Concussion Evaluation & Management

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Objectives
• Briefly review concussion basics
• Review most recent consensus statement on concussion evaluation and management
• Discuss latest research in evaluation and management of concussions

Disclosures
• Unfortunately, I have no financial disclosures.
Int’l Conference on Concussion in Sport
• November 2001 – Vienna, Austria
• November 2004 – Prague, Czech Republic
• November 2008 – Zurich, Switzerland
• November 2012 – Zurich, Switzerland
• October 2016 – Berlin, Germany

Concussion Definition
• Complex pathophysiological process affecting the brain, induced by biomechanical forces
  • "Impulsive" force transmitted to head
  • Typically rapid onset of short-lived impairment of neurologic function that resolves spontaneously
  • Usually a functional disturbance
  • Graded set of clinical symptoms
  • Resolution usually follows sequential course

Science in Concussion
• Impact → brain cell membranes stretch and tear → cannot maintain environment; can → death of cell
  • Increases metabolic demand → must work harder to perform (& repair)
  • Injury → imbalance K, Na, glutamate (can be toxic)
  • Energy crisis to brain cells
  • Axonal shear → ability of cells to send signals compromised
  • Too much → permanent damage
Energy Crisis

Epidemiology

• 1.6-3.8 million annually in US

Problem in Concussion

• Underreported
• Media
• Culture change needed →
• EDUCATION
### Concussion Data
- 85-90% college concussions resolve in 7 days (mean = 3-5 days)
- H/O concussion → almost 6x more likely to have another
- H/O >=3 → 30% w symptoms >1 week
- Greatest risk of repeat concussion = 1st 10 days

### Concussion Diagnosis
- Symptoms—somatic (eg, headache), cognitive (eg, feeling like in a fog) and/or emotional symptoms (eg, lability).
- Physical signs (eg, loss of consciousness, amnesia).
- Behavioral changes (eg, irritability).
- Cognitive impairment (eg, slowed reaction times).
- Sleep disturbance (eg, drowsiness).

*Important to obtain a detailed concussion history*
- At injury
- PPE

#### Concussion History Study Questionnaire*  
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have you ever had a concussion or head injury?</td>
<td></td>
</tr>
<tr>
<td>While playing a sport?</td>
<td></td>
</tr>
<tr>
<td>While participating in a recreational activity?</td>
<td></td>
</tr>
<tr>
<td>Have you ever been knocked out?</td>
<td></td>
</tr>
<tr>
<td>While playing a sport?</td>
<td></td>
</tr>
<tr>
<td>While participating in a recreational activity?</td>
<td></td>
</tr>
<tr>
<td>Have you ever had your &quot;bell rung&quot; or been &quot;dazed&quot;?</td>
<td></td>
</tr>
<tr>
<td>While playing a sport?</td>
<td></td>
</tr>
<tr>
<td>While participating in a recreational activity?</td>
<td></td>
</tr>
</tbody>
</table>

*See response to any question resulted in the placement of the participant in the **concussion protocol protocol**
Pre-season Baseline Testing

What is it?
- Symptom checklist
- Cognitive assessment
  - SAC, SCAT3 (Child)
  - Balance
  - Neuropsychological
- Education of players, coaches, parents

When
- HS – may do every other year
- College – may do as freshman
  - Consider repeat baseline if had concussion in previous year

Sideline Evaluation

- ANY signs of concussion ➔
  - Evaluation by healthcare provider on site
  - Appropriate disposition determined
  - Assessment Tool (SCAT3) p 15 min – AxO unreliable
  - Serial monitoring – do NOT leave patient alone

Sideline Assessment Tool

- Have a standard method and DOCUMENT
- Pocket Concussion Recognition Tool
  - Visible clues
  - Signs/Symptoms
  - Memory Function
- SCAT3 and Child SCAT3
**Return to Play?**

- If symptoms and on-field/sideline evaluation consistent with concussion → NO RTP
  - Especially true for pediatric population
  - Education and culture change needed

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**Evaluation in Office**

- Comprehensive history (include previous injuries)
- Detailed neurological examination
  - Mental status
  - Cognitive functioning
  - Gait / vestibular evaluation
  - Balance / postural testing
- Clinical status – improvement or deterioration since injury/previous assessment
Evaluation in Office

Neuropsychological Assessment
- May be used to assist in RTL and RTP decisions
- Should NOT be the sole basis of management decisions

Neuropsych Testing Problems
- Baseline
- Test-retest reliability
- When do you test? Bad sx? Asx?
- Practice effect
- More studies needed (not by ImPACT)
Neuroimaging

- CT initially to r/o bleed
- MRI – post-concussion symptoms
  - Structural changes
- DTI, fMRI, SPECT – still investigational

Concussion Treatment

- “The cornerstone of concussion management is physical and cognitive reset until the acute symptoms resolve and then a graded program of exertion prior to medical clearance and return to play.”

Acute Management

- Physical / Cognitive Rest
- NSAIDs/Tylenol
- Physical Therapy
  - Vestibular (if dizziness)
  - Cervical (if HA or neck pain)
- OMT – cervical, craniosacral
- DHA
Post-Concussion Syndrome

- Symptomatic medication (ADHD, migraine, depression)
- Vestibular PT (coordination, balance, ambulation)
- DHA
- Hyperbarics
- Moderate exercise
- OMT

Concussion Modifiers

<table>
<thead>
<tr>
<th>Factors</th>
<th>Modifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptoms</td>
<td>Number, Duration (&lt;10 d), Severity</td>
</tr>
<tr>
<td>Signs</td>
<td>Prolonged loss of consciousness (≥1 min), amnesia</td>
</tr>
<tr>
<td>Sequence</td>
<td>Concussive convulsions</td>
</tr>
<tr>
<td>Temporal</td>
<td>Frequency, repeated concussions over time</td>
</tr>
<tr>
<td>Timing</td>
<td>Injuries close together in time</td>
</tr>
<tr>
<td>Trauma</td>
<td>&quot;Penalty&quot; - recent concussion or traumatic brain injury</td>
</tr>
<tr>
<td>Threshold</td>
<td>Repeated concussions occurring with progressively less impact force or slower recovery after each successive concussion</td>
</tr>
<tr>
<td>Age</td>
<td>Child or adolescent (&lt;18 y old)</td>
</tr>
<tr>
<td>Comorbidities and pronocibilities</td>
<td>Migraine, depression, or other mental health disorders, attention deficit hyperactivity disorder (ADHD), learning disabilities (LDs), sleep disorders</td>
</tr>
<tr>
<td>Medication</td>
<td>Psychostimulants, antidepressants, other psychiatric medication</td>
</tr>
<tr>
<td>Behaviour</td>
<td>Dangerous style of play</td>
</tr>
<tr>
<td>Sport</td>
<td>High-risk activity, contact and collision sport, high-intensity training, sporting level</td>
</tr>
</tbody>
</table>
What About....?

- Genetic testing?
- ERP? EEG?
- Role of gender?
What About...?

• Genetic testing?
• ERP? EEG?
• Role of gender?
• LOC?

What About...?

• Genetic testing?
• ERP? EEG?
• Role of gender?
• LOC?
• Amnesia?

What About...?

• Genetic testing?
• ERP? EEG?
• Role of gender?
• LOC?
• Amnesia?
• Convulsions?
What About…?

- Genetic testing?
- ERP? EEG?
- Role of gender?
- LOC?
- Amnesia?
- Convulsions?
- Depression?
- Children?
- Elite v non-elite?
Prevention – Equipment

• Helmets?

• Mouthguards?

• Neck strengthening?
Prevention

• Helmets?
• Mouthguards?
• Neck strengthening?
• Rule changes?

Retirement

Season Ending
• Prolonged post-concussion syndrome
• >=3 in one season
• >=2 major in one season
• Diminished academic or athletic performance
• CT/MRI abnormality

Career Ending
• Chiari malformation
• Intracranial hemorrhage
• Diminished academic performance or cognition
• Persistent/prolonged post-concussion syndrome
• Lowering threshold for concussion
• >=3 major
• CT/MRI structural abnormalities

WHAT IF I TOLD YOU
THERE'S AN APP FOR THAT
Diagnosis – App
• HHITT = Handheld Head Injury Treatment

Gaze Stabilization Test Asymmetry Score
• Athletes with previous concussion had larger GST asymmetry scores than those without

Apolipoprotein E Genotype
• Carriers of 3 APOE rare alleles = 10x more likely to report previous concussion
• Carriers of promoter rare allele = 8.4x more likely multiple concussions
Treatment

Heart Rate Variability

Text Messages

Concussion Pearls

- When in doubt, keep them out!
- Tx: physical AND cognitive rest
- Graduated RTP and RTL protocols
- Thorough PPE and H&P
- No two brains are the same

Questions?
References


