





Concussion Evaluation & Management

Priscilla Tu, DO, FAOASM, FAAFP
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Objectives

- Briefly review concussion basics
- Review most recent consensus statement on concussion evaluation and management
- Discuss latest research in evaluation and management of concussions



Disclosures

- Unfortunately, I have no financial disclosures.



Int'l Conference on Concussion in Sport

- November 2001 – Vienna, Austria
- November 2004 – Prague, Czech Republic
- November 2008 – Zurich, Switzerland
- November 2012 – Zurich, Switzerland
- **October 2016 – Berlin, Germany**



Concussion Definition

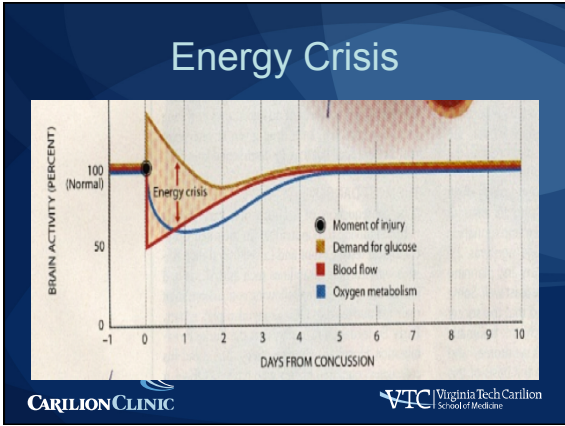
- Complex pathophysiological process affecting the brain, induced by biomechanical forces
 - "impulsive" force transmitted to head
 - Typically rapid onset of short-lived impairment of neurologic function that resolves spontaneously
 - Usually a functional disturbance
 - Graded set of clinical symptoms
 - Resolution usually follows sequential course



Science in Concussion

- Impact → brain cell membranes stretch and tear = cannot maintain environment; can → death of cell
 - Increases metabolic demand = must work harder to perform (& repair)
 - Injury → imbalance K, Na, glutamate (can be toxic)
 - Energy crisis to brain cells
- Axonal shear → ability of cells to send signals compromised
 - Too much → permanent damage





Epidemiology

- 1.6-3.8 million annually in US

Motor vehicle trauma	8973
Homicide	4088
Suicide	2841
Influenza and pneumonia	356
Cerebrovascular	246
Meningitis	67
Accidental alcohol poisoning	38
Sport-related cardiovascular events	38 ^a
Lightning strikes	10
Sport-related head trauma	6-9 ^b



Unless indicated, data are from 1999 to 2009 average National Center for Injury Prevention and Control.

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- ### Problem in Concussion
- Underreported
 - Media
 - Culture change needed →
 - EDUCATION
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Concussion Data

- 85-90% college concussions resolve in 7 days (mean = 3-5 days)
- H/O concussion → almost 6x more likely to have another
- H/O >=3 → 30% w symptoms >1 week
- Greatest risk of repeat concussion = 1st 10 days

Concussion Diagnosis

- Symptoms—somatic (eg, headache), cognitive (eg, feeling like in a fog) and/or emotional symptoms (eg, lability).
- Physical signs (eg, loss of consciousness, amnesia).
- Behavioral changes (eg, irritability).
- Cognitive impairment (eg, slowed reaction times).
- Sleep disturbance (eg, drowsiness).

Concussion Diagnosis

- Important to obtain a detailed concussion history
 - At injury
 - **PPE**



Concussion History Study Questionnaire ^a	
Have you ever had a concussion or head injury	While playing a sport?
	While participating in a recreational activity?
Have you ever been knocked out	While playing a sport?
	While participating in a recreational activity?
Have you ever had your "bell rung" or been "dinged"	While playing a sport?
	While participating in a recreational activity?

^a A yes response to any question resulted in the placement of the participant in the positive concussion history group.






Pre-season Baseline Testing

What is it?	When
<ul style="list-style-type: none">• Symptom checklist• Cognitive assessment<ul style="list-style-type: none">• SAC, SCAT3 (Child)• Balance• Neuropsychological• Education of players, coaches, parents	<ul style="list-style-type: none">• HS – may do every other year• College – may do as freshman<ul style="list-style-type: none">• Consider repeat baseline if had concussion in previous year



Sideline Evaluation

- ANY signs of concussion →
 - Evaluation by healthcare provider on site
 - Appropriate disposition determined
 - Assessment Tool (SCAT3) p 15 min – AxO unreliable
 - Serial monitoring – do NOT leave patient alone

Sideline Assessment Tool

- Have a standard method and DOCUMENT
- Pocket Concussion Recognition Tool
 - Visible clues
 - Signs/Symptoms
 - Memory Function
- SCAT3 and Child SCAT3

Return to Play?

- If symptoms and on-field/sideline evaluation consistent with concussion
→



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Return to Play?

- If symptoms and on-field/sideline evaluation consistent with concussion
→ NO RTP
 - Especially true for pediatric population
 - Education and culture change needed

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Evaluation in Office

- Comprehensive history (include previous injuries)
- Detailed neurological examination
 - Mental status
 - Cognitive functioning
 - Gait / vestibular evaluation
 - Balance / postural testing
- Clinical status – improvement or deterioration since injury/previous assessment

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Neuroimaging

- CT initially to r/o bleed
- MRI – post-concussion symptoms
 - Structural changes
- DTI, fMRI, SPECT – still investigational

Concussion Treatment



- “The cornerstone of concussion management is physical and cognitive reset until the acute symptoms resolve and then a graded program of exertion prior to medical clearance and return to play.”



Acute Management

- Physical / Cognitive Rest
- NSAIDs/Tylenol
- Physical Therapy
 - Vestibular (if dizziness)
 - Cervical (if HA or neck pain)
- OMT – cervical, craniosacral
- DHA

Stepwise Return to Play

Each step should be separated by 24 hours

- 1 NO ACTIVITY. Rest until asymptomatic.**
- 2 Light aerobic exercise.**
Examples: Light jogging; Stationary bike.
- 3 Sport-specific exercise. No contact.**
Examples: Running; Shooting on a side basket.
- 4 Non-contact sport drills.**
Examples: Full-speed agility drills; Passing drills.
- 5 Full-contact sport drills.**
Examples: Tackling drills; Scrimmaging.
- 6 Full activity.**
Practice/Game with no restrictions.

Do not advance to the next step if symptoms reappear


Post-Concussion Syndrome

- Symptomatic medication (ADHD, migraine, depression)
- Vestibular PT (coordination, balance, ambulation)
- DHA
- Hyperbarics
- Moderate exercise
- OMT

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Concussion Modifiers

Factors	Modifier
Symptoms	Number Duration (>10 d) Severity
Signs	Prolonged loss of consciousness (>1 min), amnesia
Sequelae	Concussive convulsions
Temporal	Frequency: repeated concussions over time Timing: injuries close together in time "Recency": recent concussion or traumatic brain injury
Threshold	Repeated concussions occurring with progressively less impact force or slower recovery after each successive concussion
Age	Child or adolescent (<18 y old)
Comorbidities and premorbidities	Migraine, depression, or other mental health disorders, attention deficit hyperactivity disorder (ADHD), learning disabilities (LDs), sleep disorders
Medication	Psychoactive drugs, anticoagulants
Behaviour	Dangerous style of play
Sport	High-risk activity, contact and collision sport, high level of sporting level

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What About...?

- Genetic testing?
- ERP? EEG?
- Role of gender?
- **LOC?**




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What About...?

- Genetic testing?
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- **Amnesia?**




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What About...?

- Genetic testing?
- ERP? EEG?
- Role of gender?
- LOC?
- Amnesia?
- **Convulsions?**





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What About...?

- Genetic testing?
- ERP? EEG?
- Role of gender?
- LOC?
- Amnesia?
- Convulsions?
- **Depression?**



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What About...?

- Genetic testing?
- ERP? EEG?
- Role of gender?
- LOC?
- Amnesia?
- Convulsions?
- Depression?
- **Children?**



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What About...?


- Genetic testing?
- ERP? EEG?
- Role of gender?
- LOC?
- Amnesia?
- Convulsions?
- Depression?
- Children?
- **Elite v non-elite?**




PRECISION
"I try to catch them right on the tip of his nose, because I try to punch the bone into the brain."
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Prevention – Equipment


- Helmets?




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Prevention – Equipment


- Helmets?
- Mouthguards?




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Prevention – Equipment


- Helmets?
- Mouthguards?
- Neck strengthening?




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Prevention


- Helmets?
- Mouthguards?
- Neck strengthening?
- Rule changes?

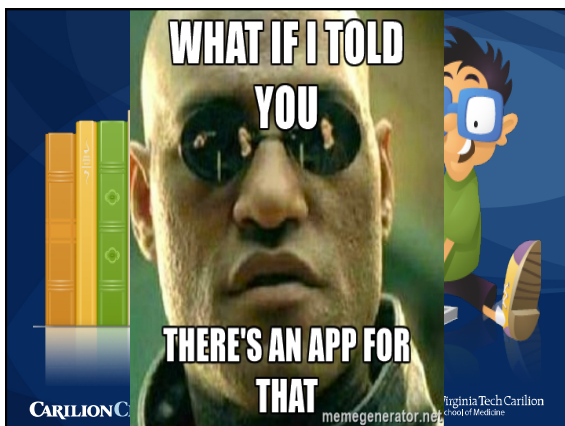


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
Retirement

Season Ending	Career Ending
<ul style="list-style-type: none">• Prolonged post concussion syndrome• >=3 in one season• >=2 major in one season• Diminished academic or athletic performance• CT/MRI abnormality	<ul style="list-style-type: none">• Chiari malformation• Intracranial hemorrhage• Diminished academic performance or cognition• Persistent/prolonged post-concussion syndrome• Lowering threshold for concussion• >=3 major• CT/MRI structural abnormalities

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WHAT IF I TOLD YOU THERE'S AN APP FOR THAT

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HIT ✓

Diagnosis – App

- HHITT = Handheld Head Injury Treatment

The screenshot shows three panels from the app. The first panel is a 'Test List' with checkboxes for various tests: Short Term Memory Test, Balance Test, Reaction Time Test, Coordination, Pattern Recognition Test, Problem Solving Test, Color Recognition Test, and Impulsive Control Test. The second panel is the 'Short Term Memory Test' grid with words: Boon, Ploy, Salient, Software, People, Country, Gold, Poem, Device, Caution, Reverse, Tackling, Penalty, Mark, Score, Window, Court, Brisk. The third panel is the 'Coordination' test showing a ball on a track with a timer at 0 of 15 seconds.

Gaze Stabilization Test Asymmetry Score

- Athletes with previous concussion had larger GST asymmetry scores than those without

The diagram shows three head-and-neck profiles. Figure 2A: Look straight ahead. Figure 2B: Turn your head 45 degrees towards the right. Figure 2C: Turn your head 45 degrees towards the left. Note: Business card should be positioned at eye level. HT T.C. MAHA, 2008

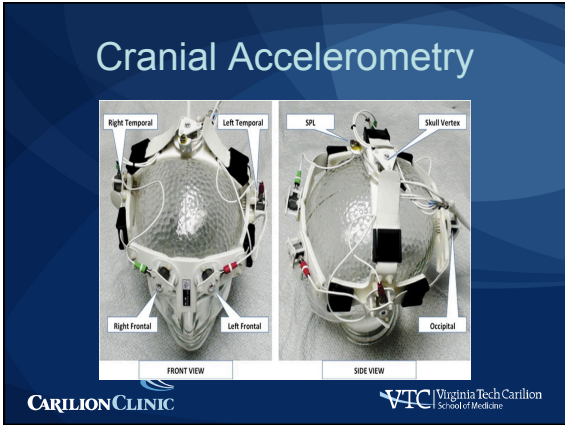
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Apolipoprotein E Genotype

The diagram shows a cross-section of a lipoprotein particle. It is a spherical structure with a core of Cholesterol esters and Triglycerid, and an outer monolayer of Phospholipid. Apolipoprotein E is shown on the surface. Chemical structures for cholesterol and phospholipid are also depicted.

- Carriers of 3 APOE rare alleles = 10x more likely to report previous concussion
- Carriers of promoter rare allele = 8.4x more likely multiple concussions

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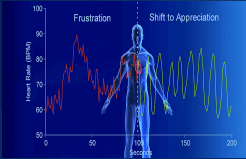
Return-to-Learn Plan		
Stage	Activity	Objective
No activity	Complete cognitive rest — no school, no homework, no reading, no texting, no video games, no computer work.	Recovery
Gradual reintroduction of cognitive activity	Relax previous restrictions on activities and add back for short periods of time (5-15 minutes at a time).	Gradual controlled increase in subsymptom threshold cognitive activities.
Homework at home before school work at school	Homework in longer increments (20-30 minutes at a time).	Increase cognitive stamina by repetition of short periods of self-paced cognitive activity.
School re-entry	Part day of school after tolerating 1-2 cumulative hours of homework at home.	Re-entry into school with accommodations to permit controlled subsymptom threshold increase in cognitive load.
Gradual reintegration into school	Increase to full day of school.	Accommodations decrease as cognitive stamina improves.
Resumption of full cognitive workload	Introduce testing, catch up with essential work.	Full return to school; may commence Return-to-Play protocol (see Step 2 in Table 2).

Source: Mastri CL, Gioia GA, Gado JE, Orosi MF

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Treatment

Heart Rate Variability



The graph shows heart rate (bpm) on the y-axis (50-100) and time on the x-axis (0-200). A red line shows a peak in heart rate during the 'Frustration' phase, followed by a lower, more stable heart rate during the 'Shift to Appreciation' phase.

Text Messages

Dude guess what happened to me



OMG the most amazing thing happened today! What happened?

I got a concussion!

What?! How?


I was coming round to your house, then a flower pot hit me on the head. What were you going to say?


Oh, I was going to say that one of my mother's flower pots fell off my balcony and hit some guy on the head.

Concussion Pearls

- When in doubt, keep them out!
- Tx: physical AND cognitive rest
- Graduated RTP and RTL protocols
- Thorough PPE and H&P
- No two brains are the same






Questions?





CONCUSSION

LOOK ON THE BRIGHT SIDE. FOR ONE BRIEF, GLORIOUS MOMENT, YOU FORGOT YOU WERE ON THE CUBS.




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