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

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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
- Overview of pathophysiology of concussion
- 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
The Concussion Pendulum

- Same Day RTP
- Minimizing “Dings”
- Bell-ringers...

- 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!
Normal Neuron Function

Signal travels down axon to another cell
Normal Neuron Function

Neurotransmitters are released in an organized manner, triggering the next cell with a specific coded message.
During injury, potassium ions ($K^+$) rush out of the cell...
...and toxic calcium ions ($\text{Ca}^{2+}$) rush into the cell, leading to metabolic dysfunction.
Neuron Following Concussion

Metabolic dysfunction results in **ENERGY CRISIS**

Massive release of neurotransmitters interferes with cell communications

Nerve cell is extremely **vulnerable** in this condition, and further injury or stress may cause **cell death or serious cell damage**.
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
“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
Purpose of TEAM meeting

- “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 published October 2016
Role of Rest

“Prescribed physical and cognitive rest may not be an effective strategy for all patients following concussion.”
Rest may have Negative Effects

- Athletes may experience “...emotional distress...depression...anxiety...” (NCAA Inter-association, 2014)
- “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
No Strict Brain Rest

“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<.05

*N=66

...3-4 weeks for **Memory**...
...and 3 weeks for vestibular and oculomotor recovery.

*C p <.05

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)
Concussion Clinical Profiles

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

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

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

References:
- Scherer & Schubert, 2009
- Alsalaheen, et al, 2010
- Mainwaring, et al, 2004
- Hutchison, et al, 2009
- Kontos et al., 2012
- Treleaven, et al, 1994
- Schneider, et al, 2014
- Heitger, et al, 2009
- Ellis, et al, 2015
- Pearce, et al, 2015
- Kontos, et al, 2012
- Scherer & Schubert, 2009
- Heitger, et al, 2009
- Ellis, et al, 2015
- Pearce, et al, 2015
- Kontos, et al, 2012
Multi-domain Assessment

“Thorough multi-domain assessment is warranted to properly evaluate the clinical profiles of concussion.”
UPMC Comprehensive Assessment Model

Collins, Kontos, Reynolds, Murawski, Fu. *KSSTA*; 2014
UPMC Clinical Evaluation

- Detailed Clinical Interview
- Computerized Neurocognitive Testing
- Vestibular-Ocular Screening
  - Establish diagnosis and prognosis
  - Establish clinical and treatment trajectories
  - Establish treatment and rehabilitation plan
    - Academic needs
    - Exertion level (type, duration, intensity)
    - Need for Vestibular Therapy?
    - Need for Vision Therapy?
    - Medication Management?
  - Return to play plan

Communicate Treatment Plan to Patient, Family, Referring Clinician
Comprehensive Multidisciplinary Approach

“A multidisciplinary treatment team offers the most comprehensive approach to treating the clinical profiles associated with concussion.”

[Bar chart showing 82% agree and 18% somewhat agree]
Multidisciplinary Model of Concussion Care

Primary Care Practices

Athletic Trainers

Emergency Departments

Complicated-Out of Region Referrals

Neurology, Neurosurgery, Neuropsychology, PMR, Primary Care, etc

Neuropsychology

PM&R

Vestibular/Exertion Physical Therapy

Neuroradiology

Orthopaedic/Neurosurgery

Behavioral Neuro-Optometry
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 → Concussion → Clinical Trajectories → Treatment and Rehab Pathways

- Empirical Data Published on Risk Factors
- Previous Concussions
- Migraine
- LD/ADHD
- Female Gender
- Age
- Motion sensitivity, Ocular Dysfunction

Clinical Trajectories:
- Vestibular
- Ocular
- Cognitive
- Migraine
- Anxiety/Mood
- Cervical

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Concussion is Treatable

“Concussion is treatable.”

- 94% Agree
- 6% Somewhat Agree
- Disagree and Somewhat Disagree
Misperceptions about Concussion Treatment

• Harris Poll of 2,012 adults

• Only Perceived Treatments:
  – Rest (51%)
  – Hydration (34%)
  – Over-the-counter medications (28%)
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!

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