ADHD and Concussion

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Disclosures

Neither I nor my spouse/partner has a relevant financial relationship with a commercial interest to disclose.
Sport Concussion Clinic
at the MassGeneral Hospital for Children™
MGHfC Sport Concussion Program

- Assessment, treatment, and education for athletes recovering from concussion.
- Multi-disciplinary active rehabilitation approach for those with persistent symptoms.
- Guided return-to-play and school
Background

• 1.8 to 3.6 million SRC per year
• 2 to 3 concussions per 10,000 player exposures (practice or game)
Concussion - a transient neurological disturbance resulting from acceleration and deceleration forces to the brain after a blow to the head or body

Translational (linear) Acceleration

Rotational (angular) Acceleration
Molecular Pathophysiology

- Metabolic
- Hemodynamic
- Structural
- Electrophysiological
Signs of Concussion

• On field or sideline
  – Gait instability
  – Blank/vacant/befuddled stare
  – Asking repetitive questions
  – Slowed speech, responses, command following
  – Brief confusion, retrograde amnesia, or post-traumatic amnesia
  – Loss of Consciousness*
Symptoms of Concussion

**On the field or sideline**
- Headache
- Dizziness
- Nausea
- Feeling mentally foggy
- Feeling in a dream like state

**Initial days following injury**
- Headache
- Dizziness
- Fatigue
- Feeling slowed down
- Drowsiness
- Difficulty concentrating
- Feeling mentally foggy
Clinical Recovery

• Professional and college: 1 to 14 days  
  (McCrea, 2005; Proglio 2008)

• On average, high school athletes take longer  
  (Henry et al, 2016)

• Most athletes recovery within 1 month  
  (Henry et al, 2016)

• Time to metabolic recovery is unknown  
  (Collins et al, 2016)
Treatment is consensus based and evidence informed

Statements of Agreement From the Targeted Evaluation and Active Management (TEAM) Approaches to Treating Concussion Meeting Held in Pittsburgh, October 15-16, 2015

Consensus statement on concussion in sport: the 4th International Conference on Concussion in Sport held in Zurich, November 2012

Collins et al, Neurosurgery 2016

McCrory et al, J Athl Train 2013
Time to Recovery

• Professional and college, male athletes:
  – Symptom resolution: 5-14 days (McCrea et al 2005)
  – Brief balance and cognitive assessment: ~ 7 days (McCrea et al 2005)
  – Neurocognitive testing: 7-21 days (Iverson et al 2006)
Factors that may increase recovery time* and modifying factors

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Pre-morbid</th>
<th>Injury related</th>
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</thead>
<tbody>
<tr>
<td>Female Sex*</td>
<td>ADHD*</td>
<td>On-field dizziness</td>
</tr>
<tr>
<td>&gt; 2 previous concussions*</td>
<td>Migraine</td>
<td>Post-traumatic migraine</td>
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<tr>
<td>Age &lt; 18 years*</td>
<td>Depression/anxiety</td>
<td>Overall symptom burden</td>
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<tr>
<td>Learning Disability</td>
<td></td>
<td>Length of LOC</td>
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<tr>
<td>Sleep Disorder</td>
<td></td>
<td>*(Lovell et al, 1999)</td>
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<tr>
<td>*(Sufrinko et al, 2016)</td>
<td></td>
<td>Post-traumatic Amnesia</td>
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<td>*(Collins et al, 2003)</td>
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ADHD

• There is a positive association between ADHD and injuries
  – fractures
  – head injuries
  – burns
  – poisoning

Mikolajczyk et al, 2014
ADHD and Concussion

ADHD is an antecedent risk factor for prolonged symptoms after SRC

Youth with active ADHD are at greater risk for sustaining concussion.
ADHD and Concussion

• ADHD associated with prolonged recovery. (Miller et al., 2015)

• ADHD associated with greater concussion history. (Alosco 2014)

Symptom Severity

Adapted from Collins et al. (2006)
Lifetime History of Concussion in High School Students with ADHD and LD

- Those with ADHD only and ADHD plus LD had higher rates of concussion than those with LD only.

- But having both ADHD and LD did not have an additive effect

Iverson, Wojtowicz, et al. (2016)
Neuromuscular Control: The Brain and Body

• Risk of injury to athletes with ADHD might be mediated by:

  1. Impairment of motor functions
  2. Developmental coordination disorders
Neurocognition and Musculoskeletal Injury

- Emerging evidence that cognition may impact neuromuscular control
Concussion Increases Odds of Sustaining a Lower Extremity Musculoskeletal Injury After Return to Play Among Collegiate Athletes

M. Alison Brooks,*†‡ MD, MPH, Kaitlin Peterson,§ BS, Kevin Biese,‖ BS, Jennifer Sanfilippo,‡¶ MS, ATC, Bryan C. Heiderscheit,†‡ PT, PhD, and David R. Bell,‡¶‖ PhD, ATC

Investigation performed at University of Wisconsin–Madison, Madison, Wisconsin, USA

- 87 cases of concussion among 75 athletes
- 58 men; 17 women
- NCAA Division I football, soccer, hockey, softball, basketball, wrestling, and volleyball
- Acute non-contact lower extremity injury within 90 days of concussion
- Age, sex, and sport matched controls

**OR 2.48**

No difference was observed in days to lower extremity injury between groups
Inadequate Sleep → Concussion → Psychological Stress → Poor Baseline Neurocognition

Impairment of neurocognitive function and performance

↓ Visual Attention
↓ Self-Monitoring
↓ Agility & Fine Motor Performance
↓ Processing Speed & Reaction time
↓ Dual Tasking

↑ Musculoskeletal Injury Risk

Sports-related concussion increases the risk of subsequent injury by about 50% in elite male football players

Anna Nordström,¹ Peter Nordström,² Jan Ekstrand³

- Concussion was associated with
  - an increased risk of subsequent injury
  - A progressively increased risk of injury
    - 0 to <3 months, HR=1.56
    - 3 to <6 months, HR=2.78
    - 6–12 months, HR=4.07

• 37 Healthy subjects
  - Neurocognitive testing
  - Jump Landing Task
• 31% higher peak vertical ground-reaction force
• 26% higher peak proximal anterior tibial shear force

Herman and Barth Am J Sports Med 2016 44: 2347-53
## Research Program: Priority areas

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<th>Sports-Related Concussion</th>
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<td><strong>Assessment &amp; Management</strong></td>
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<td><strong>Premorbid Factors</strong></td>
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<td><strong>Multiple Concussions</strong></td>
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1. **Understanding the effects of multiple concussions**
2. **Improving the methodology for assessing cognitive impairment following concussion**
3. **Examining the usefulness of baseline, preseason testing**
4. **Improving exertional testing and return to play protocols**
5. **Active rehabilitation for athletes slow to recover from concussion**
Early Intervention, Improved Access, Timely Follow-Up
• Thank you
• Questions

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