Challenges in Managing Concussed Adolescents: The Biopsychosocial Balancing Act

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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

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."

Neurometabolic Cascade

The "Complex Pathophysiological Process"

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; Thordike, 1992

*Time to ask for help

(Giza & Hovda, 2001)
Signs

- Immediate markers (signs)
  - Loss of Consciousness
- Retrograde Amnesia
- Anterograde Amnesia
- Disorientation/ Confusion

Commonly Reported Symptoms

<table>
<thead>
<tr>
<th>High School and College Athletes (within 3 days of injury)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>71%</td>
</tr>
<tr>
<td>Feeling Slowed Down</td>
<td>56%</td>
</tr>
<tr>
<td>Difficulty concentrating</td>
<td>54%</td>
</tr>
<tr>
<td>Dizziness</td>
<td>55%</td>
</tr>
<tr>
<td>Fogginess</td>
<td>53%</td>
</tr>
<tr>
<td>Fatigue</td>
<td>50%</td>
</tr>
<tr>
<td>Visual Changes (double/blurring)</td>
<td>49%</td>
</tr>
<tr>
<td>Light Sensitivity</td>
<td>46%</td>
</tr>
<tr>
<td>Memory Dysfunction</td>
<td>43%</td>
</tr>
<tr>
<td>Balance Problems</td>
<td>43%</td>
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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

Symptoms

Factor Analysis, Post-Concussion Symptom Scale
(Kontos et al., 2002; Pardini et al., 2000)

- Headache
- Dizziness
- Balance

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

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

SLEEP DISTURBANCE
- Difficulty falling asleep
- Sleeping less than usual

Now What?

HOW TO HELP THE CONCUSED ADOLESCENT

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/sleeping alone?”
- “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

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

Why the change?

- 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

Concussion Management

- Symptom Management
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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

Concussion Management

- 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

- RISK FACTORS
  - Increased stress
  - Poor diet
  - Lack of exercise
  - Lack of hydration
  - Personal history of headaches/migraines
  - Family history of headaches/migraines
  - Dehydration
  - No Headaches

Influencing recovery:
Risk Factors: Incidence

• Injury History
  – The single largest factor in recovery and future incidence
  – Those with prior injuries are more likely 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 behavior: 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

• Demographic 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
  • Link to order tool kit:
Clinical Management

ANXIETY CASE

Anxiety Case

• 15 year old male
  – Hockey player
  – Struck occipital region to ice subsequent to body check
  – Initial signs:
    • disorientation/confusion
  – Initial symptoms:
    • Headache
    • Dizziness
    • Mental fogginess
• Biopsychosocial History
  – 1 prior concussions
  – 2 year prior
  – No other relevant history
  – Above average academically
• No treatment for 5 months
  – Academic decline
  – Worsening sleep
  – Panic attacks
  – Diagnosed with migraines and anxiety by pediatrician
    • Maxalt
    • MRI (?)
    • Prism glasses

Follow-up #1

• Presenting Symptoms
  – Headache
  – Photo/phonosensitivity
  – Dizziness
  – Dysregulated sleep
    • Difficulty falling and staying asleep
  – Memory & attention dysfunction
  – Anxiety
• Treatment Recommendations
  – Return to school
  – Modified schedule
  – Continue vestibular therapy
  – Placed on Klonopin & Zoloft
  – Light physical activity

Follow-up #2

• Presenting Symptoms
  – Headache
  – Photo/phonosensitivity
  – Dizziness
  – Numbness & tingling
  – Memory & attention dysfunction
  – Anxiety
  – Mood
**symptoms reduced with physical activity**
• Treatment Recommendations
  – Continued modified school schedule
  – Discharged from vestibular therapy
  – PT’s progress notes indicated large functional gains despite symptom report
  – Increase physical activity
  – Psychotherapy

Composite Scores

<table>
<thead>
<tr>
<th>Composite Score</th>
<th>Percentile</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory composite (verbal)</td>
<td>74</td>
<td>25%</td>
</tr>
<tr>
<td>Memory composite (visual)</td>
<td>71</td>
<td>10%</td>
</tr>
<tr>
<td>Visual motor speed composite</td>
<td>42.22</td>
<td>86%</td>
</tr>
<tr>
<td>Reaction time composite</td>
<td>0.5</td>
<td>100%</td>
</tr>
<tr>
<td>Impulse control composite</td>
<td>7</td>
<td>60%</td>
</tr>
<tr>
<td>Total Symptom Score</td>
<td>52</td>
<td></td>
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</tbody>
</table>

Vestibular exam was still provocative for symptoms
Near point convergence measured at 12 cm
Anxiety Case

Follow-up #3

- Presenting Symptoms
  - Headache
  - Photo/phonosensitivity
  - Dizziness
  - Numbness & tingling
  - Memory & attention dysfunction
  - Anxiety
    - Hypervigilance, ruminating
    - Mood

- Treatment Recommendations
  - Continued modified schedule
  - Extremely resistant to full return
  - Increase physical activity
  - Psychotherapy

Anxiety Case

Follow-up #4

- Presenting Symptoms
  - Headache
  - Photo/phonosensitivity
  - Dizziness
  - Numbness & tingling
  - Memory & attention dysfunction
  - Anxiety
    - Hypervigilance, ruminating
    - "Something wrong"
    - Mood

- Treatment Recommendations
  - Full days at school
  - Discharged from vestibular therapy
  - Therapist progress notes indicated large functional gains despite symptom report
  - All other therapies/evaluations successfully completed/passed
  - Psychotherapy

Anxiety Case

Follow-up #2

- 17 year old female
  - Soccer player
  - Fell and struck back of head to the ground
  - Initial signs
    - Anterograde amnesia
    - Disorientation/confusion
  - Initial symptoms
    - Headache
    - Nausea
    - Dizziness
    - Mental foggy

- Biopsychosocial History
  - Psychotherapy for "adjustment disorder" after parents' divorce
  - No other relevant history
  - Above average academically
  - Seen 1 week after injury
  - Struggling academically
  - Panic attacks
  - PCP referred to concussion clinic

Anxiety Case #2

Follow-up #1

- Presenting Symptoms
  - Headache
  - Dizziness
  - Disregulated sleep
  - Difficulty falling and staying asleep
  - Memory & attention dysfunction
  - Anxiety was increasing
  - Attributed to school stress
  - Denied mood symptoms

- Treatment Recommendations
  - Continued modified schedule, but increased hours
  - Continued vestibular therapy
  - Light physical activity
  - Recommended psychotherapy

Anxiety Case #2

- Presenting Symptoms
  - Headache
  - Photo/phonosensitivity
  - Blurred vision
  - Nausea
  - Mentally foggy
  - Memory & attention dysfunction
  - Denied feeling anxious
  - Denied mood change

- Treatment recommendations
  - Modified Academic Schedule
  - Vestibular Therapy
  - Behavioral management
  - Referred for medications
  - Behavioral management
  - Sleep was much improved

- Vestibular exam was highly provocative for symptoms
- Near point convergence measured at 2 cm

Anxiety Case #2

Follow-up #2

- Presenting Symptoms
  - Headache
  - Dizziness
  - Memory & attention dysfunction
  - Anxiety
  - Sleep was much improved

- Treatment recommendations
  - Continued modified schedule
  - Increase physical activity
  - Psychotherapy

- Vestibular exam was still provocative for symptoms
- Near point convergence measured at 2 cm
Anxiety Case #2

Follow-up #2

- Presenting Symptoms
  - Headache
  - Photo/phonosensitivity
  - Dizziness
  - Memory & attention dysfunction
  - Anxiety
  - Mood

- Treatment Recommendations
  - Return to full school schedule
  - Discharged from vestibular therapy
  - Increase physical activity
  - Psychotherapy

- Vestibular exam was nonprovocative

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<tbody>
<tr>
<td>Memory composite (total)</td>
<td>82 32% 88 56% 98 69%</td>
</tr>
<tr>
<td>Memory composite (usual)</td>
<td>87 31% 75 56% 78 60%</td>
</tr>
<tr>
<td>Visual motor speed composite</td>
<td>28.58 14% 31.84 7% 30.85 33%</td>
</tr>
<tr>
<td>Reaction time composite</td>
<td>0.88 3% 0.37% 4% 0.57 4%</td>
</tr>
<tr>
<td>Impulse control composite</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td>Total Symptom Score</td>
<td>82 74</td>
</tr>
</tbody>
</table>

Anxiety Case #2

Follow-up #3

- Presenting Symptoms
  - Moderate Headache
  - Mild Photo/phonosensitivity
  - Mild Dizziness
  - Memory & attention dysfunction
  - Anxiety
  - Mood
  - Improving

- Treatment Recommendations
  - Continued full schedule
  - Increase physical activity
  - Psychotherapy

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<td>0 0 0 0</td>
</tr>
<tr>
<td>Total Symptom Score</td>
<td>86 74 69 25</td>
</tr>
</tbody>
</table>

Anxiety Case #2

Follow-up #4

- Presenting Symptoms
  - Denying all symptoms

- Treatment Recommendations
  - Full days at school
  - Psychotherapy
  - Discharged

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<td>87 31% 75 56% 78 60%</td>
</tr>
<tr>
<td>Visual motor speed composite</td>
<td>20.03 14% 30.05 7% 30.95 33% 35.7 4% 45.75 4% 49.75 4%</td>
</tr>
<tr>
<td>Reaction time composite</td>
<td>0.88 3% 0.37% 4% 0.57 4%</td>
</tr>
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<td>Impulse control composite</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td>Total Symptom Score</td>
<td>85 74 99 25</td>
</tr>
</tbody>
</table>

Anxiety Cases

- Summary
  - Treating psychiatric cases is challenging in patients set on “medicalizing” the problem
  - Patients who are willing to address the issues directly fair better
  - Symptoms get better with treatment
  - Psychotherapy can be a useful adjunct in psychiatric cases (mood or anxiety disorders)