment of Sleep Disturbance
• Treatment of Nausea
• Treatment of Dizziness
Normal Recovery Curves

• High School Students average recovery curve 14-21 days due to immaturity of the neurologic system (plasticity)

• College and Professional Athletes average recovery curve 7-10 days due to more mature neurologic system
The Role of Neuropsychological Testing in Concussion Management
An “Invisible” Injury Requires Multi-Modal Assessment

How to recognize the moods of an Irish setter
Pressure to Play in Sports:
Can We Trust What the Athlete Tells Us?
This “Invisible” Injury also Presents in a Wide Variety of Ways

- No two injuries are alike
- No two sports are alike
- No two lives are alike
- No two brains are alike

Understanding an individual’s **baseline function** allows provision of gold standard, individualized care once concussion occurs.
Neuropsychological Testing for Concussion

• Computerized testing is used for baseline, and most post-injury evaluations
  • Easily administered to groups/teams
  • More precise reaction time measurement
  • Provides information about a wide variety of thinking functions in a short period of time.
  • Highly sensitive to mild TBI/Concussion

• First used to manage concussion in the late 1990s, now most professional, amateur, and school-affiliated leagues require this.
Value-Added of Neuropsychological Testing

% Declined from baseline

EITHER

NEUROPSYCH

SYMPTOMS

65
82
93
Neuropsychological Testing Assists in Return-to-Play and Return-to-Learn/Return-to-Life

• Computerized Neurocognitive Screening for all injuries
• Formal Neuropsychological Testing for protracted injuries or complex cases
  – Guides Return-to-School
  – Informs Return-to-Play
  – Provides insight into treatment (Speech Therapy/Cognitive Rehab) for complex injuries
  – Helps Measure Progress
Impact of Learning on mTBI symptoms

• There has been increased awareness of the importance of monitoring cognitive as well as physical exertion.

• Cognitive Exertion (Thinking) and the added stimulation of the classroom environment can significantly increase symptoms, even when the student has begun to recover.
Cognitive Symptoms in the Classroom

– **Attention/Concentration Problems:**
  - “Drifts off” during class
  - Hard to focus on difficult material
  - Hard to focus for a sustained amount of time
  - Restlessness

– **Memory Problems:**
  - Difficulty learning new information
  - Trouble recalling previously learned information
  - Forgetful, Repetitive
  - Difficulty remembering details of the injury
Concussion-related cognitive problems

– Interference from “sensory overload”
– **Difficulty with Multitasking**
– Confused about instructions, time or places
– Feels mentally “foggy”
– Gets lost
– Thinking/processing speed may be slowed
– Difficulty handling new situations
– Word-finding problems
– Student may report feeling less cognitively able
Emotional Symptoms in the Classroom

- Concussion can change the athlete’s social roles, sense of self/identity, self esteem.
- Affects relationships with friends, parents, coaches, professors, community.
- May create difficulty in responding to new situations
- Emotional reactions may occur to the trauma of amnesia or loss of consciousness, as well as to being significantly impaired or unable to perform
- Emotional or behavioral symptoms may be the direct result of the concussion OR a result of adjustment to injured status.
Somatic Symptoms in the Classroom

- Headache pain, nausea, dizziness, clumsiness, drowsiness, visual or hearing problems, fatigability, sensitivity to light and noise, sleep disturbance etc. may influence performance and abilities
- Injury-related sleep difficulties may lead to daytime drowsiness or fatigue
- With prolonged recovery, medication may be used to manage symptoms, which also may produce side effects
When Accommodations Fail…

• Communication problems: Staff are not aware of the injury or the severity of the problems

• Education problems: Shrug off injury because the student “looks fine,” “just had his/her bell rung,” or “this is only their first concussion, I had 10 when I played football and it didn’t bother me” (individual differences)

• Resistance: From student (doesn’t want to look different, be treated differently, worried about impact on overall academics); From staff (unsure of how to implement)
SUMMARY

• Communication at all levels is key.
• Recovery is quicker and safer when students receive a consistent message.
• Teachers and injured students should discuss options/observations in recovery partnership.
• Proper accommodations should allow student to continue learning “core” information, while controlling symptoms and maintaining grades.
• “Healthy” appearance of student is usually a difficulty, not advantage, in terms of self- and other-expectations.
Post Concussion Syndrome

- Decreased Processing Speed
- Short-term Memory Impairment
- Concentration Deficit
- Irritability/Depression
- Fatigue/Sleep Disturbances
- General feeling of “fogginess”
- Persistent Symptoms >4 weeks after MTBI
Post Concussion Syndrome

- Post Traumatic Stress Disorder (PTSD)
- Anxiety
- Depression
- Adjustment Disorder
Post Concussive Vestibular Dysfunction

• More common in athletes where dizziness or fogginess is a primary presenting symptom
• Significantly abnormal VOR, saccadic eye movements and Romberg at presentation
• Benefit from early referral to vestibular therapist with experience in rehab of post concussive vestibular dysfunction
Post Concussion Syndrome

- Physical Therapy
- Occupational Therapy
- Vestibular Therapy
- Visual Therapy
- Cognitive Therapy
- Psychological Counseling
Multiple Concussions

- Following first episode of MTBI athlete is 4X more likely to experience another MTBI and 3X more likely to experience MTBI in the same season
- Concept of “Concussion Threshold”
Return to Play following multiple mTBIs

• How many concussions is too many concussions?
Persistent Cognitive Deficits

- 41% of 60+ year old retired NFL players had measurable cognitive impairment compared with normal controls
- 2/34 (6%) met diagnostic criteria for dementia
- Cognitive deficits correlated with white matter abnormalities and changes in regional cerebral blood flow
- 25% diagnosed with depression

Hart JJ, Kraut MA, JAMA Neurol 2013
Chronic Traumatic Encephalopathy

- First published case 1954, dementia pugilistica
- Associated with ApoE genotype but most cases have e3/e3 genotype found in 58% of normal population
- Many cases associated with substance abuse
- Only 153 cases reported in literature
- Irregular, multifocal and generally perivascular tau-immunoreactive neurofibrillary tangles
- Overlap with Alzheimer’s disease, Parkinson Disease, Lewy body dementia and cerebrovascular disease
Return to School

- Initially complete brain rest
- Gradual increase in activities as limited by symptoms
- Return to school depends on resolution of symptoms and neurocognitive testing
- Individualized return to school plan
- Coordination with school counselors and disability resource specialists
Return to Play Protocol

Stepwise Protocol:

1. No activity, complete rest. Once asymptomatic, proceed to next level.
2. Light aerobic exercise such as walking or stationary cycling, no resistance training.
3. Sport specific exercise
4. Non-contact training drills
5. Full contact training after medical clearance.
6. Game play.
Summary

- Asymptomatic at rest
- Asymptomatic with cognitive exertion (has returned to being a student)
- Asymptomatic with physical exertion (has completed gradual physical progression)
- Normal imaging if done
- ALL neurofunctional testing has returned to baseline or normal expected range