Active Intervention in Concussion: Results from TEAM (Targeted Evaluation and Active Management)

Erin Reynolds, Psy.D
Fellowship Director
UPMC Sports Medicine Concussion Program
Assistant Professor
Department of Orthopaedic Surgery
University of Pittsburgh/UPMC
Disclosure and Acknowledgment

I, Erin Reynolds, do not have any financial disclosures.

The Targeted Evaluation and Active Management (TEAM) Approach to Treating Concussion meeting I am discussing was underwritten by the NFL and UPMC.
Objectives

- Describe the current status of concussion care
- Describe new clinical profiles and targeted, active approaches to treating concussion
- Discuss key statements of agreement for treating concussion from the 2015 TEAM meeting in Pittsburgh
- Review emerging evidence in concussion care
Current Approach to “Managing” Concussion
The Concussion Pendulum

- Same Day RTP
- Minimizing
  - dings, bell rung

- Cocoon Therapy
- No Football!
- Limit soccer heading...
Misperceptions about Concussion

- Harris Poll of 2,012 US adults
  - 24% think a concussion will change their life forever
  - 72% believe “damage” to the brain is permanent
  - 25% of parents will not allow their kids play contact sports due to fear of concussion

- We need to change the conversation!
# Current Consensus

<table>
<thead>
<tr>
<th></th>
<th>Acute Tx</th>
<th>Medications</th>
<th>Behavioral</th>
<th>Academic Accom.</th>
<th>RTP protocol</th>
<th>Other therapies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>American Academy of Neurology (2013)</strong></td>
<td>No same day RTP</td>
<td>No evidence based intervention for concussions</td>
<td>Cognitive restructuring to prevent PCS</td>
<td>Individualized grade plans for cognitive activity</td>
<td>Supervised, graded exertion program, asymptomatic off medication</td>
<td>-</td>
</tr>
<tr>
<td><strong>International Consensus Statement (2012)</strong></td>
<td>No same day RTP; Physical and cognitive rest until symptoms resolve</td>
<td>Treatment for specific symptoms</td>
<td>Gradual return to school and social activities, before sport</td>
<td>-</td>
<td>Graded RTP</td>
<td>Low level exercise for those slow to recover; multidisciplinary management for “difficult” patients</td>
</tr>
<tr>
<td><strong>National Collegiate Athletic Association (2013)</strong></td>
<td>No same day RTP; Provide instructions; athletes should not be left alone; avoid alcohol, aspirin; determine if imaging is needed</td>
<td>-</td>
<td>Physical and cognitive rest until the acute symptoms resolve</td>
<td>Some athletes may require academic accommodations, such as reduced workload, extended testing time, due off or shortened day</td>
<td>Supervised, graded program of exertion</td>
<td>Tx for postconcussion syndrome (PCS) and depression is different than tx for acute concussion</td>
</tr>
</tbody>
</table>
Does immediate Removal from Play affect Recovery Time?

<table>
<thead>
<tr>
<th></th>
<th>Removed (n = 39)</th>
<th>Not Removed (n = 40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOI to Medical Clearance*</td>
<td>19.74 ± 13.60 Days Range: 8 – 66</td>
<td>35.10 ± 22.92 Days Range: 10 - 106</td>
</tr>
</tbody>
</table>

Athletes that were **NOT** removed from play were **5.93 times** more likely to have long recovery > 21 days

*\( p < .001 \)

Rest and Individualized Treatment (NCAA/Inter-association, 2014)

• “The foundation of sport-related concussion management is *initial physical and relative cognitive rest* as part of an *individualized treatment plan*.”
  
  – Based on: “concussion history, risk factors, symptom burden...”
**Theory Behind Rest**

- Concussion = increased metabolic demand and limited adenosine triphosphate (ATP) reserves
  - Cognitive and physical activity may steal oxygen and ATP from recovering neurons
  - Also, not playing while injured reduces likelihood for second injury during vulnerable period
Evidence that Rest is Effective

- Research in sports medicine/concussion clinics supports rest (e.g., Moser et al., 2013, Brown et al., 2014)
  - Physical and Cognitive rest
“There is little evidence regarding the efficacy of rest following concussion or to inform the best timing and approach for return to activity...”

-2013 Institute of Medicine and National Research Council Report on Concussion in Sport
Concussion “treatment” has been largely absent from guidelines and research.
2015 TEAM Approach to Treating Concussion Meeting Overview

- October 15-16, 2015 in Pittsburgh, PA
- Focus was on treating concussion
- 37 multidisciplinary participants from:
  - neurology, neurosurgery, neuropsychology, primary care, athletic training, physical therapy, research...
- 19 guests from sport, military and public health organizations also attended
Invited Guests and Participants

37 leading clinicians, researchers and thought leaders plus….

Sporting Organizations
-NCAA
-NFL
-Major League Baseball
-National Hockey League
-US Soccer
-USA Rugby

Military Organizations
-DOD
-US Army
-US Navy
-Dept of Veterans Affairs
-Brain Injury Center

Public Health
-Centers for Disease Control and Prevention
-National Institute of Health
-One Mind

Targeted Evaluation & Active Management (TEAM) Approach to Treating Concussion
Statements of Agreement for Treating Concussion

• “Provide best clinical practices summary agreements to assist in the treatment of concussion.”

• 17 Statements of Agreement related to treatment (also future areas of emphasis)

• *Neurosurgery* paper with supporting evidence in review

• A brief review of select key statements of agreement is provided here
Evidence for Rest

“There is limited empirical evidence for the effectiveness of prescribed physical and cognitive rest- with no multi site trials for prescribed rest following concussion.”
Role of Rest

“Prescribed physical and cognitive rest may not be an effective strategy for all patients following concussion.”
Passive Management: Consequences of Rest
(NCAA/Inter-association, 2014)

• Athletes may experience “...emotional distress...depression...anxiety...”

• “Passive management, such as prolonged physical and cognitive rest, may be counter-productive in these scenarios.”
Rest May have Negative Effects

- Mood worsened through removal from routines, social isolation, missed school/sport (Olsson et al., 2013; Ponsford et al., 2012)

- Hypervigilance = focus on symptoms (Heath, 2013)
  - “Somaticizers” (Root et al., 2016)

- Discharge instructions for rest = more symptoms (Zuckerbraun et al., 2014)
  - Contextual framing effect
“Strict brain rest (e.g., ‘cocoon’ therapy) is not indicated and may have detrimental effects on patients following concussion.”
Recovery...How Long?

“Although most individuals follow a rapid course of recovery over several days to weeks following injury, concussions may involve varying lengths of recovery.”
How long does it take to recover from a concussion?

• It is generally thought that 80-90% of athletes recover from a sport-related concussion (SRC) within 7-14 days (McCrory et al., 2013; Giza et al., 2013)
Study Overview

- Assessed recovery in 66 “triage” high school athletes across the first month post-concussion
  - symptoms, cognitive, vestibular, oculomotor
  - compared boys and girls
Recovery can last up to 4 weeks for Symptoms...

* $p < 0.05$

$N=66$

...3-4 weeks for **Memory**...

*\( p < 0.05 \)

**Henry L, Elbin RJ, Collins MW, Marchetti G, Kontos AP. Neurosurg, 2015**
...and 3 weeks for vestibular and oculomotor recovery.

*\( p < 0.05 \)

\( N = 66 \)

Recovery and Modifying Factors

“Recovery from concussion is influenced by modifying factors, the severity of injury, and the type and timing of treatment that is applied.”
Modifying Factors

- **Demographic Factors**
  - *Sex and age differences in recovery* (Covassin et al., 2012; Eisenberg et al., 2014; Lau et al., 2012; Meehan et al., 2012;)

- **Post-injury Factors**
  - *Dizziness* (Lau et al., 2011)
  - *Post-traumatic migraine (PTM) symptoms* (Kontos et al., 2013; Mihalik et al., 2013)
SEX DIFFERENCES - males were (95% CI 1.29-4.75, \( p < .006 \)) 2.5 times more likely than females to be “recovered” by week 4 (B).

*\( p < .05 \)  
N=66

### On-field Dizziness = 6.3x Greater Risk for Protracted (>21 days) Recovery

Predictors reliably distinguish between rapid and protracted recovery groups

**Lau B, Kontos AP, Lovell MR, Mucha A, Collins MW, AJSM, 2011.**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Wald $\chi^2$</th>
<th>OR</th>
<th>$p$</th>
<th>95% CI for OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dizziness</td>
<td>5.44</td>
<td>6.34</td>
<td>0.02</td>
<td>1.34 -29.91</td>
</tr>
<tr>
<td>LOC</td>
<td>2.53</td>
<td>0.27</td>
<td>0.11</td>
<td>0.54 – 1.35</td>
</tr>
<tr>
<td>Vomiting</td>
<td>1.45</td>
<td>0.42</td>
<td>0.23</td>
<td>0.10 – 1.72</td>
</tr>
</tbody>
</table>

Direct LR with 3 predictors: $\chi^2 (3, 94)= 11.77, p= .008$
Sub-acute PTM Symptoms = 7.3x Greater Risk for Protracted (>21 days) Recovery (N= 97)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Wald</th>
<th>p</th>
<th>Odds Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTM v. No Headache/PTM</td>
<td>7.60</td>
<td>.006</td>
<td>7.29</td>
<td>1.80-29.91</td>
</tr>
<tr>
<td>Headache v. No Headache/PTM</td>
<td>2.20</td>
<td>.14</td>
<td>2.83</td>
<td>0.72-11.20</td>
</tr>
<tr>
<td>PTM v. Headache</td>
<td>3.93</td>
<td>.04</td>
<td>2.57</td>
<td>1.10-6.54</td>
</tr>
</tbody>
</table>

Concussion Clinical Profiles

“Concussions are characterized by diverse symptoms and impairments in function resulting in different clinical profiles and recovery trajectories.”

- Disagree: 0%
- Somewhat Disagree: 6%
- Somewhat Agree: 0%
- Agree: 94%
Clinical Profiles of Concussion

Vestibular
Anxiety/Mood
Cervical
Post-Traumatic Migraine
Ocular
Cognitive/Fatigue

Collins, Kontos, Reynolds, Murawski, Fu. KSSTA; 2014.
Growing Empirical Support

Scherer & Schubert, 2009
Alsaheen, et al, 2010
Mucha, et al, 2014

Mainwaring, et al, 2004
Hutchison, et al, 2009
Kontos et al., 2012

Heitger, et al, 2009
Ellis, et al, 2015
Master, et al, 2015
Pearce, et al, 2015

Kontos, et al, 2012
McCrea, et al, 2003

Treleaven, et al, 1994
Schneider, et al, 2014

Mihalik, et al, 2005
Kontos, et al, 2013
Multi-domain Assessment

“Thorough *multi-domain assessment* is warranted to *properly evaluate the clinical profiles of concussion.*”
Concussion
Neuro-cognitive
Vestibular
Physical Exertion
Ocular-Motor
Symptoms

Collins, Kontos, Reynolds, Murawski, Fu. KSSTA; 2014.

UPMC Comprehensive Assessment Model
Comprehensive Multidisciplinary Approach

“A multidisciplinary treatment team offers the most comprehensive approach to treating the clinical profiles associated with concussion.”
Multidisciplinary Model of Concussion Care

- Neurology
- Neurosurgery
- Neuropsychology
- PMR
- Primary Care
- Orthopaedic/Neurosurgery
- Vestibular/Exertion Physical Therapy
- Neuroradiology
- Behavioral Neuro-Optometry
- Emergency Departments
- Primary Care Practices
- Athletic Trainers
- Complicated-Out of Region Referrals
Concussion is Treatable

“Concussion is *treatable*.”

![Bar chart showing agreement on concussions being treatable.]

- Disagree: 0
- Somewhat Disagree: 0
- Somewhat Agree: 6%
- Agree: 94%
Misperceptions about Concussion Treatment

- Harris Poll of 2,012 adults
- Only Perceived Treatments:
  - Rest (51%)
  - Hydration (34%)
  - Over-the-counter medications (28%)
Early Intervention

“Active treatment strategies may be initiated early in recovery following concussion.”
Matching Treatments and Profiles

“Matching targeted and active treatments to clinical profiles may improve recovery trajectories following concussion.”
Using Concussion Clinical Trajectories to Inform Targeted Treatment Pathways

Pre-Existing Risk Factors

Empirical Data Published on Risk Factors

Previous Concussions

Migraine

LD/ADHD

Female Gender

Age

Motion sensitivity, Ocular Dysfunction

Concussion

Extensive Data Published on Prognostic Factors

On-field Dizziness (Lau et al, 2011)

Post-traumatic Migraine (Kontos et al. 2013)

Clinical Trajectories

Vestibular

Ocular

Cognitive

Migraine

Anxiety/Mood

Cervical

Treatment and Rehab Pathways

UPMC Sports Medicine

© UPMC 2015
Conclusions

• Concussion is heterogeneous with emerging clinical profiles

• Prescribed rest is NOT the only intervention for concussion

• We need to move the discussion on concussion toward more active and targeted treatments
Moving Forward...Next Steps

• Conduct multi-site studies to characterize concussion
  – Quantify clinical profiles
  – NCAA-DoD CARE Study

• Conduct RCTs to determine treatment effectiveness
  – Timing, intensity, type
  – Match Tx to clinical profiles
Next steps (cont.)

- Identify biomarkers to quantify injury and recovery
  - Neuroimaging, blood
  - Need assay approach to match complexity

- Determine the role of concussion, sub-concussive impacts on long term effects
  - CTE, other neurodegenerative
  - Need well-controlled, in vivo studies...
...well, perhaps not this well controlled!
Thank you!
Erin Reynolds, Psy.D.
reynoldse2@upmc.edu