Understanding the Impact of Concussions: From Injury through Recovery

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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”

**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
    - Quijano, 1943; Thordhike, 1952

Kozlowski et al., 2007

Giza & Hovda, 2001
Signs

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

Symptoms

- Neuropsychiatric
  - Increased lability
  - Sadness
  - Nervousness/Axiety
  - Irritability

- Cognitive Symptoms
  - Attention Problems
  - Memory dysfunction
  - "Fogginess"
  - Fatigue
  - Cognitive slowing

- Migraine (physical sx)
  - Headaches
  - Visual Problems
  - Dizziness
  - Noise/Light Sensitivity
  - Nausea

- Sleep Disturbance
  - Difficulty falling asleep
  - Sleeping less than usual

Commonly Reported Symptoms

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

<table>
<thead>
<tr>
<th>#</th>
<th>Symptom</th>
<th>Prevalence</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Headache</td>
<td>71%</td>
</tr>
<tr>
<td>2</td>
<td>Feeling slowed down</td>
<td>58%</td>
</tr>
<tr>
<td>3</td>
<td>Difficulty concentrating</td>
<td>57%</td>
</tr>
<tr>
<td>4</td>
<td>Dizziness</td>
<td>55%</td>
</tr>
<tr>
<td>5</td>
<td>Foginess</td>
<td>53%</td>
</tr>
<tr>
<td>6</td>
<td>Fatigue</td>
<td>50%</td>
</tr>
<tr>
<td>7</td>
<td>Visual Changes (double/nurtling)</td>
<td>49%</td>
</tr>
<tr>
<td>8</td>
<td>Light Sensitivity</td>
<td>47%</td>
</tr>
<tr>
<td>9</td>
<td>Memory Dysfunction</td>
<td>43%</td>
</tr>
<tr>
<td>10</td>
<td>Balance Problems</td>
<td>42%</td>
</tr>
</tbody>
</table>

Note: Lists and figures are placeholders and not the actual content.
Why should mental health care practitioners care?

• Summary of Mental Health Sequelae of TBI
  – Patients with TBI have higher rates of depression, substance abuse, aggression, and impulsivity prior to injury.
  – TBI associated with 2-4 increased risk for suicide attempts, suicide, and psychiatric disorder
  – Highest risk for suicide and attempt in those with both TBI and psychiatric disorder
  – Role of worthlessness, hopelessness, belonging, support, perception of functional impairment
  – Inter-relationship of sleep, HA, depression, PTSD, and suicidality
  – Multiple concussions increase risk for depression and suicidality
  – Associated with neurocognitive impairment in memory, executive function, inhibition

Why should mental health care practitioners care?

• mTBI + adolescence = the perfect storm?
  – Distress: headache, depression, reaction to school difficulties, and loss of activity
  – Disinhibition: difficulty with prefrontal cortical activity to inhibition action, negative emotion
  – Development: On top of developmentally immature brain with increase drive for reward relative to capacity to inhibit

Now What?

HOW TO HELP THE CONCUSED ADOLESCENT
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 Kruijf et al., 2002
    • Allen et al., 1999

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

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, and necessary
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

RISK FACTORS

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

- Migraine Threshold
- Increased stress
- Poor diet
- Personal history of headaches/migranes
- Family history of headaches/migranes
- 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?

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

- 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

• 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

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
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
Anxiety Case

**Presenting Symptoms**
- Headache
- Photo/phonosensitivity
- Blurred vision
- Nausea
- Numbness & tingling
- Mentally foggy
- Memory & attention dysfunction
- Anxious
- Mood symptoms

**Treatment recommendations**
- Homebound instruction
- Vestibular and Vision Therapies
- Behavioral management
- Referred for medications
- Behavioral management
  - Sleep was much improved

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<th>Percentile scores if available are taken in small sample</th>
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<tr>
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<td>74 25%</td>
</tr>
<tr>
<td>Memory composite visual</td>
<td>77 00%</td>
</tr>
<tr>
<td>Visual motor speed composite</td>
<td>42.22 80%</td>
</tr>
<tr>
<td>Reaction time composite</td>
<td>6.5 10%</td>
</tr>
<tr>
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<td>13 10%</td>
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**Follow-up #1**

**Presenting Symptoms**
- Headache
- Photo/phonosensitivity
- Dizziness
- Dysregulated sleep
  - Difficulty falling and staying asleep
- Memory & attention dysfunction
- Anxiety
- Mood symptoms

**Treatment Recommendations**

- Return to school
  - Modified schedule
- Continue vestibular therapy
- Placed on Klonopin & Zoloft
- Light physical activity

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**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

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**Vestibular exam was highly provocative for symptoms**

- Near point convergence measured at 29 cm

**Follow-up #2**

**Vestibular exam was still provocative for symptoms**

- Near point convergence measured at 12 cm

**Vestibular exam was mildly provocative for symptoms**

- Near point convergence measured at 6 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

### Composite Scores

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<tr>
<td>Memory composite (actual)</td>
<td>77  51%</td>
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<tr>
<td>Visual rotor speed composite</td>
<td>42.72 10%</td>
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<tr>
<td>Reaction time composite</td>
<td>9.2  10%</td>
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<tr>
<td>Impulse control composite</td>
<td>12  9%</td>
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### 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

### Composite Scores

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Anxiety Case #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 fogginess
  - 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

- 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

Follow-up #1

- Presenting Symptoms
  - Headache
  - Dizziness
  - Dysregulated 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

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

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

- Sleep was much improved

- 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

![Composite Scores](image)

- Vestibular exam was nonprovocative

#### Follow-up #3
- **Presenting Symptoms**
  - Moderate Headache
  - Mild Photo/phonosensitivity
  - Mild Dizziness
  - Memory & attention dysfunction
  - Anxiety
    - Improving
  - Mood
    - Improving

![Composite Scores](image)

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

#### Follow-up #4
- **Presenting Symptoms**
  - Denying all symptoms

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

![Composite Scores](image)
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)