Concussion: Scope of the problem, diagnosis, referrals

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Learning Objectives

• At the conclusion of this presentation, participants will be able to
  • Describe basic epidemiology and pathology of concussion
  • Discuss limitations in making a conclusive concussion diagnosis
  • Discuss why and when to make referrals for treatment
Epidemiology

• Incidence (increasing)
  • \( 521/10^5 \) (2001) – \( 824/10^5 \) (2010)
    • 75% Mild

• Increased risk for Age 0-4, 15-19 and \( \geq 75 \)

• 2.5 Million Emergency Department visits - hospitalizations - deaths/year
  • 0-4 year-highest rated of ED visits

• Prevalence
  • 3.2-5.3 million, 145K in pediatric (under-reported)
Cause of Injury

- **Traffic Related**
  - Highest rate 15-24 y/o
  - Highest rate of mortality
Cause of Injury

• Traffic Related
• Falls
  • Increased incidence with end of age spectrums
    • Latest CDC data reports falls as most common cause
      • Highest risk:
        • 0-4
        • 75 and older
Cause of Injury

- Traffic Related
- Falls
- Recreational
  - Sports
    - Chronic Traumatic Encephalopathy
    - Incidence not clearly delineated
      - Reported under other categories
Cause of Injury

• **Traffic Related**
• **Falls**
  • Increased incidence with advancing age
• CDC data reports falls as most common cause

• **Recreational**
  • **Sports**
    • Chronic Traumatic Encephalopathy
    • Incidence not clearly delineated

• **Blunt trauma**
  • “struck by or against”
  • Most common in 0-4 year old group
Cause of Injury

- Traffic related
- Falls
  - Increased incidence with advancing age
  - CDC data reports falls as most common cause
- Recreational
  - Sports
    - Chronic Traumatic Encephalopathy
    - Incidence not clearly delineated

- Blunt trauma
- Assault
  - More common in urban areas
    - Less than falls, traffic related and blunt trauma
Cause of Injury

- Abusive TBI
  - Likely under-reported
Military Service

• Etiology
  • Similar to other populations
    • 80% in non-deployed settings
  • Blast exposure
  • DoD estimate
    • 235K 2000-2011
How Common are Sport Concussions in the United States?

• Estimated up to 3.8 million occurrences/year
• Many are likely unrecognized, not reported or misdiagnosed
Are all injured athletes identified?

• Talavage TM et al: J Neurotrauma 2010
• High school varsity/JV football players
  • Dx’d with concussion:
    • Altered ImPACT and fMRI
  • Not dx’d with concussion but high # or high magnitude collisions
    • Altered ImPACT and fMRI
Diagnosis

CONCUSSION DEFINITIONS
American Congress of Rehabilitation Medicine

- Traumatically induced alteration in brain function, manifested by at least one of the following:
  - Loss of consciousness
  - Memory loss either before or after the event
  - Feeling Dazed or Confused
  - Focal neurological finding
Consensus Statement on Concussion in Sport: the 5th International Conference on Concussion in Sport Berlin 2016

A sport related concussion (SRC) is a traumatic brain injury induced by biomechanical forces. Several common features that may be utilized in clinically defining the nature of a concussive had injury include:

caused wither by a direct blow to the head, face, neck or elsewhere on the body with an impulsive force transmitted to the head,

typically results in the rapid onset of short-lived impairments of neurological function that resolves spontaneously, However, in some cases, signs and symptoms evolve over a number of minutes to hours.

may result in neuropathological changes, but the cute clinical sign and symptoms largely reflect a functional disturbance rather than a structural injury and, as such, no abnormality is seen on standard structural neuroimaging studies.

results in a range of clinical signs and symptoms that may or may not involve loss of consciousness, Resolution of the clinical and cognitive features typically follows a sequential course, However, in some cases symptoms may be prolonged.

The clinical signs and symptoms cannot be explained by drug, alcohol, or medication use, other injuries (such as cervical injuries, peripheral vestibular dysfunction, etc.) or other comorbidities (e.g. psychological factors or coexisting medical conditions).
Concussion

- Complex process resulting from an impulsive blow—can be to body or head
- Any new neurological symptom like headache, dizziness, fogginess
- Loss of consciousness in less than 10%
- Nearly 4 million a year, may be an underestimation

Definition: CDC 2003

• Impact or forceful motion (acceleration / deceleration) resulting in a brief alteration of mental status, such as confusion or disorientation, loss of memory for events immediately before or after the injury, or brief LOC <30 min

More severe TBI are associated with extended periods of unconsciousness (more than 30 minutes), prolonged PTA (more than 24 hours), or penetrating skull injury.

• Observed signs of neurological or neuropsychological dysfunction

• Headache, dizziness, irritability, fatigue or poor concentration, when identified soon after injury, can be used to support the diagnosis of mild TBI, but cannot be used to make the diagnosis in the absence of LOC or altered consciousness.
A concussion is a change in brain function after a force to the head that may be accompanied by temporary loss of consciousness but is identified in awake individuals with the use of measures of neurologic and cognitive dysfunction.

Indicators of concussion, observed in alert (alert: Glasgow Coma Scale Score, 13 to 15) individuals after a force to the head, are the following:

- Observed and documented disorientation or confusion (disorientation or confusion: loss of one's sense of direction, position, or relationship with one's surroundings) immediately after the event

- Impaired balance (balance: a state of body equilibrium) within 1 day after injury,

- Slower reaction time (reaction time: the interval of time between application of a stimulus and detection of a response) within 2 days after injury, and

- Impaired verbal learning and memory (verbal learning and memory: the acquisition, retention, and retrieval of verbal material; memory of words and other abstractions involving language) within 2 days after injury.
Stretching the axons

Axons-like telephone wires
Axonal transport interruption, swelling and disconnection, like an Earthquake has occurred to a Highway- you get a big traffic jam.
Pathophysiology

- Children are different from adults
  - Cerebral water content
  - Extent of myelination
  - Cerebral blood flow
  - Skull properties
CONCUSSION ASSESSMENT

You see what you look for,
YOU LOOK FOR WHAT YOU KNOW
Clinical Presentation and Evaluation

History
• Trauma to head or body
• Other factors to consider
  • Whiplash
  • Psychiatric
  • Previous concussions
  • Social

Symptoms
• Physical
• Cognitive
• Behavioral

It should all make sense
You see what you look for,
You look for what you know
No diagnostic test for concussion
Physical Examination

SCAT 3
• Brief Neurological and MSK Examination
  • Brief cognitive screen
  • Balance
  • Coordination
  • Sensation
  • Limb strength

Deeper look
• Cranial Nerve
  • I-XII
• Visual
  • Rapid picture naming
• Vestibular
  • Dix-Hallpike
Anosmia

Olfactory Nerves - I

Loss of smell and taste
Benign Paroxysmal Positional Vertigo
Concussion Recovery

• Typically fairly rapid
• Watchful waiting
• To rest or not to rest
  • NO return to sport-related activity until medically cleared
    • Dr. Kerr to discuss Berlin Guidelines
  • Otherwise, activity as tolerated
    • Dr. Rieger to discuss return school, sports and beyond
Slower to Recover

• Consider
  • Multiple concussions
    • Time course of previous injury(ies)
  • Cervical injury
  • Mood disorder
  • Endocrine Dysfunction
  • Social Stress
Referrals to consider

• Emergency Department
  • Nausea, vomiting, marked arousal problems, focal deficits
    • Parents tend to know when their child is not right
  • Physical therapy
    • Cervical spine, paraspinal and upper back musculature pathology
    • Vestibular therapy
• Neuro-ophthalmology
  • Persistent visual complaints
  • Vision therapy
• Psychology/Neuropsychology
  • Persistent cognitive difficulties
  • Supportive therapy
  • Accommodation plan for return to school
• Neuroendocrine
  • Emerging evidence of pituitary dysfunction
    • Not well studied in pediatric populations
Summary

• TBI/Concussion is common
• Small percentage of mild TBI develop chronic problems
• Referrals as needed
  • Neurological change
  • Treatment for those slow to recover
• Much remains to be learned re:
  • Objective diagnosis
  • Effectiveness of treatments
  • Proper identification
  • Definitions
Thank you!