Pre-hospital Response to Trauma and Brain Injury

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Traumatic Brain Injury is Common

- 235,000 Americans hospitalized for non-fatal TBI each year.
- 1.1 million seek hospital care for TBI
- 50,000 people die each year
- Finland – 3.8% hospitalized for TBI by age 35
- New Zealand – 31.6% of people seek medical care for TBI by age 25
Other Areas to Address

- Spinal cord injury
- Hemorrhage
  - Subarachnoid / Aneurysm / AVM
Pre-hospital Care

- Assessment
- Immobilization
- Rapid Initiation of Treatment?
Assessment

- **ABCs**
- **Glasgow Coma Scale (3-15 points)**
  - Eyes (1-4 points)
    - Opens spontaneously, to speech, to pain, nothing
  - Verbal (1-5 points)
    - Oriented, confused, inappropriate, incomprehensible, nothing
  - Motor (1-6 points)
    - Obey commands, localizes, withdraws, abnormal flexion, abnormal extension, nothing
- **GCS 8 = Intubate?**
- **Hypoventilation with high SCI?**
- **Neurogenic (spinal) shock or other?**
Immobilization

- Cervical Collar
- Long Spine Board
- In-line traction and log rolling
- Do not get fooled by distracting injury
Rapid Initiation of Treatment

- Steroids
- Moderate Hypothermia
- Transport ASAP
To the Emergency Department

- Assessment
- Diagnosis
- Treatment
- Consultation
Assessment

- Physical exam
  - ABC’s
  - Vitals
  - GCS
- Neurologic Exam
  - More specific motor (is there a level?)
  - Is everything working right?
  - Attention to specific patterns (e.g. central cord, Brown Sequard, etc.)
Diagnosis

- After physical exam, consider imaging
  - X-ray (Spine)
    - Is it complete?
  - CT
  - MRI
Who needs a CT?

- Many factors go into this question
  - Risk assessment
  - Reliability (patient)
  - Support structure
  - Radiation – It’s ok to say ‘no’.
  - Obvious cases are obvious.
Low Risk

- Asymptomatic
- Slight Headache
- No LOC
- No structural abnormality on exam
Moderate Risk

- Altered LOC
- Progressive Headache
- ETOH / Drugs
- Seizure
- Amnesia
- Vomiting
- Secondary or distracting injury
- Abuse?
High Risk

- Depressed LOC
- Obvious exam abnormality
  - Focal neuro signs
- Any penetrating injury
Findings and Treatments

- Brain injury
- Fracture (skull)
- Spinal cord injury
- SAH / Aneurysm
Traumatic Brain Injury

- Concussion
- Epidural Hematoma
- Subdural Hematoma
- SAH / Axonal Shear
Concussion

- Most common
- Symptoms may last
- Sports injuries are common
- “When can I play?”
  - Multiple opinions.
  - Asymptomatic x 1 wk, no pain with exertion
Epidural Hematoma

- **True Emergency**
  - Often involves middle meningeal artery
  - Temporal bone fracture

- **Rapid accumulation of blood with rapid rise in ICP**

- **Prompt intervention is key to survival**
  - Burr hole drainage
Epidural Hematoma
Subdural Hematoma

- Cortical vessels damaged by shear forces, laceration, or contusion
- Can be complicated by edema secondary to initial injury
- Most common over a frontal or parietal area
- Consultation
  - Treatment may vary from observation to surgery
  - Is atrophy a good thing?
Subdural Hematoma
Traumatic SAH

- As much as 60% of people with other serious head injuries will show some subarachnoid blood
- SAH blood increases morbidity and mortality when seen in moderate and severe brain injuries
- Up to 90% of people that present with traumatic SAH and GCS>12 have good outcomes
- Use of supportive care
Diffuse Axonal Shear

- Hard to see on a CT scan
- MRI more sensitive
- Decreased LOC in a relatively benign appearing CT
General Treatment Guidelines

- **GCS 8 – intubate**
  - 3% of traumatic head injuries have associated spinal cord injury
  - Use of in-line cervical stabilization
  - RSI

- **Maintaining adequate ICP**
  - Sedation and paralysis (make sure neurosurgeon is involved)
  - Lidocaine for intubation
  - Mannitol 1g/kg
  - Mannitol > hyperventilation (Soustiel)
General Treatment (cont.)

- Judicious use of fluids
- Use of steroids (later)
- Use of moderate hypothermia
Cervical Spine Injuries

- Incidence in trauma system entries (Penn and New Mexico)
  - Overall incidence of CSI 4.3%
  - CSI without cord injury 3.0%
  - Cord injury without fracture 0.7%

- Many variations of injury

- Thoracic and Lumbar injuries as well
Evaluation of Spinal Injury

- Starts pre-hospital with immobilization
- Many different criteria
  - NEXUS
  - Canadian C-spine Rule
- Multiple imaging modalities
- Multiple algorithms
National Emergency X-Radiography Utilization Study (NEXUS)

- First mentioned in 1992
- Validated again about 10 years later in a study with over 34,000 patients
- Sensitivity to find cervical spine injuries noted to be 99.6%
Cervical spine radiography is indicated for patients with trauma unless they meet all of the following criteria:

- No posterior midline cervical spine tenderness
- No evidence of intoxication
- Normal level of alertness
- No focal neurologic deficit
- No painful distracting injuries
Spine Injury Diagnostics

Many algorithms include the following

- X-ray
  - How many views?
- Flexion / Extension
- CT (bones only?)
- MRI (cord/ligamentous injury?)
- Consultation
- Immobilization
- What about T and L spines?
- Examples (No algorithm is perfect for every patient)
Treatment of Spinal Injury (ED Perspective)

- Immobilization
- Surgical Stabilization
- Steroids
Steroids

- Started in the 90’s based on results of the NASCIS II trials
- CRASH study 2005 for head injury – no improvement in mortality
- Multiple studies since then show limited neurologic improvement
- Complications such as hyperglycemia and increased rate of infection
Steroids (cont.)

- Still debate on the standard of care
- People still mostly giving the steroid over concern of possibility of improvement and legal implications.
- Not time sensitive for pre-hospital care
- 30mg/kg IV x1, followed by 5.4 mg/kg IV over 23 hours
- Start within 8 hours
Moderate Hypothermia

- Extensive research related to cardiac arrest shows positive results.
- Less research regarding neurotrauma
- Famous case of Kevin Everett
  - Rapid decompression vs. cooling?
- June 2008 NEJM study showed worse outcomes
- More prospective studies needed – numbers are small
- Practicality for pre-hospital care??
Evaluation for SAH

- Around 4% of ED visits are for headaches
  - 9 per day in our ED based on this number
  - 1-4% are SAH retrospectively
  - 25-33% of “classic” histories have SAH
    - Small numbers for these studies
- Many types, but majority not emergently dangerous
- Concerning histories include WHOML, thunderclap
  HA, syncope.
- What needs to be done?
Evaluation for SAH

- ED standard is CT/LP
- 2008 study in Annals of Emergency Medicine states CT alone is inadequate
  - Sensitivities as low as 93%
  - Probably closer to 98%
    - Does the scanner matter?
- Another 2008 study in Annals shows that CT + LP gives 100% sensitivity and 67% specificity and is sufficient to rule out SAH
Evaluation for SAH

- As time passes, sensitivity for CT decreases.
  - High 90s to low 90s within 12 hours as blood dissipates
- LP in first 12 hours will show increased red cells
- Xanthocromia becomes very important as time passes, and becomes the most sensitive
Other SAH Questions

- Does negative CT/LP need more workup?
  - Probably not. Asymptomatic screening for AVM/aneurysm is not standard and has associated risk.
  - Warning headaches? Higher risk for later problems?

- Can CT angiography replace LP?
  - Not yet, but probably some day.

- What generation is your CT?
  - 4 slice? 64 slice?

- Is the neurosurgery literature in agreement with this method????
Conclusions From an ED / Prehospital Perspective

- Neurotrauma patients have life altering / life threatening injuries
- ABC’s and immobilization are the first step
- Rapid diagnosis and consultation are key to definitive stabilization
- Consider time sensitive interventions
- Consider the pitfalls of distracting injury and intoxication