Managing Concussion Complexities

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Disclosure Statement

Psychological Assessment Resources, Inc.
* Test Author (royalties)
* Behavior Rating Inventory of Executive Function (BRIEF)
* Tasks of Executive Control (TEC)
Many other tests & measures (no royalties)

Acute Concussion Evaluation (ACE) – office, ED
ACE Care Plan in Hospital/In-Hospital
Post-Concussion Symptom Inventory (PCSI) 5-7, 8-12, 13-16; Parent
BRIEF – Concussion Monitoring – Parent, Self-Report
Children's Exertional Effects Rating Scale (ChEERS)
Concussion Listening Assessment, Clinical Assessment (CLAAS) – Parent, Self-Report
Progressive Activties of Controlled Exertion (PACE) – Self-Efficacy (Child/Parent)
Multiple Assessment of Cognition & Symptom (MACS)
Concussion Recognition & Response (CRR) – Parent, Coach app
Concussion Assessment & Response (CAR) – Medical app

Objectives

This session will help participants:

1. Concussion Basics
2. Concussion Complexities
   - Subtypes
   - Pre-injury hx
   - Post-injury understanding & management
3. Assessing these factors
4. Treating these factors

Centers for Disease Control and Prevention Guideline on the Diagnosis and Management of Mild Traumatic Brain Injury Among Children

Multimodal Assessment of Cognition & Symptoms (MACS)
Concussion Recognition & Response (CRR) – Parent, Coach app
Concussion Assessment & Response (CAR) – Medical app
CONCUSSION BASICS

What is a concussion?

- A bump, blow or jolt to the head or body that causes the brain to move rapidly back & forth
- Causes stretching of brain, causing chemical changes, and cell damage
- Causes change in how brain works (signs & symptoms)
- Once these changes occur, brain is more vulnerable to further injury and sensitive to increased stress

What are the new findings?

- Children and adolescents are expected to take up to 8 weeks to recover following sport-related concussion.
- The traditional reliance on baseline neuropsychological testing is not recommended in children and adolescents.
- A total period of cognitive and physical rest following sport-related concussion in children and adolescents should be followed with gradual symptoms-based physical and cognitive activity.
- All schools be encouraged to have a concussion prevention and management policy and should offer appropriate academic accommodations and support students recovering from sport-related concussion.

Cases

- Typical
- Atypical
  - Pre-Injury: Headache, Anxiety, Mood Disorder, ADHD, Learning Disability
  - Family factors
  - RRRREESSSTTTTT (Management)
3,700 Deaths
4.5 per 100,000
37,000 Hospitalizations
63.0 per 100,000

Pediatric Care
Urgent Care
[None]

Emergency department

Many Causes
Motor Vehicle Collisions
Falls
Struck By/ Against
Assaults
Sports & Recreations

Concussion = Traumatic Brain Injury

Neurometabolic Cascade Following Traumatic Brain Injury
(Giza & Hovda, 2001)
**Pathophysiologival Basis (2001)**

- Stress and strain of force:
  - cell wall
  - diffuse axonal injury
- Massive ionic flux of potassium and calcium.
- Metabolic demands on cells exposed to ionic flux results in injury-induced diaschisis
  - loss of coupling between neuronal activation and cerebral blood flow,
  - Produces energy crisis
  - Mitochondrial dysfunction

**Anatomical Timeline of a Concussion**

**Defining the Key Factors**

- LOC <10%
- Antero-grade Amnesia 25-40%
- Retro-grade Amnesia 20-35%
- Neurocog dysfx & Post-Concuss Sx’s

**C. Risk Factors**
- Pre-Injury Risks
- A. Injury Characteristics
- B. Symptom Assessment

**Concussion**
- Sec-Min
- Sec-Hrs
- Hours - Days - Weeks+

**Signs of a Concussion**

*what you observe*

**Cognitive**
- Appears dazed/stunned
- Confused about events (assignment or position)
- Answers questions more slowly
- Repeats questions/forgets instruction or play
- Can’t recall events prior to or after the hit/fall

**Physical**
- Vomiting
- Loses consciousness
- Balance problems
- Moves clumsily
- Drowsy

**Behavior/Emotion**
- Behavior or personality changes
Symptoms of a Concussion
(what they feel and report)

**Physical**
- Headache
- Fatigue
- Visual problems (blurry/"double")
- Nausea/vomiting
- Balance problems/ dizziness
- Sensitivity to light/noise
- Numbness/tingling

**Cognitive**
- Mental fogginess
- Difficulty concentrating
- Difficulty remembering
- Feeling slowed down

**Emotional**
- More emotional
- Irritable
- Sad
- Nervous

**Sleep**
- Sleeping more/less
- Trouble falling asleep
- Drowsiness

**Invisible injury**
- TBI not appreciated
- Look "normal"

**Psychosocial Issues**
- Cut off from social group (team)
- Loss of identity
- Pressures to be "normal", return & contribute
- Pressure of schoolwork

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Recovery of Child/ Adolescent: Our Best Guess

- Research literature still limited understanding of concussion recovery outcomes across full age range, and for boys and girls (IOM, 2013; CDC 2016; Berlin, 2016; NIH, 2016).
- Don’t expect “7-10 days” for recovery!

- Largest pediatric-adolescent study (Zemek et al., 2016; n>3,000; age 5-18) indicates 70 +/-% symptom recovery within 4 weeks

- And – Age, sex, injury type/severity matter!

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Who needs what treatment and when and how much (for how long)?

**"Typical" Recovery (1-4 wks)**
1. Clinically Predictive Assessment
2. Targeted Treatment/ Rehabilitation

**Atypical Recovery (4+ wks)**

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General Symptom Recovery Tracking

Concussion Complexity

Prolonged Symptom Culprits
- Headaches
- Fatigue
- Vestibular/ocular-motor (dizziness, balance)
- Cognitive problems (attention, memory, executive function, speed)
- Anxiety/mood problems
**Concussion Effects**

- Injury
- Effects
  - Fatigue
  - Vestibular
  - Cognitive
  - Emotional
  - Ocular Motor
  - P.T.
  - Migraine
  - Sleep

**Prolonged Recovery/Persistent Symptoms**

- Injury
- Atypical Recovery (4+ wks)

**Education/Reassurance**
- PACE (starting Day 1)
  - School (Cognitive)
  - Social-Emotional
  - Physical

**Sx Targeted Treatments**
- Headache
- Emotional
- Cognitive
- Vestibular
- Ocular-motor
- Cervical

**Clinical Tools**
**Symptom Assessment**

**Acute Concussion Evaluation (ACE)**  
**Post-Concussion Symptom Inventory (PCSI)**  
**Post-Concussion Executive Inventory (PCEI)**

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**Post-Concussion Symptom Inventory (PCSI)**

- **Child Report**
  - Age 5-7 – 5 items
  - Age 8-12 – 17 items
  - Age 13-18 – 21 items

- **Parent Report**
  - Age 5-18 – 20 items

**Assesses:**
- 4 symptom categories
- Pre- and Post-Injury ratings to identify injury-specific effects
- Developmentally sensitive
- Psychometric support
- Included in the NIH CDE toolkit
- Used worldwide

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**Evidence-Based Post-Concussion Assessment**

- Central score is the **Retrospective Adjusted Post-Injury Difference (RAPID) score** (Post-Pre)
- Detect change in symptoms, executive function from pre to post-injury, and across recovery.
- Guides intervention supports across recovery
Assessing & Monitoring Key Executive Functions

- Problems with executive functions are common following brain injuries (Chapman et al., 2010; Isquith, Roth, & Gioia, 2013).
- Routinely assessed in an ecologically valid manner (Gioia, Kenworthy, & Isquith, 2010).
- The BRIEF is most widely used measure of the executive functions following brain injury in children/adolescents.
- BRIEF has demonstrated sensitivity to executive function deficits associated with TBI of all severity levels.
- We modified the BRIEF to include scales sensitive to concussion (Working Memory, Emotional Control, Task Initiation/Completion).

RCIs applied to the Post-Concussion Executive Inventory

<table>
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<tr>
<th>Scale</th>
<th>RAPID score</th>
<th>m/s</th>
<th>80%</th>
<th>90%</th>
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<tr>
<td>Working Memory</td>
<td>8</td>
<td>0-2</td>
<td>3</td>
<td>4+</td>
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<tr>
<td>Emotional Control</td>
<td>1</td>
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<td>1</td>
<td>2+</td>
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<td>Task Completion</td>
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<td>0-3</td>
<td>4</td>
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<tr>
<td>Total</td>
<td>13</td>
<td>0-6</td>
<td>7-8</td>
<td>8+</td>
</tr>
</tbody>
</table>
Defining Academic Outcomes


- Results: Non-recovered (RC-) group reported higher levels of concern, more school-related problems than RC+ group.
- High school students report higher levels of problems.
- Higher symptom burden associated with greater reported academic problems.
- Significantly greater impairment on cognitive testing in RC- group.

Summary: empirical evidence of concussion’s impact on learning/performance reported by students. Identifies academic effects to target interventions.

### Symptoms of a Concussion

**Physical**
- Headache
- Fatigue
- Visual problems (blurry/"double")
- Nausea/vomiting
- Balance problems/ dizziness
- Sensitivity to light/noise
- Numbness/tingling

**Cognitive**
- Mental fogginess
- Difficulty concentrating
- Difficulty remembering
- Feeling slowed down

**Emotional**
- More emotional
- Irritable
- Sad
- Nervous

**Sleep**
- Sleeping more/less
- Trouble falling a sleep
- Drowsiness

### Targets for Supports

- Healthcare Provider Input:
  - Diagnose
  - (Re)Define
  - Recommend/Suggest

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### Academic Effects of Concussion in Children and Adolescents

**Purpose:** The aim of this work is to study the nature and extent of the adverse academic effects faced by students recovering from concussion.

**Methods:** A sample of 269 students aged 5 to 18 who sustained a concussion and their parents reported academic concerns and problems (e.g., symptoms interfering, distributed academic skills) in a structured school questionnaire within 4 weeks of injury. Postconcussion symptoms were measured as a matter of injury severity. Students were examined based on recovery status (resumed or actively symptomatic) and level of school (elementary, middle, and high school).

**Results:** Initially, symptoms and their parents reported higher levels of concern for the impact of concussion on school performance (P < .001) than non-recovered and their parents high school students (P < .001). Greater severity of postconcussion symptoms was associated with more school-related problems and worse academic effects, regardless of time since injury (P < .001).

**Conclusions:** This study provides initial evidence for a concussion’s impact on academic learning and performance, with more severe effects reported by students who had not yet recovered from the injury. School-based management with targeted recommendations can result in significant academic effects. Parents and students are encouraged to continue monitoring concussion’s impact on learning and academic performance, and the role of ongoing recovery for students with persistent postconcussion symptoms.
Guiding Progressive Activities of Controlled Exertion

Active Recovery Management (Typical Recovery: 1-4 weeks)

Setting the Positive Foundation: Key Messages
- You will get better.
- You will improve and recover.
- You have control of your activity.
- Your efforts to control your activity & time will pay off.
- Find your “sweet spot” of activity (not too little/much).
Progressive Activities of Controlled Exertion (PACE)*

1. Set the Positive Foundation for Recovery (Ed & reassurance)
2. Define the Parameters of the Activity-Exertion Schedule
3. Skill Teaching: Activity-Exertion Monitoring/Management
4. Reinforcing the Positive, Progressive Path to Recovery

*Gioia, 2015

“Active” Aerobic Rehabilitation

A Preliminary Study of Subsymptom Threshold Exercise Training for Refractory Post-Concussion Syndrome

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Objectives: To evaluate the safety and effectiveness of submaximal aerobic exercise training for the treatment of post-concussion syndrome.

Methods: 28 patients with post-concussion syndrome were randomized to aerobic exercise training or a control group. The exercise group was prescribed a submaximal aerobic exercise program, consisting of 30-45 minutes of aerobic exercise at 50-70% of maximum heart rate, 3-5 times per week for 8 weeks.

Results: The exercise group showed significant improvement in symptoms compared to the control group. The exercise group also showed significant improvement in quality of life measures.

Conclusion: Submaximal aerobic exercise training is a safe and effective treatment for post-concussion syndrome.

“Active” Aerobic Rehabilitation

“Treatment with controlled exercise is a safe program that appears to improve PCS symptoms when compared with a no-treatment baseline.”

Pictorial Children’s Effort Rating Table (PCERT)

INTRODUCTION
The majority of patients with sport-related concussion symptoms experience “mild” and resolution within the first 1-2 weeks. However, some children and adolescents also experience symptoms lasting beyond what is considered normal and acceptable. These symptoms include fatigue, headaches, difficulty concentrating, irritability, and sleep disturbances. The Pictorial Children’s Effort Rating Table (PCERT) is a tool designed to help healthcare providers measure the child’s perceived level of exertion as they engage in physical activity.

The PCERT consists of 7 levels of exertion, ranging from “not doing a thing” to “very hard.” Each level is represented by a pictorial image of a child exercising, with text indicating the level of exertion. The PCERT is intended to be used in conjunction with other assessment tools to help determine the child’s physical activity prescription.

4. Resting & a break
5. Very hard
6. Getting a little hard
7. Easy
8. Very easy
Promoting Health/Reducing Risk in Sports

Life Outcome

“Reasonable” Outcomes

Predictors

“Exposure”
Biological resilience/vulnerability
(genetics)
Personal life history factors
(healthy/unhealthy)

Age

Bad Outcomes

Cases

• Typical
• Atypical
  – Pre-Injury: Headache, Anxiety, Mood Disorder, ADHD, Learning Disability
  – Family factors
  – RRRREEESSSTTTT (Management)

Health Promotion

Sleep
Stress Management
Physical Activity
Eat Well
Relate!

SCORE
Safe Concussion Outcome, Recovery & Education

PLAY HARD.
PLAY SAFE.
PLAY SMART!