Sports Related Concussions and Stingers

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Disclosures

I have no actual or potential conflict of interests in relation to this presentation.
Goals

- Definition
- Emergency Dept workup
- Assessment tools
- Removal from play
- Return to play algorithm
- Current state of research
  - Labs
  - Imaging
- Case
Definition

- A traumatic brain injury involving temporary loss of brain function. It is caused by a direct blow to the head, face, or neck that applies force to the brain within the skull.

- Headache or pressure in the head
- Nausea or vomiting
- Balance problems or dizziness
- Double or blurry vision
- Bothered by light or noise
- Feeling sluggish, hazy, foggy or groggy
- Confusion, concentration, or memory issues
- Just not feeling right
- Loss of consciousness not required
Why we care

- Bleeding
- Associated injuries
- Cumulative effects of repeated concussions
- Long term effects
  - Dementia
  - Alzheimer’s
  - Parkinson’s
  - Depression
- Second impact syndrome
Second Impact Syndrome

- 2nd head injury that occurs before symptoms from first injury have cleared
- Can be remarkably minor
- Loss of autoregulation of the brain’s blood supply
  - Vascular engorgement
  - Increased ICP
  - Brain Herniation
  - Brainstem failure (can be extremely rapid: seconds to minutes)
  - 50% mortality

Removal from play is key!
Jake Snakenberg

- Jake was a 15 yo male who died in 2004 from second impact syndrome. He played for Grandview High School in Aurora, CO

- In 2011, a new law bearing Jake’s name was passed requiring concussion education for all coaches. If a coach suspects concussion, child must be removed from play for further evaluation.

- All high schools will have a concussion protocol for outpatient resource and referrals.
# Grading Systems

<table>
<thead>
<tr>
<th>Grade</th>
<th>Colorado</th>
<th>AAN</th>
<th>Cantu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade I</td>
<td>Mild</td>
<td>No LOC</td>
<td>Confusion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No amnesia</td>
<td>PCSS &lt; 15 min</td>
</tr>
<tr>
<td>Grade II</td>
<td>Moderate</td>
<td>No LOC</td>
<td>Confusion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Amnesia</td>
<td>PCSS &gt; 15 min</td>
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<td></td>
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<tr>
<td>Grade III</td>
<td>Severe</td>
<td>No LOC</td>
<td>Confusion</td>
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LOC - loss of consciousness  
PTA - Post traumatic amnesia  
PCSS - Post concussion signs or symptoms
Neurocognitive Testing

- Post-Concussion Symptom Scale (PCSS)
- Standard Assessment of Concussion (SAC)
- Standard Concussion Assessment Tool (SCAT5)
- ACE (Acute concussion evaluation)
- Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT)
ImPACT

- Computer based assessment
- Takes about 20 minutes
- Requires pre-injury assessment for comparison
ACE (acute concussion evaluation)

- Does not require pre-injury testing
- No computer required
- Highly reliable
A 2011 study showed that athletes who had taken a pre-season baseline ImPACT computerized neuropsychological test, and took the ImPACT test again after suspected concussion were less likely to return to play on the same day, and less likely to return to play within a week of their injury, than the three out of four injured athletes who did not undergo such testing.
Emergency Dept Workup

- Imaging (CT, MRI) not helpful in diagnosis of concussion, but can diagnose other structural lesions.
- Not needed for most concussions
- PECARN

<table>
<thead>
<tr>
<th>Under 2 Years Old</th>
<th>Between 2 and 18 Years Old</th>
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</thead>
<tbody>
<tr>
<td>Altered mental status</td>
<td>Altered mental status</td>
</tr>
<tr>
<td>Scalp hematoma</td>
<td>LOC</td>
</tr>
<tr>
<td>Loss of Consciousness ≥ 5 seconds</td>
<td>History of vomiting</td>
</tr>
<tr>
<td>Severe mechanism of injury</td>
<td>Clinical signs of basilar skull fracture</td>
</tr>
<tr>
<td>Palpable skull fracture</td>
<td>Severe mechanism of injury</td>
</tr>
<tr>
<td>Abnormal behavior per parent</td>
<td>Severe headache</td>
</tr>
</tbody>
</table>
**PECARN < 2 yo**

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**mdcalc.com**

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### Age

<table>
<thead>
<tr>
<th>Age</th>
<th>&lt;2 Years</th>
<th>≥2 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCS ≤14, palpable skull fracture or signs of AMS</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>AMS: Agitation, somnolence, repetitive questioning, or slow response to verbal communication</td>
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</tr>
<tr>
<td>Occipital, parietal or temporal scalp hematoma; history of LOC ≥5 sec; not acting normally per parent or severe mechanism of injury?</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Severe mechanism: MVC with patient ejection, death of another passenger, rollover; pedestrian or bicyclist w/o helmet struck by motorized vehicle; fall from &gt;0.9m or 3ft; head struck by high-impact object</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

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**RESULT**

- **CT Recommended**
- **Observation Recommended**
- **No Risk**

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PECARN > 2 yo

mdcalc.com

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**PECARN Algorithm for Children > 2 Years Old**

**Age**  
- <2 Years  
- ≥2 Years

**GCS ≤14 or signs of basilar skull fracture or signs of AMS**  
- No  
- Yes

AMS: Agitation, somnolence, repetitive questioning, or slow response to verbal communication

**History of LOC or history of vomiting or severe headache or severe mechanism of injury**  
- No  
- Yes

Motor vehicle crash with patient ejection, death of another passenger, or rollover; pedestrian or bicyclist without helmet struck by a motorized vehicle; falls of more than 1.5m/5ft; head struck by a high-impact object

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**RESULT**  
- CT Recommended

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**RESULT**  
- Observation Recommended

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**RESULT**  
- No Risk
So you’ve got a concussion, now what?

- CDC Heads Up 6-Step Progression
  - Step 1- Back to regular activities (such as school)
  - Step 2- Light aerobic activity
  - Step 3- Moderate activity
  - Step 4- Heavy, non-contact activity
  - Step 5- Practice and full contact
  - Step 6- Competition

- 24 hours between steps
- Fall back if symptoms return
- 7-day waiting period before beginning in absence of neurocognitive testing
- This means that return to sports will take at least two weeks
Current Research

- Biomarkers
  - Glial fibrillary acidic protein (GFAP)
  - Ubiquitin C-terminal hydrolase-L1 (UCH-L1)
  - Neuro-filament light chain
  - Tau protein
Imaging

- fMRI (Functional MRI)
- DTI (Diffusion tensor imaging)
- MRS (Magnetic resonance spectroscopy)
- MEG (Magnetoencephalography)
- TMS (Transcranial magnetic stimulation)
Let’s end with a case...

- 20 month male falls off a 3 foot chair while father of child wasn’t looking
- Head strikes the hard wood floor
- No LOC, but child fell asleep shortly after
- No vomiting
- Acting normally in the ER WR
Father and mother of child elected to observe the child at home. He did well. No long term issues (yet)
Questions?