WEBINAR SERIES

HEADS

Concussion: Presentation, Pathophysiology, **Evaluation, and Clinical** Implications **Presented By:** Michael Heptig, Psy.D. **Clinical Neuropsychologist**

Bancroft NeuroRehab Rebound • Recover • Reconnect

Learning Objectives

- Define concussion including prevalence and pathophysiology
- Describe the symptoms commonly endorsed following a concussion
- Develop a basic understanding of concussion recovery and possible barriers
- Understand the benefit of the Neuropsychological Evaluation in treatment and recovery following a concussion





What is a concussion?

- Definition traumatic insult to brain; mild traumatic brain injury (mTBI)?
- complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces typically resulting in the rapid onset of short lived neurological impairment, which resolves spontaneously and may or may not involve loss of consciousness (McCrory et al., 2013)



What is a concussion?

Complicated Mild TBI:

- Typically present with findings on brain scan
- Post-injury progression similar to Moderate TBI
- Uncomplicated Mild TBI/Concussion:
 - Typically does not coincide with imaging findings



Prevalence

- Estimates range from 1.7–3.8 million incidents reported annually, making concussion the most common class of traumatic brain injury (TBI) in the United States (Likely a vast underestimation)
 - 80-90% of TBIs are classified as concussion



Prevalence

May fail to represent the true number of concussions due to under- reporting of symptoms has been reported as being commonplace among athletes (Khurana & Kaye, 2012).

Estimates of the number of athletes who fail to report concussive symptoms vary from 20% -60% (Chrisman, Quitiquit, & Rivara, 2012).





Lateral vs. Rotational force



Pathophysiology

Trauma causes changes in the neurons, preventing the brain from working normally, including:

- Inability to regulate electrolytes, which prevents brain cells from operating properly.
 - Release of toxic excitatory neurotransmitters such as "glutamate" which is toxic to the cell.
- Increased metabolic energy demands to assist with the cell recovery.

No structural damage.



Pathophysiology



Clinical Presentations

Symptoms during the acute stage of a concussion typically result in changes in one or more of the following four clinical domains:

- 1. physical (e.g. headache, dizziness, nausea, balance issues)
- 2. cognitive (e.g. impaired memory, attention, reaction time)
- 3. behavioral (irritability, depression, anxiety)
- 4. sleep disturbance (e.g. insomnia, hypersomnia) (McCrory et al., 2013).

A concussion is an evolving injury and some symptoms may not occur immediately following the insult.



Clinical Presentations

- Although these typically resolve in 7 10 days, approximately 10-15% of individuals experience persistent symptoms.
- Among the factors that have been hypothesized to contribute to prolonged symptoms are:
- 1. pre morbid conditions (e.g., migraines; mood disorders)
- 2. gender (female)
- 3. age (childhood and adolescence)
- 4. severity of symptoms (McCrory et al., 2013).

***All concussions are different



Course of Concussion Recovery

- Obtaining effective, specialized health care can be an important factor in recovery which is why evaluation is so critical.
 - Psychoeducation and reassurance
 - Initial, brief period of rest is recommended in current research with stepwise return to normal activities



Importance of Concussion Management

- Prolonged effects of concussion including lasting depression and neurocognitve impairment have been observed in high school athletes who have incurred multiple concussions (Covassin, Moran, & Wilhelm, 2013; Kontos, Covassin, Elbin, & Parker, 2012; Moser et al., 2005).
- Research has also demonstrated that individuals with a history of past concussions are six times more likely to incur another concussion (Zemper, 2003).

Second Impact Syndrome

- 2nd concussion before brain can heal from energy crisis of first concussion
- Cumulative effect; Leads to irreversible damage, brain hemorrhaging, even death
- Seems to be more probable in young, developing brains



Concussion Laws

In 2009, the state of Washington passed what is now referred to as the Zachary Lystedt Law

All 50 states including Washington, DC have passed legislation with the intent of addressing the impact of mTBIs among young athletes. The final state to officially pass concussion legislation was Mississippi in January 2014 (Harvey, 2013; Concussion Laws by State, 2014).



Return to Play vs Return to School

- One study found that at least 40.5% of student athletes returned to play prematurely following a concussive episode, failing to wait until they were asymptomatic (Yard & Comstock, 2009).
- Also interesting to note, significant differences were found in regard to gender with male athletes almost twice as likely to be noncompliant in regard to return to play guidelines (Yard & Comstock, 2009).



Return to Play vs Return to School

Symptomatology following a concussive episode may include a temporary decline in cognitive functioning, impaired impulse control, or mood fluctuations which could cause significant academic and social issues if the parents, teachers, and coaches of the student athlete are unaware of the underlying etiology (Moser, 2007).



Return to Play

- Initially, there is an expectation of limited physical activity and cognitive rest until all symptoms of the concussion have subsided for a full 24 hours.
- Gradually increasing activity in a stepwise fashion through each stage, and increasing the activity level each day, the athlete could progress through the entire protocol within a week. (McCrory et al., 2013).
- If any PCS occur during the process the athlete is expected to return to the last step of the protocol in which they were asymptomatic until all PCS resolve for a full 24 hours and then proceed to the next step (McCrory et al., 2013).





| Rehabilitation | Functional Exercise At | Objective of |
|-------------------------|--------------------------|--------------------------|
| Stage | Each Stage Of | Each Stage |
| | Rehabilitation | |
| No activity | Complete physical and | Recovery |
| | cognitive rest | |
| Light aerobic exercise | Walking, swimming, or | Increase heart rate |
| | stationary cycling | |
| | keeping intensity <70% | |
| | maximum predicted | |
| | heart rate | |
| Sport-specific exercise | Skating drills in ice | Add movement |
| | hockey, running drills | |
| | in soccer. No head | |
| | impact activities | |
| Non-contact training | Progression to more | Exercise, coordination, |
| drills | complex training drills, | and cognitive load |
| | eg passing drills in | |
| | football and ice hockey | |
| Full contact practice | Following medical | Restore confidence |
| | clearance participate | and assess functional |
| | in normal training | skills by coaching staff |
| | activities | |
| Return to play | Normal game play | |

Return to Play Protocol From 4th International **Conference on Concussion in Sport**





Return to School

- Much less attention has been paid to the cognitive deficits seen following a concussive episode and the effects these deficits can have on students returning to school following such an incident.
- Multiple studies have shown cognitive impairments following a concussive episode during the acute stage of injury, as well as prolonged effects for children and adolescents who incur multiple concussions (Covassin et al., 2013; Moser et al., 2005).



Graduated return-to-school strategy

| Stage | Aim | Activity | Goal |
|-------|---|---|--|
| 1 | Daily activities at home that do not give the child symptoms | Typical activities of the child during the day as long as they do not increase symptoms (e.g., reading, texting, screen time). Start with 5–15 min at a time and gradually build up | Gradual return to typical activities |
| 2 | School activities | Homework, reading or other cognitive activities outside of the classroom | Increase tolerance to cognitive work |
| 3 | Return to school part-time | Gradual introduction of schoolwork. May need to start with a partial school day or with increased breaks during the day | Increase academic activities |
| 4 | Return to school full time | Gradually progress school activities until a full day can be tolerated | Return to full academic activities and catch up on missed work |





Postconcussion Syndrome (PCS)

- Remember, approximately 10-15% of individuals experience persistent symptoms.
- Persistent, <u>nonspecific</u> symptoms following a mild TBI/concussion (one or three months post-injury).
 - Can present differently depending on the individual, their history, mechanism of injury, and situational/environmental factors.
- PCS is a serious, often times debilitating syndrome.



Factors Influencing PCS

- Persistent symptoms beyond the typical recovery period of several days to weeks may be attributable to factors other than the concussion:
 - Demographic, psychosocial, medical (premorbid or comorbid diagnoses), iatrogenic effects, and situational factors
 - A history of multiple concussions may also prolong recovery
 - Imperative that clinicians consider possible contributing factors that may cause or maintain post-concussion symptoms



Initial Assessment

- Self Report Measures Accurate?
- Athletes competitive desire to return to game leads to under-reported symptoms
- Performed immediately following a potential concussive injury
 - Concussion Recognition Tool (CRT5)
 - Sports Concussion Assessment Tool (SCAT5)
 - Standardized Assessment of Concussion



Physical Assessment

Emergency Department or PCP

- Clinical status
- Neurological examination
 - Mental status
 - Cognitive function
 - Gait and postural stability
- Need for Imaging
 - Risk factors: GCS <15, older age, dangerous mechanism of injury, skull fracture, anterograde amnesia, vomiting, significant head pain, seizure, intoxication





Neurocognitive Testing

- Conventional structural neuroimaging (e.g., <u>CT</u>, MRI) typically contributes little to a concussion evaluation.
- fMRI; DTI; Blood Biomarkers offer possibilities for diagnosis but need more research
 - Diagnosis of a concussion typically depends on the symptoms experienced by the athlete during the acute phase of the concussion (McCrory et al., 2013).



Neurocognitive Testing

- The Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) is one of the most widely used computerized neurocognitive assessment in North America (Schatz & Sandel, 2012).
 - created with the specific intention of identifying concussion in athletes (Allen & Gfeller, 2011).
 - takes approximately 20-25 minutes to administer
 - The use of NPE (Pre and post injury)



Neuropsychologist

- Licensed Psychologist
- Extensive training in brain-behavior relationships:
 - educated in brain anatomy, brain disease,
 - brain function
 - -training/education in test administration and interpretation
- **Board Certification**



Benefits of Neuropsychological Assessment

- Diagnostic tool
- Provides a rich source of information for physicians: provides an integrated picture of current functioning
- Provides a cognitive baseline/monitoring



Benefits of Neuropsychological Assessment

- Develops comprehensive treatment plans saves time and cost-effective
- Provides information about ability to return to work/accommodations
- Provides information about academic accommodations (return to school)



Benefits of Neuropsychological Assessment

- Post-concussion/Follow-up testing assess for potential improvements in cognitive abilities and general symptoms over time
 - When recovery is not progressing in a typical fashion, neuropsychological assessment can also provide valuable information to guide treatment.



Neuropsychological Assessment: From Referral to Report

Refer Schedule (1-2 sessions) Interpretation/report writing Feedback Report sent to referral source



How to Refer for a Neuropsychological Assessment

- Provide referring question
- Provide medical records
- Provide available educational records
- Provide referring diagnosis
- Provide insurance information



Neuropsychological Assessment : Nuts and Bolts

- Administration time varies, may take 2-10 hrs
- Neuropsychologist may give input regarding appropriate timing of assessment
- Administered in 1-2 sessions
- Report takes approximately 1-2 weeks
- Billable time includes scoring, interpretation
- Often includes education and feedback sessions



Neuropsychological Assessment : Nuts and Bolts

- Administration of <u>standardized</u> neuropsychological instruments
- Multiple measures given for each cognitive domain



Neuropsychological Assessment : Interpretive Process

- Comparison of pre-morbid and current level of functioning (decline?)
- Comparison of cognitive domains to current level of functioning (cognitive pattern?)
- Integration of behavioral/emotional/cognitive factors in performance (influence of internal and external factors in functional performance)



Neuropsychological Assessment: Report Components

- Reason for referral
- Thorough review of records: medical, educational, neuroimaging, lab results

> Interview:

patient and collateral report, possible physician and case manager personal & family educational, developmental,

medical, psychiatric history



Neuropsychological Assessment

- Behavioral Observations
- Assessment of Cognitive Domains
 Orientation/Effort/Motivation
 Attention/Concentration/Working Memory
 General Intellectual Functioning
 - **Academic Abilities**

Language



Neuropsychological Assessment

Assessment of Cognitive Domains Auditory Memory Visual Memory **Visual Spatial Functioning** Sensory/Motor Abilities **Executive Functioning** Emotional/Psychological Functioning





Neuropsychological Assessment

- Recommendations:
- Linked to summary
- Linked to referral question!!
- Include:
- Medical
- Therapies
- Environmental/Social
- Cognitive



Review: Learning Objectives

- Define concussion including prevalence and pathophysiology
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Conclusions

- Neuropsychological evaluations have a role in diagnosis, treatment planning, and understanding prognosis for individuals that have sustained a concussion
- Reports provide integrated pictures of a client's cognitive, emotional, and functional abilities
- Evaluations can target treatments









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Thank you!





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