Management of Severe Traumatic Brain Injury

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Objectives:

• Describe the primary and secondary survey for a trauma patient with traumatic brain injury – including accurate use of the Glasgow Coma Scale (GCS)
• Identify important early steps in treatment of patients with severe traumatic brain injury
• Summarize the steps for control of elevated intracranial pressure (ICP)
• Summarize the indications and current operative strategies for severe TBI patients
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## Guidelines - Head Injury

<table>
<thead>
<tr>
<th>Guidelines</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guidelines for the Surgical Management of Traumatic Brain Injury</td>
<td>2006</td>
</tr>
<tr>
<td>Guidelines for the Field Management of Combat Related Head Trauma</td>
<td>2005</td>
</tr>
<tr>
<td>Early Indicators of Prognosis in Severe Traumatic Brain Injury</td>
<td>2000</td>
</tr>
</tbody>
</table>
Guidelines - Methodology

• Develop narrow clinical questions where treatment controversies exist
• Evaluate all relevant literature
• Classify strength of evidence for each paper
• Determine quality of support for treatment
• Establish a statement
Guidelines - Evidence

- Class I   Well designed RCT,
- Class II  Comparative studies. Non-random control cohort
- Class III Case series, Case report, Expert opinion
Guidelines - Statements

• Practice Standards - Class I : Strongest
• Guidelines - Moderate certainty
• Options - Unclear Certainty
Guidelines

• For surgical management of head injury only “Option” level recommendations can be supported!
Guidelines - Advantages

- Provide a framework for decision making
- Identify knowledge gaps
- Provide a critical review of available literature
Guidelines - Disadvantages

- Often misused
- May impact reimbursement
- May impact insurance authorization
- May create a legal standard
Head Injury Triage

• Pre-hospital treatment
  • ABCs, Spinal Immobilization, Mannitol, Hyperventilation, Resuscitation

• Evaluation
  • Rapid Neurological exam, Pupils, motor asymmetry, Level of consciousness; CT scan; hemodynamic instability

• Definitive treatment
  • Surgery, ICP monitor, Critical Care management
### Glasgow Coma Scale score (GCS 3 – 15)

<table>
<thead>
<tr>
<th>Eyes (4)</th>
<th>Verbal (5)</th>
<th>Motor (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td></td>
<td>Obeys commands</td>
</tr>
<tr>
<td>5</td>
<td>Orientated</td>
<td>Localises</td>
</tr>
<tr>
<td>4</td>
<td>Spontaneously</td>
<td>Normal flexion</td>
</tr>
<tr>
<td>3</td>
<td>To speech</td>
<td>Abnormal flexion</td>
</tr>
<tr>
<td>2</td>
<td>To pain</td>
<td>Extension</td>
</tr>
<tr>
<td>1</td>
<td>Nil</td>
<td>Nil</td>
</tr>
</tbody>
</table>
Types of Injuries

• Skull Fractures
• Parenchymal Brain Injury
• Epidural Hematoma
• Subdural Hematoma
  • Acute
  • Chronic
Skull Fractures

• Open Vault
• Depressed Vault
• Frontal Sinus
• Facial Fractures
• Basilar Fractures
Open Vault Fracture

- Extent of laceration
- Duration of exposure
- Contamination
- Compound fracture
Depressed Fracture

• Indications for intervention
• Depressed more than thickness of table
• >10 mm
• Neurological deficit corresponding to location of depressed fragment
• CSF leak
Frontal Sinus Fracture

• Potential for delayed intracranial infection or mucocele
• Exterior wall - observe
• Posterior wall - controversial
• Cosmesis
Cranialization

• Meticulously extirpate the mucosa
• Remove posterior sinus wall
• Repair the dura
• Obliterate nasofrontal duct
• Restore contour to forehead
Parenchymal Injury

• Acute traumatic ICH rarely occurs
• Usually coalescence of contused brain
• 20% of contusions will expand
Parenchymal Injury

• Consider surgery for the following...
  • Recalcitrant ICP / mass effect
  • GCS 6 - 8 with Frontal or Temporal contusion > 20 cm3
  • Any lesion >50 cm3
  • Non eloquent location of contusion
  • Debridement
  • Decompressive craniectomy - controversial but may benefit for impending herniation
Epidural Hematoma

• 1% of head injuries (less common than SDH)

• M:F = 4:1

• Brief LOC followed by “lucid interval”

• Pathophysiology
  • dural striping and arterial laceration (middle meningeal artery)

• Underlying Brain is usually uninjured
Epidural Hematoma

• CT Findings
  • Usually lentiform (85%)
  • Flat against brain (5%)
Epidural Hematoma

- Usually deteriorate over hours
- H/A; Vomiting; Seizure
- Signs of herniation
- CT scan findings
Epidural Hematoma

• Treatment is usually surgical
• Can occasionally observe
  • Small ( < 1 cm)
  • Mild symptoms and no signs of herniation
• ICU observation
• Caution in Pediatric patients
Epidural Hematoma

- Evacuate >30 cm³ regardless of GCS
- <30 cm³, < 15 mm thick, < 5 mm shift, GCS 8 can be observed
- Blown pupil - operate STAT
- Craniotomy is preferable
Epidural Hematoma

• Goals of surgery
  • Remove clot and decompress brain
  • Establish hemostasis
  • Prevent re-accumulation
Posterior Fossa EDH

- Usually venous (sinus)
- Symptoms can be subtle
- Cerebellar findings
- 25% mortality
Acute Subdural Hematoma

• More serious than EDH due to underlying brain injury
• More diffuse compression and parenchymal injury
• Pathophysiology
  • brain laceration
  • bridging vessel tear
Acute Subdural Hematoma

- CT findings
  - Crescent shaped
  - Hyperdense
  - Mass effect
Acute Subdural Hematoma

• Mortality is 50 - 90%
• Age (higher mortality in older patients)
• Anticoagulation (90 - 100% fatal)
• 4 hour rule
• Admission GCS
Acute Subdural Hematoma

- GCS = 3; 90% mortality; 5% functional recovery
- GCS = 4; 76%; 10%
- GCS = 5; 62%; 18%
- GCS = 6/7; 51%; 44%
Acute Subdural Hematoma

• Can be observed if small (<1 cm)
• Usually a surgical emergency
• Goals are similar to EDH
  • decompression
  • hemostasis
  • prevent re-accumulation
Acute Subdural Hematoma

- Surgical pitfalls
- Potential for rapid swelling
- Inelastic brain
- Coagulopathy
Chronic Subdural Hematoma

• Elderly patients
• Anticoagulation
• Remote incidental trauma
• Clot “crankcase oil”
Chronic Subdural Hematoma

• Treat symptomatic lesions
• Drainage via twist drill
• Burr hole
• Craniotomy
Chronic Subdural Hematoma

- Correct coagulopathy
- Consider anticonvulsants
- Hydration
Medical Therapy

• Prophylaxis
• Anticonvulsants
• Reversal of Coagulopathy
• VTE
• Antibiotics for CSF leak
• No role for steroids
Medical Therapy

• Temporize ICP prior to surgery
• Mannitol bolus
• Hyperventilation
Medical Therapy

• Critical Care
  • Resuscitate
  • Monitor and manage elevated ICP
  • Hypertonic saline
  • Paralytics
  • Maintain CPP
  • Head elevation
  • Induced coma
Controversies

• Decompressive craniectomy
• Mild hypothermia
• Concussion