HEAD INJURY
Initial Assessment and Management

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 INITIAL ASSESSMENT
- ABCs (Airway, Breathing, Circulation)
- GCS (Glascow Coma Scale)
- Trauma Score

MANAGEMENT
- Airway: Secure and control
- Ventilation: Mechanical if necessary
- Circulation: Monitor and support
- Head Immobilization
- Neurological Monitoring
- CT Scan for severe injuries

HELMET LAWS
-预防颅脑损伤
- Wear Helmets!
OBJECTIVES

• Review Pathophysiology of Head Trauma
• Discuss Current approach to the Management of Head Trauma
• Discuss Herniation Syndrome
  • Recognition
  • Management
• Review Indications for who should go to neurotrauma center
TRAUMA

- Trauma Remains a Major Killer
- Fewer Americans Dying on Highways
  - 40 k/year down from > 55 k
- More Dying of Penetrating Trauma
- Head Injury Remains a Major Cause of Mortality and Morbidity for Multiple Trauma Victims

Head Injury

- An Injury Every 15 seconds
- Every 5 Minutes Someone DIES or is DISABLED by Head Injury
- Over 25,000 Children Sustain Severe Head Injuries Each Year
- Half of all Major Head Injuries Result from MVC's
  - Only 15% were Wearing Seat Belts
- Care and Lost Wages = Millions of $$

Source: American Association of Neurological Surgeons

Head Injury Epidemiology

- Major Cause of Mortality and Morbidity
- 40% of Multi Trauma Patients Have CHI
- 25% of All Trauma Deaths
- Significant Long Term Costs For Care
- Appropriate Management Can Decrease Costs in Lives and $$$

HEAD INJURY

Two Categories of Injury

- Primary Brain Injury
- Secondary Brain Injury

Mechanism
Blunt vs. Penetrating

Primary Brain Injury

- Direct Injury to Tissue From Kinetic Energy
- Blunt or Penetrating
- Physical Damage to Brain Tissue
- Extent of Damage Fixed at Time of Injury

Severe Head Trauma- GCS <8

- Symptoms include:
  - depressed consciousness
  - focal neuro signs
  - multiple trauma
  - depressed skull fracture
- Patients comprise 10% of all head trauma
- 60% have associated major organ damage
- 40% overall mortality
Moderate Head Trauma = GCS 9-13
• Symptoms include:
  • change in level of consciousness at time of injury
  • progressive headache
  • posttraumatic seizure
  • vomiting, amnesia.
• Comprises 10% of all patients with head injury
• 40% will have an abnormal CT
• Mortality 20%

Minor Head Injury = GCS 14-15
• Symptoms include:
  • disorientation or confusion
  • amnesia
  • are transient.
• Most head injuries are minor - 80%
• Workup depends on whether or not the patient is high or low risk

Primary Brain Injury
• Two Types
  • Focal Impact
    • Localized Defects
  • Deceleration or Shear Injury
    • Diffuse Injury to White Matter Throughout CNS
• Injury may be Trivial or Fatal
• Interventions Have Little Effect Post Injury
• Prevention More Effective
  • Education
  • Engineering

Subdural Hematoma
Epidural Hematoma

Intracranial Hemorrhage

Subarachnoid Hemorrhage
- Most common CT finding after head injury, occurs in 44% of all severe head trauma
- Outcome varies inversely with presenting GCS
- Risk of cerebral vasospasm minimal if bleeding secondary to trauma and not aneurysm rupture
- CCT shows blood in perimesencephalic cisterns

Cerebral Edema

Cerebral Contusion
- Bruise on surface of brain
- If on same side as impact = coup; opposite side = contrecoup injury
- Commonly associated with depressed skull fracture
- Brief LOC
Diffuse Axonal Injury

- Immediate coma lasting >6 hours without any focal CT abnormality except occasional petechial hemorrhages.
- Mechanism is shear injury
- If severe it is usually due to MVA, causes posturing, and has 25% mortality

You Do Not Have A Portable CT:

- Altered Mental Status with History of Injury:
  - Must consider CHI
  - Generalized versus Focal Deficit

Secondary Brain Injury

- Result of Body’s Response to Injury
- Damaged Tissue Releases “Mediators” of Injury
  - Damaged Tissue Capillaries “Leak”
  - Edema Fluid into Surrounding Tissue
  - Cerebral Edema Follows
  - Cerebral Perfusion Compromised

Secondary Brain Injury

- Hypoxia and Hypoperfusion Exacerbates Injury
- Head Injury that is Delayed in Onset or
- Progressive in Nature

Pediatrics-Special Considerations

- Peaks age 5-7 in early afternoon
- Most often due to MVA, bicycle accidents and falls
- Think NAT in children 1-3 year (fundoscopic exam for retinal hemorrhages associated with SAH and “shaken baby”)
- Large surface area predisposes head to injury with increased mortality in kids<3 compared with adults
- Cranial sutures may allow some expansion to relieve pressure
- Modify GCS
- Diffuse injury more common therefore burr holes usually ineffective
- Posttraumatic seizures occur more frequently in Peds than adults
Penetrating Head Trauma

- Most common penetrating injury secondary to GSW to head
- If initial GCS<5 almost 100% fatal
- Poor prognosis if wound crosses midline and/or low in brain
- Possibly only indication for plain skull x-rays

GOAL OF INITIAL HEAD INJURY MANAGEMENT...

Salvage Brain Tissue That Has Not Sustained Irreversible Primary or Secondary Injury

Secondary Brain Injury

- Can Be Treated
- Can Be Prevented
- Key Is Maintaining Perfusion and Oxygenation

Intracranial Pressure

- Perfusion of Brain Dependent On
  - Mean Arterial Pressure
  - Intracranial Pressure
  - Venous Pressure
- \( CPP = MAP - (ICP+MAP) \)

Pathophysiology Secondary of Brain Injury

- Skull a Rigid Box
- Increasing Volume Causes Increased Pressure
  - Boyle’s Law: \( P \times V = k \)

Assessment of Head Injury

- ATLS / BTLS Primary Survey
  - A B C
  - Brief Neurological Exam
    - GCS
    - AVPU
- Consider Mechanism of Injury
  - High versus Low Risk Mechanism
- Altered LOC Suggests Brain Injury
Glasgow Coma Scale

*GCS developed for use 6 hours after injury in isolated head trauma (nonintoxicated/stable patients)

Previous Teachings

- Hyperventilation Reduces Intracranial Volume
- Decreased Cerebral Blood Flow
- Decreases Intracranial Pressure
- Limiting IV Fluids Decreased Edema

Brain Injury Guidelines

- Guidelines for the Management of Severe Head Injury
- Brain Trauma Foundation, 1995
  - Updated 2011
- AANS
- Consensus Approach Similar to AHA for ACLS Guidelines
  - Based on Review of Literature

Research Findings

- Severe Head Injury: GCS < 8, No Herniation
- Hyperventilation Causes Cerebral Ischemia
  - Decreases Cerebral Blood Flow
  - Less Effect on Cerebral Edema
  - pCO2 < 30 mmHg may alter autoregulation
  - Associated with Poorer Outcomes

- Hypoxemia Early in Injury
  - Increased Morbidity and Mortality
- Hypotension Early in Injury
  - Increased Morbidity and Mortality
- Fluid Resuscitation did not Increase Edema
  - Chestnut RM et al, J Trauma 34:216, 1993

Recommendations:

Early Management of Severe Head Injury

- FIRST PRIORITY is Trauma Resuscitation
  - Per ATLS / BTLS Guidelines
  - Provide Airway and 100 % Oxygen
  - Correct and Prevent Shock
    - Maintain Systolic Blood Pressure of 100 torr
- Rapid Transport to Appropriate Facility
Recommendations: Early Management of Severe Head Injury

- Provide Adequate Airway
  - Limit ICP rise during Intubation
  - Rapid Sequence Induction
  - Intracranial Pressure Monitoring
  - KEY COMPONENT

Recommendations: Early Management of Severe Head Injury

- AVOID PROPHYLACTIC
  - HYPERVENTILATION
  - MANNITOL
  - STEROIDS OF NO VALUE IN HEAD TRAUMA
  - GIVE PROPHYLACTIC ANTICONVULSANTS

AIRWAY MANAGEMENT in the CHI Patient

GOAL OF DAI

- Allow Intubation
  - Secure Airway
  - Provide Ventilation
- Relaxed Patient Easier to Visualize Cords
- Decrease Risk of Aspiration with Non-Empty Stomach
- Limit Rise in Intracranial Pressure
- PREVENT HYPOXEMIA

The Greatest Error That Can Be Made Is To Take A Breathing Patient and Render Them Apneic and NOT BE ABLE TO INTUBATE THEM!

Recognition of Need For Airway Control

- Airway Compromise
  - Trauma, Decreased LOC, Edema
  - Combative or Agitated Patient
  - Awake Patient
  - CHI with Elevated ICP
  - Open Eye Injury
  - Be Certain Cause of Airway Compromise Not Readily Correctable

Consider Alternatives To Paralysis
Be Prepared To Perform Cricothyrotomy
BASIC SEQUENCE
• Preparation
• Preoxygenation
• Pretreatment
• Paralysis with Anesthesia
• Pass the Tube and Confirm Position

RAPID SEQUENCE INTUBATION

<table>
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<th>TIME (MIN)</th>
<th>DEPOLARIZING AGENT</th>
<th>NON-DEPOLARIZING AGENT</th>
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<tr>
<td>-4.00</td>
<td>PRE-OXYGENATE, IV, MONITOR, PULSE OXIMETRY, CHECK EQUIPMENT</td>
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<tr>
<td>-3.00</td>
<td>LIDOCAINE 1 mg/kg IV</td>
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<tr>
<td>-2.45</td>
<td>ATROPINE 0.01 mg/kg (0.5 mg; ADULT DOSE; min dose 0.1 mg)</td>
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<tr>
<td>-2.30</td>
<td>VECURONIUM 0.01 mg/kg (1 mg ADULT DOSE) (DEFASICULATING DOSE)</td>
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<td>-2.20</td>
<td>BEGIN SELLICK MANEUVER</td>
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<tr>
<td>-2.00</td>
<td>MIDAZOLAM 0.1 mg/kg (7 mg adult)</td>
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<tr>
<td>-1.30</td>
<td>SUCCINYLCHOLINE 1.5 mg/kg (100 mg) 2.0 mg/kg &lt;10 yrs</td>
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INTUBATION

+0.30 ASSESS TUBE PLACEMENT

Herniation Syndrome
• Signs of Increased Intracranial Pressure
• Deterioration of Neurological Status
• Decreased LOC
• Dilatation of Ipsilateral Pupil or Both Pupils
• Contralateral Hemiparesis
• Cushing’s Reflex
• Bradycardia
• Hypertension

Management of Herniation
• Rapidly Lower Intracranial Pressure
• Secure Airway, if Not Yet Done
• Administer 100% Oxygen
• Hyperventilation May Be Useful
• Capnography!!! ET CO2 30-35 mmHg
• Mannitol, if Not Volume Depleted
• 1 gm per Kilogram, IV may help
• Other Diuretics of Little Value

High v. Low Risk Minor Head Trauma Patients

High risk
Focal Neurologic findings
Asymmetric Pupils
Skull fracture
Multiple trauma
Serious painful distracting injuries
External signs of trauma
Initial GCS 13
Loss of consciousness >2min
Posttraumatic confusion/amnesia >20min
History of bleeding disorder/anticoagulation
Recent ingestion of intoxicants
Unreliable/unknown history of injury
Suspected child abuse
Age >60, <2yr

Low risk
Currently asymptomatic
No other injuries
No focal on examination
Normal pupils
No change in consciousness
Intact orientation/memory
Initial GCS 14-15
Accurate history
Trivial mechanism
Injury>24 hr age
Reliable home observers

Concussion
• Symptoms include "seeing stars," nausea, dizziness, or disorientation for a brief period of time.
• Brief LOC lasting several seconds
• GCS 15 at presentation
• Normal CCT
• Completely resolved in less than 6 hours
Concussion in Sports

- Grade 1: confusion without amnesia, no LOC; may return if symptom free for 20 minutes.
- Grade 2: confusion with amnesia, no LOC; may return after 1 wk without symptoms.
- Grade 3: LOC; may return after 2 wks without symptoms.

Indications for CCT

- LOC
- Progressive headache, intoxication, unreliable history, posttraumatic seizure, repeated vomiting, signs of basilar skull fracture, skull penetration or depressed skull fracture, GCS<15, or focal neuro deficit.
- Patients on coumadin, heparin, or those with bleeding disorders even with only trivial history of head trauma.
- Elderly patients and alcoholics have a low threshold to scan.

“Minor CHI”

- How Should These Patients Be Evaluated?
- Observe or Scan?
- Predictive Factors For More Severe Injury

“Low Risk”

- Asymptomatic
- Mild Headache
- Dizziness
- Superficial Scalp Injuries
- Absence of High Risk or Moderate Risk Criteria
- Consider Severity of Mechanism

“Low Risk”

- Imaging Not Needed
- Observe in ED
- Discharge with “Head Injury Instructions”
- Must Have Reliable Persons to Monitor at Home

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Concussion and Sports

- http://www.cdc.gov/concussion/headsup/clinicians_guide.html
- Any one with concussion should NOT RETURN TO PLAY THAT NIGHT.
“Moderate Risk”
- History of LOC
  - at Event or Subsequent
- Progressive Headache
- Unreliable Hx or Intoxication
- Amnesia
- Seizure Post Injury

“Moderate Risk”
- Clinical Sx of Fracture
  - Facial
  - Basilar
- Suspected Child Abuse
- Age < 2 years
- Possible Skull Penetration or Depressed Skull Fx

“Moderate Risk”
- These were Indications for Plain Films or “Observation” in Hospital
- These Patients Should HAVE CT SCAN
- In Hospital “Observation” Not Always Reliable
- CT Cheaper than Overnight Admission
  - “Normal CT”
    - < 0.5 % Have Intracranial Injury

“High Risk”
- Depressed LOC Not Due to:
  - Drugs, Alcohol or Other Cause
  - Focal Neurological Signs
  - Progressive Decreasing LOC
- CT and Immediate Neurosurgical Consult
- Treat Increased ICP

Summary
- Key Points in Managing Severe Head Injury
  - Prompt Recognition of Severe Head Injury
  - Rapid Airway Management
  - Management of Shock
  - Rapid Transport
  - Recognition and Management of Hemiation

Resources
- http://www.cdc.gov/concussion/
- https://www.braintrauma.org/coma-guidelines/searchable-guidelines/