There are no conflicts of interest to disclose
Objectives

• Definition/Pathophysiology
• Incidence/Epidemiology
• Myths/Facts
• Clinical Evaluation – History/Physical
• Diagnosis and Treatment
What is a concussion?

• Concussion = traumatic brain injury

• US Centers for Disease Control: Disruption in normal brain function due to blow or jolt to head

• Zurich guidelines, 2008: Complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces
1. Widespread depolarization and neurotransmitter release

2. Potassium efflux

3. Calcium in the cell impairs ATP production in mitochondria, worsening energy crisis

4. Calcium influx also causes axonal swelling

5. Na/K ATP-requiring transporters work overtime to restore balance
After the Injury

- Increased metabolic needs of the cell
- Cerebral blood flow reduced
- Cerebral blood flow uncoupling
Metabolic Mismatch of Concussion

- Days in animal models and adult humans
- Longer in children and adolescents
- Up to 1 month in 11-14 yo
- Physical or cognitive exertion diverts resources needed for recovery
Concussion Burden

- 650,000 children/adolescents with concussion annually in US
- Unknown larger number who do not seek care
- 325,000 will have a CT scan; 90% negative
- Only 50% sports-related
Concussion Myths

• Requires blow to head
• Always results in loss of consciousness
• Mild Traumatic Brain Injury means mild consequences
• You can tell how bad a concussion is from the very beginning
Concussion Facts

• Blow to head not required
• Loss of consciousness in only 10% of concussions
• mTBI ≠ “mild” clinical symptoms
• Severity cannot be determined at time of injury
Patient Evaluation

- History
- Physical Exam
- Radiology
- Neurocognitive Testing

- Diagnosis
- Treatment
Concussion *IS* a clinical diagnosis

**History:**
- Mechanism of injury
- Temporal association of symptom onset

**Symptoms:**
- Ask about *all symptoms*
- Patients may not report or intentionally hide symptoms to prevent removal from play
Concussion Signs and Symptoms

Physical
- Headache/pressure in head
- Nausea/vomiting
- Balance Problems
- Dizziness
- Vision problems
- Fatigue/Drowsiness
- Sensitivity to light/sound
- Sleep disturbance

Cognitive
- Difficulty concentrating
- Difficulty remembering
- Feeling foggy

Emotional
- Irritability or mood changes
- Personality changes
- Anxiety
Concussion-Focused Physical Examination

- Head and Neck
  - Range of motion
- Balance
  - Tandem heel to toe gait forward eyes open and closed
  - Tandem heel to toe gait backwards eyes open and closed
  - Double leg tandem stance with eyes closed
Balance
Concussion-Specific Oculomotor Exam

• **Saccades**
  – Horizontal and vertical eye movement with head stationary

• **Gaze stability testing**
  – Horizontal/vertical head movement while focused on stationary object

• **Smooth Pursuits**
  – Visual tracking of an object, nystagmus

• **Dysmetria**
  – Finger-nose-finger

• **Convergence deficit**
  – Bring item towards nose, measure distance where object becomes blurry
Radiographic Evaluation

Concussion is NOT a Radiographic Diagnosis

• Current imaging modalities (CT, MRI) do not identify anatomic abnormalities in concussion
• Acute evaluation is to identify intracranial hemorrhage
• Clinical observation is an option
Neurocognitive Testing

- ImPACT® (Immediate Post-Concussion Assessment and Cognitive Testing), AxonSport
- Not necessary to diagnosis concussion
- May be adjunct in decision for return to play
- Must be interpreted in clinical context
Acute Concussion Management

• Goal: Protect the brain during the vulnerable stage of metabolic mismatch

• Cognitive and physical exertion exacerbates and prolongs symptoms

• Cognitive and physical rest improves and hastens resolution of symptoms
What is cognitive rest?

• Complete elimination of activities that cause symptoms
  – School
  – Homework
  – Reading
  – Computer use
  – Videogames
  – Text messaging
  – Social media
Return to Learn

• Return to learn plan in 5 steps
• If symptoms return, go back to the previous step
• Specific instructions helpful for families
  – Patient/parents progress through plan based on symptoms
Return to Learn Protocol

1. Limit Cognitive Activity

• Goal: Rest during period of metabolic mismatch

• Complete physical and cognitive rest until symptom-free 24 hours
  
  – No physical exercise, school, homework, computer use, videogames, text messaging, reading for school

• Consider activities that do not worsen symptoms - baking, cooking, drawing, crafts, Legos®, listening to soft music, talking on the phone
Return to Learn Protocol

2. Light Cognitive Activity

- Goal: Reintroduce cognitive activity
- Reintroduce activities in 5-10-15 minute blocks – television, music, computer time, texting, reading, homework
- Increase repetition and duration of activities if symptoms do not return
Return to Learn Protocol

3. Moderate Cognitive Activity

• Goal: Increase duration of cognitive activity
• Reading, video games, homework for 30 minutes or more at a time
• Repeat a few times daily
• May cause mild symptoms that resolve with a break
Return to Learn Protocol

4. More Prolonged Cognitive Activity

• Goal: Re-entry to school part-days
• Homework 1-2 hours per day in 30 minute increments with breaks
• Half-day school with breaks and accommodations
• Work until mild symptoms then take a break
Return to Learn Protocol

5. Sustained Cognitive Activity

• Goal: Re-entry to school full days
• Full homework load at home in 30-45 minute increments for up to a total of 3-4 hours
• Full day school with breaks and accommodations
Return to Play Protocol

1. Limit Physical Exertion

• Goal: Rest during metabolic mismatch

• Complete physical and cognitive rest – no activities that elevate HR or cause sweating

• Concurrent with Step 1 of Return to Learn Plan
Return to Play Protocol

2. Light Aerobic Exercise Training

• Once in school symptom-free
• Goal: increase heart rate (HR)
Examples include walking, swimming or stationary cycling keeping intensity <70% maximum predicted HR, but no resistance training at this step.
• Return to previous step if symptoms present
Return to Play Protocol

3. Sport-Specific Exercise Training

• Goal: add movement

• Examples: skating drills in hockey, running drills in soccer, no head impact activities
Return to Play Protocol

4. Non-contact training drills

• Goal: increase exercise, coordination and cognitive load

• Examples include more complex training drills, passing drills

• May start progressive resistance training
Return to Play Protocol

5. Full contact practice

- Not until medically cleared
- Goal: restore confidence and assess functional skills by coaching staff
- Normal physical exam – balance, vestibular, oculomotor
- Normal cognitive function
  - Asymptomatic with full day school; normal school function
- No symptoms with full physical exertion
- Normal contact training activities
Return to Play Protocol

6. Return to normal full contact game play
Follow-up

- Concussion management can be initiated by primary care pediatricians when:
  - Symptoms respond to rest
  - Slow ramp up back to cognitive/physical activities tolerated well
  - Primary care follow-up once a week for 2-4 weeks until full return to cognitive and physical activities
Referral

• Indications for referral to concussion specialist
  – Symptoms unresponsive to cognitive rest beyond 2-3 weeks
  – Repeated concussions
  – Pre-existing comorbidities – depression, anxiety, ADHD, dyslexia, learning disability, migraines
  – Prolonged symptoms beyond 4 weeks
Summary

• Concussion is a prevalent mild traumatic brain injury
• Presentation is heterogeneous and can be subtle
• Prompt recognition and treatment with cognitive rest is crucial to prevent prolonged course
• Primary care pediatricians can initiate care and manage most concussions
• www.chop.edu/concussion
• Muchas Gracias!!!
• masterc@email.chop.edu
• Gracias por su atención. Si usted desea una copia de la presentación, o para más información acerca de nuestros programas internacionales, visite nuestra página:

http://www.chop.edu/latin-america/