Head Trauma

• Review of cranial anatomy
• Patient assessment
• Common injury patterns
  – Concussions
  – Fractures
  – Hemorrhagic injuries
  – Intracranial hypertension
  – Penetrating injuries
Head Trauma

- Subacute care
- Delayed sequelae
- Prevention
Review of Cranial Anatomy

- Scalp
- Skull/sinuses
- Meninges
- Brain
- Vasculature
- Ventricles
Review of Cranial Anatomy
Review of Cranial Anatomy

Ventricles of the Brain
- Lateral Ventricle
- Interventricular foramen
- Third Ventricle
- Cerebral aqueduct
- Fourth Ventricle
- Central canal

Superficial veins
- Falx
- Superior sagittal sinus
- Basal vein
- Great cerebral vein
- Transverse sinus
- Confluence of sinuses

Arteries
- Anterior cerebral artery
- Anterior communicating artery
- Posterior communicating artery
- Posterior cerebral artery
- Internal carotid artery
- Basilar artery
- Vertebral artery

(Images showing brain anatomy and vascular system)
Patient Assessment

• Consider head injury in following trauma patients
  – “Significant” mechanism
  – Altered consciousness
  – Headache
  – Abnormal neurological function
  – Skull fracture
  – Facial or cervical spine injury
Patient Assessment

• Stabilization – “ABC’s”
• Cranial inspection
• Neurological exam
• Grading of severity
• CT head
Stabilization

- Oxygenation
- Resuscitation
- Hemostasis
- Seizure prophylaxis
- Spinal precautions
Cranial Inspection
Neurological Examination

- Level of consciousness
- Cognitive function
- Cranial nerve exam
- Strength
- Sensation
- Coordination
- Reflexes
Grading of Injury

- 14-15 – minimal/mild
- 9-13 – moderate
- < 8 – severe
- 3 – worst
- “T” added if intubated

Glasgow Coma Scale

<table>
<thead>
<tr>
<th>Eye Opening</th>
<th>Points</th>
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</thead>
<tbody>
<tr>
<td>Eyes open spontaneously</td>
<td>4</td>
</tr>
<tr>
<td>Eyes open to verbal command</td>
<td>3</td>
</tr>
<tr>
<td>Eyes open only with painful stimuli</td>
<td>2</td>
</tr>
<tr>
<td>No eye opening</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Verbal Response</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oriented and converses</td>
<td>5</td>
</tr>
<tr>
<td>Disoriented and converses</td>
<td>4</td>
</tr>
<tr>
<td>Inappropriate words</td>
<td>3</td>
</tr>
<tr>
<td>Incomprehensible sounds</td>
<td>2</td>
</tr>
<tr>
<td>No verbal response</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Motor Response</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obeys verbal commands</td>
<td>6</td>
</tr>
<tr>
<td>Response to painful stimuli (UE)</td>
<td></td>
</tr>
<tr>
<td>Localizes pain</td>
<td>5</td>
</tr>
<tr>
<td>Withdraws from pain</td>
<td>4</td>
</tr>
<tr>
<td>Flexor posturing</td>
<td>3</td>
</tr>
<tr>
<td>Extensor posturing</td>
<td>2</td>
</tr>
<tr>
<td>No motor response</td>
<td>1</td>
</tr>
</tbody>
</table>

Total score = eye opening + verbal + motor
GCS<5: 80% die or remain vegetative
GCS>11: 90% complete recovery
Grading of Injury

• Consider ICP monitoring with GCS < 8
CT Head
CT Head

- Fractures
- Hemorrhage
- Swelling
- Hydrocephalus
- Pneumocephalus
- Anoxia
- Stroke
- Foreign bodies
CT Head

Midline shift

Cisternal effacement

Pneumocephalus
Exploration??? Not so much…
Concussion

- Altered consciousness
- No underlying structural damage
- Second impact syndrome
- Return to play guidelines
- Chronic traumatic encephalopathy
## Concussion

<table>
<thead>
<tr>
<th>Severity</th>
<th>Grade 1: Mild</th>
<th>Grade 2: Moderate</th>
<th>Grade 3: Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>R. Cantu Guidelines (2001)</td>
<td>-Post-traumatic amnesia &lt; 30 min, No loss of consciousness</td>
<td>- Loss of consciousness &lt; 5 min, or Amnesia lasting 30 min – 24 hours</td>
<td>- Loss of consciousness &gt; 5 min, or Amnesia &gt; 24 hours</td>
</tr>
<tr>
<td>Colorado Medical Society</td>
<td>- Confusion, No loss of consciousness</td>
<td>- Confusion, Post-traumatic amnesia, No loss of consciousness</td>
<td>- Any loss of consciousness</td>
</tr>
<tr>
<td>American Academy of Neurology</td>
<td>- Confusion, Symptoms last &lt; 15 min, No loss of consciousness</td>
<td>- Symptoms last &gt;15 min, No loss of consciousness</td>
<td>- Loss of consciousness</td>
</tr>
</tbody>
</table>
Fractures

- Open vs. closed
- Depressed vs. non-depressed
- Basilar skull fractures
- Fractures involving sinuses
- Occipital condyle fractures
- CSF fistula
Hemorrhage

Epidural hematoma

Subdural hematoma
Hemorrhage

Subarachnoid and intraventricular hemorrhage

Intraparenchymal contusions

Diffuse axonal injury
Intracranial Hypertension

- Monro-Kellie doctrine – total volume within skull is constant
  - Brain
  - Blood
  - CSF
- “Normal” ICP’s
  - Adults, usually < 15 mmHg
  - Lower range in children/infants
- Types of monitoring
Factors Affecting ICP

- Intracranial mass lesions
- Positioning (head of bead)
- Venous outflow – beware too tight c-collar
- Ventilation
- Pain
- Stimulation
- Osmolarity
- Temperature
Other Monitoring Modalities

- Jugular venous oxygen
- Brain tissue oxygenation
- Cerebral blood flow
- Cerebral microdialysis
Craniotomy/Craniectomy

- Large mass lesions
- Significant midline shift
- Clinical findings
- Radiographic progression
- Refractory intracranial hypertension
- Posterior fossa involvement
Decompressive Craniectomy
Penetrating Injuries (GSW)

• Prognostic factors
  – Crossing midline
  – Involvement of multiple lobes
  – Traversing geographic center of brain
  – Traversing ventricles
  – Vascular proximity
  – Ballistics, caliber
Penetrating Injuries (GSW)
Subacute Care

• Oxygenation
• Perfusion
• Nutrition
• Glycemic control
• DVT prophylaxis
• GI prophylaxis
• Infection control
Delayed Sequelae

- Hydrocephalus
- Stroke
- Pseudoaneurysm/fistula
- Sinus thrombosis
- CSF fistula
- Meningitis
- Chronic subdural hematoma
- Epilepsy
Prevention

- Seat belts
- Air bags
- Child safety seats
- Helmets
- Designated drivers
- Sideline screening
- Judicious use of blood thinners
- Fall prevention
- “Common” sense
References

• Greenberg, *Handbook of Neurosurgery*.
• www.braintrauma.org.
• ATLS manual (ACS).
• Neuropathology-web.org