Traumatic Brain Injury

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Traumatic Brain Injury

• Insult to the brain capable of producing physical, intellectual, emotional, social, and vocational change
CDC Facts About TBI

• 1.4 million TBI’s per year in US
• 50,000 die annually from TBI
• 80,000 – 90,000 result in long-term disability
• Distribution
  – Falls 28%
  – MVC’s 20%
  – Struck by or against objects (Pedestrian struck) – 19%
  – Assaults – 11%
Categories of Brain Injuries

- **Primary Brain Injury** – Primary injury to the brain and associated vascular structures
- **Secondary Brain Injury** – Conditions that can further injure the brain that are associated with the original traumatic event (hypoxia, hypo/hypercapnia, anemia, hypotension, hyper/hypoglycemia, etc.)
Types of TBI’s

- **Diffuse Injuries** – Disruption of axons usually caused by acceleration/deceleration forces
  - Concussion or Mild Diffuse Axonal Injury
  - Moderate Diffuse Axonal Injury
  - Severe Diffuse Axonal Injury
Concussions

• Mild-moderate impact to the skull with movement of the brain w/i the cranium temporarily disturbing the functions of the brain
**Concussions**

**School of hard knocks**
A concussion occurs when a violent blow to the head causes the brain to slam against the skull beyond the ability of the cerebrospinal fluid to cushion the impact. Between 1996 and 2001, NFL teams reported nearly 900 concussions.

1. When a football player takes a hit to the head, speeds range from 17 to 25 miles per hour with a force averaging 98 times the force of gravity.

A study commissioned by the NFL revealed most hits occurred from a blow to the side of the head, often on the lower half of the face.

2. The shock wave passes through the brain and bounces back off the skull. The concussion usually occurs at the opposite side from the point of impact.

3. The impact can cause bruising of the brain, tearing of blood vessels and nerve damage.

**Symptoms**

- **Immediate**
  - Confusion
  - Amnesia
  - Loss of consciousness
  - Ringing in the ears
  - Nausea and vomiting
  - Convulsions

- **Delayed**
  - Irritability
  - Headaches
  - Depression
  - Sleep disorders
  - Poor concentration
  - Trouble with memory

**Cumulative effects**
Studies show that prior concussions may lower the threshold for subsequent concussion injury and increase severity of symptoms.

Sources: MayoClinic.com, Biokinetics, Washington Post, Science Daily, kidshealth.org, Kaiser Permanente

Andrew Lucas, Jeff Goertzen | The Denver Post

**Soccer Concussion**
Concussion Grading

• **Grade I**
  – Transient confusion
  – No loss of consciousness
  – Concussion symptoms clear in 15 minutes

• **Grade 2**
  – Transient confusion
  – No loss of consciousness
  – Concussion symptoms last more than 15 minutes
Concussion Grading

- **Grade 3**
  - Loss of consciousness either brief or prolonged.
Concussion Symptoms

• Drowsy
• Restless
• Confusion
• Headache
• Dizziness
• Nausea & vomiting
• Amnesia
• Visual disturbances
• Changes in equilibrium and coordination
• Changes in BP, pulse & respiratory rate
Concussion symptoms

**Concussion causes, symptoms**

**WHAT HAPPENS**
Impact to the head or a violent shaking causes the brain to hit the inner wall of the skull. Nerves and tissue are damaged and swelling can occur.

**SYMPTOMS IN CHILDREN**
- Headache or dizziness
- Loss of consciousness
- Ringing in the ears
- Slurred speech
- Fatigue or listlessness
- Sensitivity to light
- Nausea or vomiting
- Loss of balance

**RECOVERY TIME**
Symptoms usually subside in seven to 10 days.

Source: Mayo Clinic

THE COLUMBUS DISPATCH
Concussion Related Amnesia

- **Retrograde Amnesia** – No recall of the events before the injury
- **Antegrade Amnesia** – Short-term memory loss after regaining consciousness
  - Perseveration
  - Anxiety
Moderate DAI ~20% TBI’s

• Minute petechial bruising of the brain tissue with unconsciousness
• Unconscious initially
• Persistent confusion, disorientation, amnesia about the event
• Inability to concentrate
• Uncharacteristic mood swings, anxiety
• Sensory deficits
Severe DAI ~ 16% TBI’s

- Severe mechanical shearing of many axons in both cerebral hemispheres extending to the brainstem
- Unconscious for prolonged periods
- Abnormal posturing
- Increased ICP’s
- May need airway maintenance & breathing support
Focal TBI’s

- Specific grossly observable brain lesions
- **Skull Fractures**
- **Cerebral Contusion**
- **Cerebral Edema**
- **Cerebral Ischemia**
- **Cerebral Hemorrhage**
Cerebral Contusions

- Bruising of the brain in particularly in the frontal, temporal, or occipital lobes of the cortex, producing a structural change
Cerebral Contusions

- Greater neurologic deficits
- Seizures
- Hemiparesis
- Aphasia
- Personality changes
- Prolonged comatose state
Coup Countercoup Injuries
Effects of Increased Intracranial Pressure

Normal 10-15 mmHg

- Early signs of increased ICP
  - Headache
  - Nausea
  - Vomiting
  - Altered level of consciousness
Increasing ICP

• **Effects on the Cortex & Upper Brainstem**
  – BP rises, pulse slows
  – Pupils reactive
  – Cheyne-Stokes breathing
  – Localizes to pain – Flexion withdrawal
  – Reversible

• **Cushing’s Triad**
  – Increased SBP, widened pulse pressure, decrease in pulse and respiratory rate
Increasing ICP

- **Effects on the Middle Brainstem**
  - Wide pulse pressure
  - Bradycardia
  - Pupils sluggish reaction to fixed (nonreactive)
  - Central hyperventilation
  - Abnormal posturing extension - Decerebrate
Increasing ICP

• Effects on the lower portion of the Brainstem/Medulla
  – Pupils fixed & dilated
  – Pulse irregular & BP fluctuates
  – Widening of QRS, ST changes
  – Ataxic ventilation
  – Flaccid
Types of Brain Hemorrhages

- Epidural hematoma
- Subdural hematoma
- Subarachnoid hematoma
- Intracerebral hematoma
Epidural Hematoma

- Associated with a laceration or tear of the middle cerebral artery
- Associated with a linear or depressed temporal bone skull fracture
- Rapidly developing lesion/hematoma
- 50% have a transient loss of consciousness with a lucid interval
- Need immediate recognition & rapid transport for definitive care
Subdural Hematomas

• Collection of blood between the dura & the surface of the brain.
• Bleeding from the veins that bridge the subdural space
• **Acute subdural hematoma** – Symptomatic within the 1st 24 hours of injury
• **Subacute subdural hematoma** – Symptomatic in 2-10 days post injury
• **Chronic subdural hematoma** – Symptomatic after two weeks of injury
Patients at Risk for Subdural Hematomas

- Geriatric population – due to brain atrophy
- Individuals with coagulopathies or anticoagulants
  - Hemophiliacs
  - Alcoholics
  - Individuals with atrial fibrillation, DVT prophylaxis due to anticoagulants
Subarachnoid Hematomas

- Intracranial bleeding into the cerebrospinal fluid
- Sudden severe initially localized headache
- Headache spreads over time & becomes dull and throbbing
- Dizzy
- Stiff neck
- Unequal pupils
- Vomiting
- Seizures
- Loss of consciousness
- Coma
- Death
Intracerebral Hematomas

• Collection of > 5 ml of blood in the brain
• From penetrating trauma and coalescence of blood from blunt trauma
• Signs & symptoms can be immediate or delayed
• Signs and symptoms depend on the size and location
Penetrating Injuries to the Brain

- Missiles from guns
- Stab wounds
  - Scissors
  - Knives
- Shrapnel
- Impalement

Indications of a head injury:
- Scalp wound
- Fracture
- Swelling, bruising
- Loss of consciousness
- Nasal discharge
- Stiff neck
TBI’s Assessment

- Airway
- Breathing
- Circulation
- Neurologic Examination + GCS
- Fluid
- Medication Intervention