Learning Objectives

- Achieve a higher level of knowledge regarding mood disorders & mental health after concussion.
- Verbalize understanding of the pathophysiology of concussion in the context of emotional dysfunction.
- Verbalize an understanding of why there is an increased risk of mood disorders after concussion.

General Public’s Knowledge on Concussion

What do they really know?
What do parents really know?

General Public’s (Parental) Knowledge on Concussion

- 86% could not identify the definition
- 25% do not let their kids play sports because of fear of concussion
- 50% were under the impression that there is no cure for concussion
- 55% believed safety equipment could prevent most concussions
- 12% thought athletes should be allowed to return to play immediately after concussion
- 25% do not let their kids play sports because of fear of concussions
- 50% were under the impression that there is no cure for concussion
- 59% believed safety equipment could prevent most concussions

How Much Do We Know About Symptoms?

- Cross-sectional national electronic survey
- N = 8137; 57% male; 58% post-secondary education
- 84% identified physical sx’s
- 91% identified cognitive sx’s
- 53% identified mental health sx’s

Recognizing the Symptom of Mental Illness following Concussions in the Sports Community: A Need for Improvement.

<table>
<thead>
<tr>
<th>Physical symptoms</th>
<th>Number of persons identifying the symptoms (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>84%</td>
</tr>
<tr>
<td>Nausea</td>
<td>71%</td>
</tr>
<tr>
<td>Vomiting</td>
<td>62%</td>
</tr>
<tr>
<td>Fatigue</td>
<td>59%</td>
</tr>
<tr>
<td>Difficulty sleeping</td>
<td>57%</td>
</tr>
<tr>
<td>Dizziness</td>
<td>56%</td>
</tr>
<tr>
<td>Numbness</td>
<td>55%</td>
</tr>
<tr>
<td>Blurred vision</td>
<td>54%</td>
</tr>
<tr>
<td>Photophobia</td>
<td>54%</td>
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<tr>
<td>Tinnitus</td>
<td>51%</td>
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<tr>
<td>Dizziness</td>
<td>48%</td>
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<tr>
<td>Vertigo</td>
<td>47%</td>
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<tr>
<td>Numbness</td>
<td>42%</td>
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<tr>
<td>Dizziness</td>
<td>37%</td>
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<tr>
<td>Vertigo</td>
<td>34%</td>
</tr>
<tr>
<td>Numbness</td>
<td>30%</td>
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<tr>
<td>Dizziness</td>
<td>27%</td>
</tr>
<tr>
<td>Vertigo</td>
<td>25%</td>
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</table>

<table>
<thead>
<tr>
<th>Cognitive symptoms</th>
<th>Number of persons identifying the symptoms (%)</th>
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<tbody>
<tr>
<td>Memory loss</td>
<td>91%</td>
</tr>
<tr>
<td>Attention loss</td>
<td>89%</td>
</tr>
<tr>
<td>Irritability</td>
<td>85%</td>
</tr>
<tr>
<td>Fatigue</td>
<td>80%</td>
</tr>
<tr>
<td>Impaired concentration</td>
<td>78%</td>
</tr>
<tr>
<td>Mood swings</td>
<td>77%</td>
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<tr>
<td>Anxiety</td>
<td>76%</td>
</tr>
<tr>
<td>Irritability</td>
<td>75%</td>
</tr>
<tr>
<td>Fatigue</td>
<td>74%</td>
</tr>
<tr>
<td>Impaired concentration</td>
<td>73%</td>
</tr>
<tr>
<td>Mood swings</td>
<td>72%</td>
</tr>
<tr>
<td>Anxiety</td>
<td>71%</td>
</tr>
<tr>
<td>Irritability</td>
<td>70%</td>
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<tr>
<td>Fatigue</td>
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</tr>
<tr>
<td>Impaired concentration</td>
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<tr>
<td>Mood swings</td>
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<td>59%</td>
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<thead>
<tr>
<th>Mental Health symptoms</th>
<th>Number of persons identifying the symptoms (%)</th>
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<tbody>
<tr>
<td>Sleep disturbance</td>
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<tr>
<td>Feelings of depression</td>
<td>89%</td>
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<tr>
<td>Anxiety</td>
<td>85%</td>
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<tr>
<td>Fatigue</td>
<td>82%</td>
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<tr>
<td>Irritability</td>
<td>81%</td>
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<tr>
<td>Mood swings</td>
<td>79%</td>
</tr>
<tr>
<td>Anxiety</td>
<td>78%</td>
</tr>
<tr>
<td>Irritability</td>
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</tr>
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</table>

Disclosures

I have no relevant disclosures.
Attitudes About Concussion

High school boys fear looking “weak” if they report concussions


Why are we Concerned about Concussions and Mood?

• High school student, good grades, Tier 1 Elite Ice Hockey league
• Supportive family, long-term girlfriend
• About 1 year before his 1st diagnosed concussion:
  – Reported “blackouts” while playing
  – Treated for depression
• Cleared after 3 weeks, traveled to college showcase, played 3 games “best he had ever played”
Concussion: What is it?

The Difficulty in Defining Concussion

• 42 working definitions of concussions; most are not evidence-based
• We do not define concussion neurologically
• We do not understand the natural history of concussion
• We have little, if any data on neurobiological recovery following concussion
• No one gold standard test for diagnosis


Concussion Definition from the Experts

Concussion is an evolving injury in the acute phase with rapidly changing clinical signs and symptoms, which may reflect the underlying physiological injury in the brain. Concussion is considered to be one of the most complex injuries in sports medicine to diagnose, assess and manage. A majority of concussions in sport occur without LOC or frank neurological signs. At present, there is no perfect diagnostic test or marker that clinicians can rely on for an immediate diagnosis of concussion in the sporting environment. Because of this evolving process, it is not possible to rule out SRC when an injury event occurs associated with a transient neurological symptom.

Concussion in Sport Group, Berlin 2016

43rd Definition of Concussion

• Change in brain function
• Following a force to the head or body
• May have temporary loss of consciousness, but most do not
• Evaluated neuro & cognitive function in awake individuals by
  ➢ Mostly subjective measures
  ➢ Some objective measure
• Symptoms: worsens with increase in metabolic demands, improves with relative rest
• Most people recover quickly, some don’t
• The ones that don’t, often have emotional and psychological deficits because of it

Roni Robinson, 2017
Influencing factors: Baseline symptoms

- 11% of athletes report baseline symptoms (N=670, HS/College)
- Athletes with a high level of symptoms at baseline reported the same level of symptoms after concussion.


Concussion Simplified

And...Symptoms every time you increase the demands of the brain.

Headache
LOC
Nausea
Vomiting
Balance problems
Dizziness
Fatigue
Trouble falling asleep
Sleeping more than usual
Sleeping less than usual
Drowsiness
Sensitivity to light
Sensitivity to noise
Irritability
Sadness
Nervousness
Feeling more emotional
Numbness or tingling
Feeling slowed down
Feeling mentally foggy
Difficulty concentrating
Difficulty remembering
Visual problems

Concussion Pathophysiology

What is really going in inside that brain??

Normal Neuron Function

Pathophysiology of Concussion
Shortly after brain trauma, cerebral blood flow is affected in two distinct ways:

1. Cerebral blood flow is restricted (decreases cerebral swelling)
2. Cerebral blood flow is uncoupled to cerebral metabolism
**Pre-Injury Risk factors for Prolonged Recovery**

- Motion sickness
- Anxiety
- ADHD
- History of SI/self harm
- Dyslexia
- Negative childhood experiences
- Prior Concussion
- Life stressors
- Substance Abuse

**Impact of Comorbidities on Concussion Recovery**

Characteristics of prolonged concussion recovery in a pediatric subspecialty referral population.

- N = 247
- Ages 5-18 yo
- Data abstracted from chart review

<table>
<thead>
<tr>
<th>Pre-Existing Variable</th>
<th>Median Days Return to School</th>
<th>Median Days until Symptom Free</th>
<th>Median Days until Fully Cleared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anxiety</td>
<td>32</td>
<td>64</td>
<td>76</td>
</tr>
<tr>
<td>No Anxiety</td>
<td>32</td>
<td>64</td>
<td>69</td>
</tr>
<tr>
<td>Depression</td>
<td>32</td>
<td>64</td>
<td>69</td>
</tr>
<tr>
<td>No Depression</td>
<td>32</td>
<td>64</td>
<td>69</td>
</tr>
<tr>
<td>ADHD</td>
<td>24</td>
<td>61</td>
<td>77</td>
</tr>
<tr>
<td>No ADHD</td>
<td>32</td>
<td>66</td>
<td>69</td>
</tr>
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</table>


**Concussion Simplified**

- Headache
- LOC
- Nausea
- Vomiting
- Balance problems
- Distress
- Fatigue
- Trouble falling asleep
- Sleeping more than usual
- Sleeping less than usual
- Drowsiness
- Sensitivity to light
- Sensitivity to noise
- Irritability
- Sadness
- Nervousness
- Feeling more emotional
- Numberless or tingling
- Feeling slowed down
- Feeling mentally foggy
- Difficulty concentrating
- Difficulty remembering
- Visual Problems

**And...symptoms every time you increase the demands of the brain.**

**Treatment goals**

- Avoid repeat heat injury

**Treatment goals**

- Avoid repeat heat injury
- Minimize the impact on schoolwork
Treatment goals

• Avoid repeat heat injury
• Minimize the impact on schoolwork
• Prevent deconditioning

Cognitive  Physical  Social

Straightforward Concussion Recovery

Initial rest

Return to school/ return to learn

Gradual advance to full cognitive load

Scale back on school work & gradually Ramp up slowly

Front load academic accommodations based on deficits

Light cognitive activity at home

What happens when things don’t go as planned?

Prolonged Recovery After Concussion

• Complex pathology of acute concussion is somewhat established

• Prolonged recovery, we are not certain how to explain this pathology or why it happens

• Lack of biological explanations for prolonged recovery

Are these symptoms real?

Concussion in the Classroom: What do we see?

How does it effect learning?

• Poor cognitive stamina
• Poor emotional stamina
• Highly demanding activities increase symptoms
• Lack of sleep
• Headaches
• Takes longer to complete assignments
  • Memory problems
  • Decreased speed of learning
  • Attention deficits

Implications on Academic Performance

Vestibular and vision problems are prevalent after concussion and cannot be under-appreciated.
Vestibular and vision problems are prevalent after concussion and cannot be under‐appreciated.

"My eyes hurt."

"I have to read the same thing over and over again to understand it."

"I studied all night, and then the next day, I can’t remember what I studied."

"It takes me longer to do the same work."

Academic adjustments
- Pre-printed teachers notes (eliminates looking up and down)
- Large print (18 font) - easier to track side to side
- Decrease reading requirements (books on tape)
- Extra time for tests & assignments
- Decrease crowding on a page or use reading strip
- Taking BREAKS

Prolonged Concussion symptoms & mood
- Physiological symptoms worsen
- Psychological symptoms worsen
Concussion: The Invisible Injury

- Students/Athletes look normal
- Imaging is normal
- Culture amongst adolescents to not admit injury
- Expectation to “get over it” or “get back into the game”

Is it really in their head?

Setting Expectations to Prevent Mood Disorders After Concussion

Communicate expectations of academic requirements to the student & the family.

- Let the student know what is expected
- Anxiety of the unknown
- School avoidance

Common Symptoms of Concussion

- Difficulty: Thinking Clearly, Concentrating, Remembering New Information
- Feeling: Headache or Pressure in the Head, Fuzzy or Blurry Vision, Dizziness or Balance, Sensitivity to Noise or Light, Feeling Tired or Having no Energy, Nausea or Vomiting
- Irritability or Apathetic Sadness
- More Emotional than Usual
- Nervousness or Anxiety
- Not feeling “Right” or Feeling “Down”

- Sleeping Habits: More Than Usual, Less Than Usual, Trouble Falling Asleep or Staying Asleep

Common Symptoms of Depression

- Difficulty: Thinking Clearly, Concentrating, Remembering New Information
- Feeling: Headache or Pressure in the Head, Fuzzy or Blurry Vision, Dizziness or Balance, Sensitivity to Noise or Light, Feeling Tired or Having no Energy, Nausea or Vomiting
- Irritability or Apathetic Sadness
- More Emotional than Usual
- Nervousness or Anxiety
- Not feeling “Right” or Feeling “Down”

- Sleeping Habits: More Than Usual, Less Than Usual, Trouble Falling Asleep or Staying Asleep

Psychological Effects of Concussion: Not Well Understood

- Negative effects of concussion on neurological functioning & neurocognitive performance have been well established
- Effects of concussion on psychiatric symptoms have received only minimal attention (But it is increasing)
- Increasing data in the research suggesting increased psychiatric distress among individuals with a history of concussion

Is it really just in their head?
How Concussions Affect Mood

- 14 face-to-face interviews
- Postconcussion symptoms caused difficulty with:
  - Emotions (e.g., irritable, easily frustrated)
  - Roles at school (e.g., concentration difficulties, fatigue)
  - Roles in their social environment (e.g., letting the team down, not being able to contribute to sport)
- Minimized or masked symptoms to decrease the potential of being viewed differently by their peers.


How Mood Affects Concussion

"Catastrophizing" and "Fear-avoidance" (Depression and emotional unrest) can prolong concussion recovery.


Are there Lasting Impacts to the Brain?

- Emergence of research linking head collisions with behavioral & cognitive changes
- Brain degeneration from repeated blows to the head
- Sub concussive hits vs concussion


A single concussion can have lasting effects

- Population based registry in Sweden
- 9% who suffered TBI before 25 yo
- 77% mTBI/Concussion
- 12% recurrent injuries
- Increased risk of impaired adult functioning including: psych diagnosis, lower education, and gov't aid


Depression in General Population

- National Survey of Child Health (n = 36,040)
- 2.7% had parent-reported concussions
- Risk of depression increased 3.3 fold if positive hx of concussion
- Strength: representative sample
- Weakness: retrospective recall, doesn't explain time course of depression after concussion; doesn't examine pre-concussion risk factors


Service Members Experience Health Symptoms 5 Years after Mild Blast-induced Concussion

Service Members Experience Health Symptoms 5 Years after Mild Blast-induced Concussion

Causes of death in the US population aged 1 to 21 years

Suicide and Concussion

Canadian Survey of Youth and TBI

Relationship between Concussion & Suicide
When the Brain Breaks After Concussion

- Factors associated with risk of prolonged concussion also increase risk of depression
- Sequelae of concussion also increase risk of depression
  - Lifestyle change
  - Cognitive changes
  - Sleep disturbances
  - Headaches/pain
  - Loss of their “ideal self”

Alterations in Cognitive Processing:
- Greater impulsivity
- Poorer problem-solving
- Greater emotional lability
- Frustrations with cognitive limitations

Clinical Implications for the APN

- Concussion sets into play cascade of brain changes that can predispose to depression and SI
- Most studies focus on long-term risk, there is consistent evidence that the risk of mood changes occurs early in the process (as soon as the 1st week)
- Pre-existing conditions and multiple concussions at greatest risk
- Suicide & suicidal behavior is much more likely to occur in those with mental health problems afterwards

Recommendations & Clinical Implications

- Pre-season neurocognitive baseline testing is done, can also screen for depression, anxiety, SI and alcohol/substance abuse
- Post-concussion: continue to monitor
  - Emotional lability
  - Depression
  - Suicidal behavior
  - Self-injuring behaviors (cutting)
- Schools can provide supportive environment
- Ensuring the right treatment for patient/student
  - Counseling
  - Support Groups
  - Psychiatry for mood stabilizers
  - Facilitating communication/Modeling behavior

Confusion & Controversy

It’s been suggested increasingly that exposing children to repetitive head hits can lead to significantly compromised cognitive abilities later in life.

Cultural Shift Starts Here

Anyone concerned about this diagnosis? Texas QB expert: Hooray! Decision for concussion, but not ‘zero-tolerance’ issue.

Changing mindset for concussion missed Texas loss to OU: Drought
Summary: Is It Really All In Their Head?

- **YES!** This is a *brain injury*
- Anxiety & depression are real symptoms after concussion
- History of pre-morbid life stressors, higher alert for alterations in mental health after concussion
- Suicide risk must be assessed
- Can be seen weeks, months, years after initial trauma
- More resources & more research are necessary

**More Resources**

[www.chop.edu/concussion](http://www.chop.edu/concussion)