Concussion: the basics

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Outline

• Concussions
  – Brief history
  – Definition
  – Pathophysiology
  – Signs and symptoms

• Management
  – Acute
  – Clinical evaluation
  – Behavioral Management

• Risk Factors
  – Post-traumatic and premorbid

• When to ask for help
A brief history of concussion

3000 bce

415 bce

1300s-1600s ce

20th century

1700 bce

1700s-1800s ce

present
What is a concussion?

According to the CDC:

• A complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces secondary to direct or indirect forces to the head. Disturbance of brain function is related to neurometabolic dysfunction, rather than structural brain injury, and is typically associated with normal structural imaging findings (CT Scan, MRI).

• Concussion may or may not involve a loss of consciousness.

• Concussion results in a constellation of physical, cognitive, emotional, and sleep-related symptoms. Recovery is a sequential process and symptoms may last from several minutes to days, weeks, months, or even longer in some cases.”
**Take home**:  
-A concussion rarely results in a visible or structural injury  
-It is a functional injury that changes the way the brain uses and produces energy
What is a concussion?

- Epidemiology
  - 100-300/100,000 worldwide based on ER admissions only
  - Total estimates are 600/100,000
    - Holm et al., 2005
  - More likely in those who have already been concussed*
    - Quigley, 1945; Thorndike, 1952

* Kozlowski et al., 2007

Diagram:
- Struck by object: 22.9%
- Collision: 17.2%
- Struck by person: 11.1%
- Assault: 3.1%
- Unknown: 1.2%
- Fall: 44.5%
Signs

• Immediate markers (signs)
  – Loss of Consciousness
  – Retrograde Amnesia
  – Anterograde Amnesia
  – Disorientation/Confusion
Symptoms

NEUROPSYCHIATRIC
- Increased lability
- Sadness
- Nervousness/Anxiety
- Irritability

COGNITIVE SYMPTOMS
- Attention Problems
- Memory dysfunction
- “Fogginess”
- Fatigue
- Cognitive slowing

SLEEP DISTURBANCE
- Difficulty falling asleep
- Sleeping less than usual

MIGRAINE (PHYSICAL SX)
- Headaches
- Visual Problems
- Dizziness
- Noise/Light Sensitivity
- Nausea

Factor Analysis, Post-Concussion Symptom Scale
(Kontos et al., 2012; Pardini et al. 2004)

N=15,000 High School and University Athletes within 24-72 hours of concussion
N=327, High School and University Athletes Within 7 Days of Concussion
Commonly Reported Symptoms

High School and College Athletes (within 3 days of injury)

<table>
<thead>
<tr>
<th>SYMPTOM</th>
<th>PERCENT</th>
</tr>
</thead>
<tbody>
<tr>
<td># 1 Headache</td>
<td>71 %</td>
</tr>
<tr>
<td># 2 Feeling slowed down</td>
<td>58 %</td>
</tr>
<tr>
<td># 3 Difficulty concentrating</td>
<td>57 %</td>
</tr>
<tr>
<td># 4 Dizziness</td>
<td>55 %</td>
</tr>
<tr>
<td># 5 Fogginess</td>
<td>53 %</td>
</tr>
<tr>
<td># 6 Fatigue</td>
<td>50 %</td>
</tr>
<tr>
<td># 7 Visual Blurring/double vision</td>
<td>49 %</td>
</tr>
<tr>
<td># 8 Light sensitivity</td>
<td>47 %</td>
</tr>
<tr>
<td># 9 Memory dysfunction</td>
<td>43 %</td>
</tr>
<tr>
<td># 10 Balance problems</td>
<td>43 %</td>
</tr>
</tbody>
</table>

Lovell, Collins et al., 2004; N = 215
Now What?

HOW TO HELP THE CONCUSED ADOLESCENT
Concussion Management

• *Most* aware of negative effect of premature *physical* exertion, but fewer are aware of problems that cognitive exertion can cause

• Cognitive Exertion (Thinking) and the added stimulation of the school environment can significantly increase symptoms throughout recovery

• Research has demonstrated generalized hyperactivation with concussion that is likely related to symptom increases when returning to school

• Obvious Means: testing, group work, movies, shop class, overhead lighting

• Subtle Causes: background noise (cafeteria, movement during and between classes), taking notes (especially off of a projector), sustained attention

• Psychosocial Stressors: relationships with peers, teachers; pressure to perform
Concussion Management

• Acute Management
  • Rule out more serious intracranial pathology
    • CT, MRI, neurologic examination primary diagnostic tests
  • Prevent against cumulative effects of injury
    • Less biomechanical force causing extension of injury
    • Prevent against Second Impact Syndrome

• Early after injury, rest is crucial
  • After the first few days, returning to some routine is important
  • Prolonged periods of being “shut down” reinforces negative behavioral and emotional patterns
Symptom Evaluation/Clinical Interview: What is Asymptomatic?

IS NOT “How are you feeling?” or “Do You Have a Headache?”
IS a series of questions inquiring about subtleties of injury

“Do you have a pressure in your head that increases as day progresses?”
“Are you more sensitive to lights and noises than normal?”
“Do you become dizzy when looking up/down, turning head, standing quickly?”
“Do you feel more fatigued than normal at the end of the day?”
“Do you have blurred or fuzzy vision while reading or difficulty reading?”
“Do you feel more distractible in school than normal?”
“Do you feel a sense of fogginess during the day?”
“Do you have difficulty falling/staying asleep?”
“Have you or your parents noticed that you are more irritable than normal?”

“Asymptomatic” is not an easily defined term, though is at the core of proper concussion management
Concussion Management

• Symptom Management
  – Symptoms are a part of recovery
  – Managing symptoms is crucial to recovery
  – When is it okay to push and when is it time to rest?

• Using a pain scale

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Scale</th>
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<tbody>
<tr>
<td>Setback/slowing recovery</td>
<td>10</td>
</tr>
<tr>
<td>Doing too much</td>
<td>9</td>
</tr>
<tr>
<td>Time to rest</td>
<td>8</td>
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<tr>
<td>Functional Symptoms</td>
<td>7</td>
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<td>6</td>
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<td>5</td>
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</tbody>
</table>
Concussion Management

The old mentality:
• Rest is the best treatment
  – Symptom provocation is a sign of continued impairment

  – Symptoms are treated with rest:
    • Physical: complete rest
    • Cognitive: no/minimal school

Why the change?
• Rest seems to work initially (first 3-5 days) post-injury
  – The effects thereafter plateau
  – Patients with either very low or very high levels of activity have more persistent symptoms
    • Majerske et al., 2008
  – Total rest is actually harmful
    • de Kruijk et al., 2002
    • Allen et al., 1999
Concussion Management

- Over-stimulation has the most profound effect in the acute-subacute post-injury phase

- Little/No stimulation does not bode well for neuropsychological recovery either

- Balance between symptom provocation and rest is difficult, but necessary

“Setback/slowing recovery”

“Doing too much”

“Time to rest”

“Functional Symptoms”
Concussion Management

Treatment Model

• What treatments work in other pathologies?
  – Graded exposure works
    • Anxiety
    • Chronic pain
    • Migraine
  – Approach-Confront strategies are effective in symptom management and treatment
    – Martin, 2010

In mTBI?

• The research is limited, but...
  – Modified CBT protocols works in chronic cases (adult samples)
    • Potter & Brown, 2012
    • Ferguson & Mittenberg, 1996
    • Miller & Mittenberg, 1998
    • Leonard & Tucker, 2004
  – Physical activity is also beneficial
    • Silverberg & Iverson, 2012
    • Iverson et al., 2012
    • Leddy et al., 2012
Concussion Management

1. Regular sleep pattern
2. Regular Diet
3. Regular Hydration
4. Physical Exercise*
5. Stress Management

Increased stress
Dysregulated sleep
Dehydration
Lack of exercise*
Poor diet

Migraine Threshold

Personal history of headaches/migraines
Family history of headaches/migraines

Concussion

No Headaches

134x495

Concussion Management

Dehydration
Poor diet
Increased stress
Migraine Threshold

1. Regular sleep pattern
2. Regular Diet
3. Regular Hydration
4. Physical Exercise*
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Dysregulated sleep
Dehydration
Lack of exercise*
Poor diet
Increased stress

Migraine Threshold

Personal history of headaches/migraines
Family history of headaches/migraines

Concussion

No Headaches
Influencing recovery:

RISK FACTORS
Risk Factors: Incidence

- Injury History
  - The single largest factor in recovery and future incidence
  - Those with prior injuries are more like to be injured in the future
    - Lowered threshold?
    - Personality factors?
Risk Factors: Incidence

- Gender
  - Females are more likely to sustain injuries when looking at equivalent activities
  - Males sustain more head injuries overall
    - Risk taking behaviors
    - Sports
Risk Factors: Incidence

• Age
  – More common in males, teenagers and young adults
  – Children and adolescents make up a larger portion of ER visits
    • Ultimately, the data is inconclusive
Risk Factors: Prolonged Recovery

• Signs/Symptoms
  – Post-traumatic amnesia
  – On field dizziness
  – Subacute “fogginess”
  – Initial impaired neurocognitive performance
  – More severe symptom report
  – LoC is not predictive of prolonged recovery
Risk Factors: Prolonged Recovery

• Premorbid Conditions
  – Migraines
    • High overlap between
      – Gordon et al., 2006
  – ADHD/Learning Disability
    – Alosco et al., 2014
    – Hutchinson et al., 2014
  – Depression/Anxiety
    – Hutchinson et al., 2014

• Premorbid Factors
  – Age
    • Younger take longer
  – Gender
    • Females take longer
Involving other disciplines:

WHEN TO ASK FOR HELP
Coordinating Care

• Not every patient recovers with time and proper management alone
• Depending on the presenting symptoms, consider adjunct therapies
  – Medications
  – Physical Therapies
  – Psychotherapy
Coordinating Care

• Medication
  – Useful in addressing
    • Chronic headache
    • Fatigue
    • Insomnia
    • Mood & Anxiety
    • Cognitive issues
  – Typically mostly used for brief periods
  – Maximizing the effort
    • Medications affecting change in multiple systems
Coordinating Care

• Physical Therapy
  – Consider musculoskeletal PT where neck and back pain are presenting problems
    • can be addressed within days post injury

• Vestibular Therapy
  – Consider this where dizziness-imbalance & mental fogginess are persistent
    • Deficits may be to central or peripheral vestibular system
Coordinating Care

• Psychotherapy
  – Changes in mood/anxiety may be
    • Premorbid
    • Direct result of the injury
    • Resulting from psychosocial factors that may or may not be related to the injury
  – Discuss with patient his/her primary symptoms
    – What to expect
    – Who to involve
  – Do not ignore the psychosocial factors
    – Symptoms are rarely exclusive to a single cluster
  – Create/foster a supportive environment
Summary

- Concussions are a neurometabolic injury
  - Energy production and use is impaired
- Presentation and intensity varies
  - HUGE individual differences
  - Incidence and Recovery times are influenced by several factors
- Balance between rest and exposure
  - Over- and under-stimulation can be harmful
- In cases of protracted recovery, coordinating care across professionals is necessary
Concussion Resources: CDC Tool Kit

- Three kits with information for physicians, parents, and coaches
- Information on High School and Youth Management of Concussion
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