

Neuroimaging and Diagnostics of Concussion

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February 13th, 2020

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Goals

- ◉ Defining concussion
- ◉ Role of radiology in concussion assessment
- ◉ Neuroimaging techniques
- ◉ Role of neuropsychology in concussion assessment

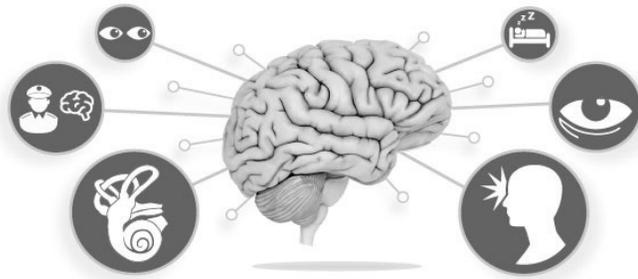
Definition of concussion...

- ◉ “is a brain injury and is defined as a complex pathophysiological process affecting the brain, induced by biomechanical forces” [Zurich, 2012]
- ◉ “is a mild traumatic brain injury typically caused by the acceleration / deceleration forces from a blow to the head or body” [AACN, ABN, NAN, APA 2012)

Definition of concussion...

- ◉ “Traumatic alteration in mental status that may or may not involve loss of consciousness” [NATA, 2014]
- ◉ “a clinical syndrome of biomechanically induced alteration of brain function” [AAN, 2013]

Variability in Symptoms

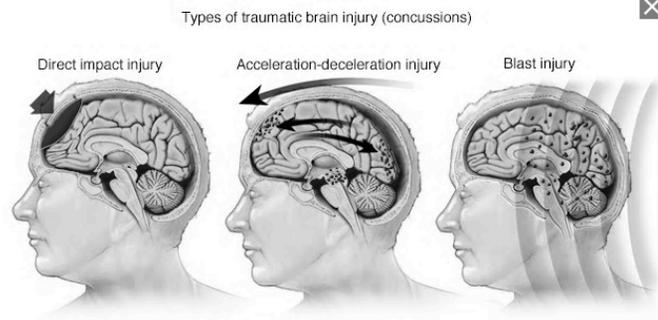


Age as a Factor

- Symptoms > is younger pediatric population
- Wider variability in recovery in youth compared to adults
- No significant difference in acute presentation between pediatric and adult populations



Causes



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Types of concussion injuries

Common injuries that cause concussions include falls or other direct hits to the head, car accidents and blast injuries from explosions. These injuries can affect the brain in different ways and cause different types of concussions.

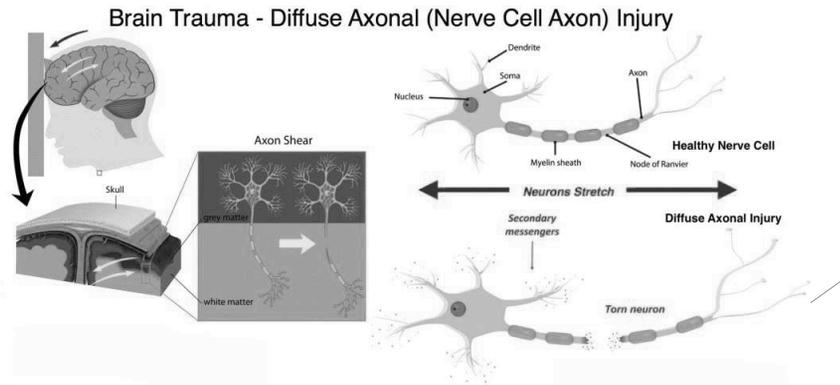
Effects

HOW TRAUMATIC BRAIN INJURY (TBI) AFFECTS DAILY LIFE

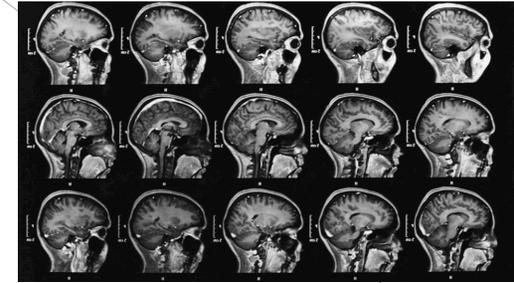
HEALTHY	TBI
<ul style="list-style-type: none"> ● Frontal: Concentration, Problem Solving, Speech 	<ul style="list-style-type: none"> ● Frontal: Lack of Focus, Irritability, Language Difficulty
<ul style="list-style-type: none"> ● Parietal: Sense of Touch, Pain, Temperature 	<ul style="list-style-type: none"> ● Parietal: Difficulty with Reading, Spatial Misperception
<ul style="list-style-type: none"> ● Occipital: Healthy Vision 	<ul style="list-style-type: none"> ● Occipital: Blind Spots, Blurred Vision
<ul style="list-style-type: none"> ● Temporal: Memory, Organization 	<ul style="list-style-type: none"> ● Temporal: Problems with Short- & Long-Term Memory
<ul style="list-style-type: none"> ● Cerebellum: Balance & Coordination 	<ul style="list-style-type: none"> ● Cerebellum: Difficulty Walking, Slurred Speech
<ul style="list-style-type: none"> ● Brainstem: Breathing, Steady Heart Rate 	<ul style="list-style-type: none"> ● Brainstem: Changes in Breath, Difficulty Swallowing

Data © Mayfield Clinic

Effects



Role of Radiology in Concussion Assessment



Identify traumatic injuries including...

- ◉ Extracranial hemorrhage
- ◉ Intracranial hemorrhage
- ◉ Skull Fractures
- ◉ Shear injuries (axonal injury)
- ◉ Cerebral edema
- ◉ Infarction
- ◉ Herniation

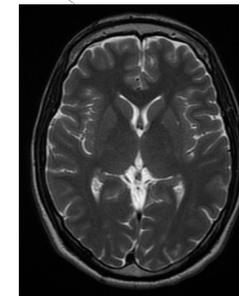


Neuroimaging Techniques

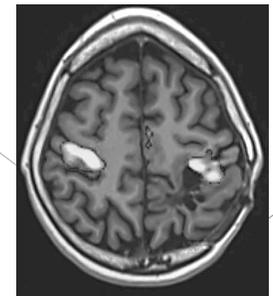
CT



MRI



fMRI



CT versus MRI?

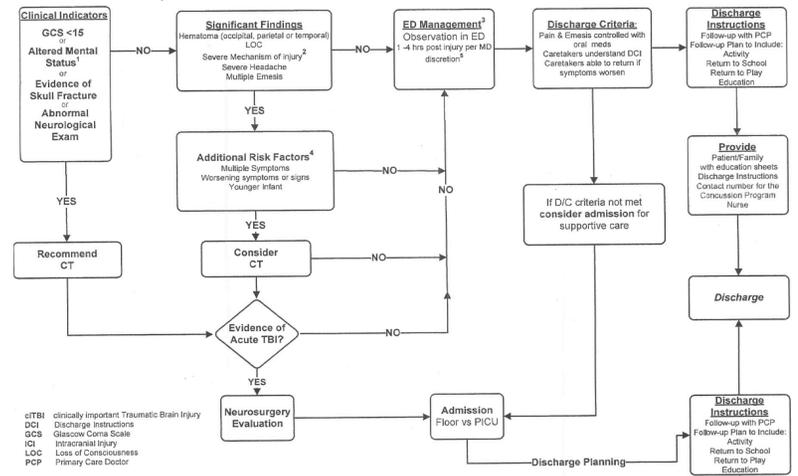


- Serial CT scans deliver cumulative radiation dose (risk for cancer)



- MRI more expensive, longer scan time, lower sensitivity for detecting fractures and hyperacute hemorrhage

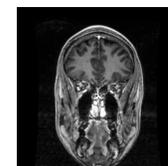
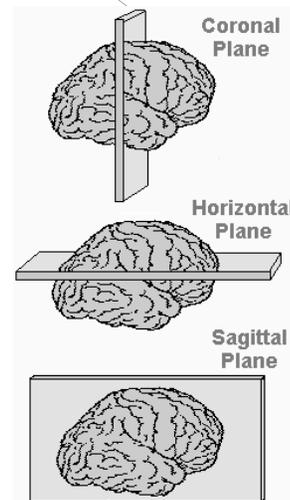
CT Scan: Clinical Pathway



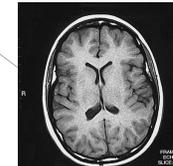
Indications for posttraumatic imaging

- CT: Initial study ASAP
- 2nd CT:
 - > within 24 hours after surgery
 - > 1-2 days after trauma
 - > if change in clinical state
 - > unexpected change in intracranial pressure
- Further CT:
 - > before removing ICP monitor
 - > any deterioration in clinical state,
- MRI:
 - > Initial scan at time of second CT, depending on clinical state
- Follow-up:
 - > 1-3 months for monitoring

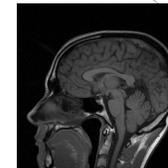
MRI Sectional Analyses



Coronal



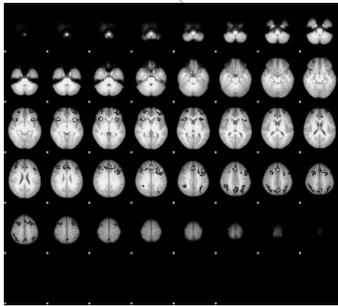
Horizontal Or Axial



Sagittal

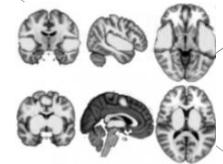
fMRI

- Currently, an “applied tool” ... “that can be employed by basic and clinical neuropsychologists as well as other professionals, to test hypotheses about normal brain function and about clinical disorders.”¹¹



fMRI Research in Concussion

- fMRI can detect pathologic disruption of connectivity after concussion to predict long term complications
- Variability, but some research suggests that fMRI can determine concussion given pattern of hyper- and hypoactivation

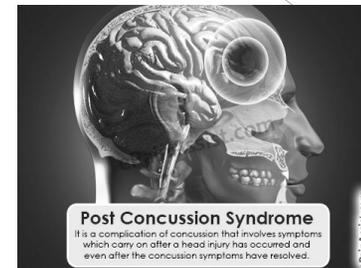


Neuropsychology Role in Concussion Assessment



Post Concussive Symptoms

- 85% concussion make a full recovery
- Majority of the 15% that don't recover, have pre-existing LD, AD/HD, Anxiety, Depression, and/or serial concussions



Concussion & Recovery

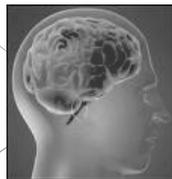
- ◉ Most patients recover within one week (>90%)
- ◉ Prolonged recovery (>7 days) is estimated to be 10 percent
- ◉ Unconscious – 4.15 times higher odds of prolonged recovery

What is a Neuropsychological Evaluation

- ◉ Review history
- ◉ Develop a flexible assessment plan
- ◉ Observations
- ◉ Standardized Neuropsychological Testing
- ◉ Written report with results and recommendations
 - “The interaction between the brain & behavior”

What we Assess...

- ◉ General intellect
- ◉ Academic achievement
- ◉ Executive skills
Attention
- ◉ Learning and Memory
- ◉ Sensory Perceptual Skill
- ◉ Language
- ◉ Visual-spatial skills
- ◉ Motor coordination
- ◉ Behavioral and emotional functioning
- ◉ Social skills
- ◉ Adaptive Function



Concluding Remarks

- ◉ Concussion definition is widely debated
 - > Variability in symptoms, presentation, and outcome
- ◉ Standard imaging is generally non-conclusive and can not diagnose a concussion
 - > Research supports functional imaging techniques as diagnostic tool
- ◉ Neuropsychology available for post concussive symptoms
 - > Most common symptoms are somatic or mood related

Questions?

Thank you!

