ICU Management of Traumatic Brain Injury

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Definition

- Concussion
- Contusion
- Diffuse Axonal Injury
Concussion

When in doubt...sit out !!
Concussion
Concussion
Concussion
Concussion

- Usually don’t require hospitalization
- Grade 1- Amnesia<30 min, no LOC
- Grade 2- LOC< 5 min, amnesia > 30 min
- Grade 3- LOC>5 min, amnesia = 24 hrs

- Second Injury Syndrome: Mortality 50-100%
Multiple Concussions

- Concussion #2 – 1 month off if CT normal and only mild or moderate
- Concussion #3- Season ending injury, do MRI
- Same for Concussion #2 if severe

- When will you see a concussion in the ICU?
Cerebral Contusion
Cerebral Contusion

Before impact

Initial impact: Coup

Secondary impact: Contre-coup

Post-injury
Cerebral contusion

- Focal bruised areas of the brain
- Associated edema
- Possible enlargement (blossoming)

- When will you see contusions in the ICU?
- When will neurosurgery intervene?
Diffuse Axonal Injury

Axon Shear (Post Concussion Syndrome)

A. Trauma causes the axon to twist and tear
B. The result is permanent death of the brain cell
Diffuse Axonal Injury
Diffuse Axonal Injury

- Grade I- coma 6- 24 hours, mild memory impairment, mild disability
- Grade II- coma >24 hours, long amnesia, behavior and cognitive deficits
- Grade III- coma weeks to months, posturing, cognitive, memory, speech, personality deficits
Epidural Hematoma
Epidural Hematoma
Subdural Hematoma
Subdural Hematoma
Grading Head Injuries

- Minimal: GCS=15, no LOC
- Mild: GCS=14, may have brief LOC
- Moderate: GCS=9-13 or LOC >5 min or focal neuro deficit
- Severe: GCS=5-8
- Critical: GCS=3-4
How to Admit Trauma Patients

- Minor Head Injury- GCS= 14
  - Elevate HOB
  - Neurochecks q 1 or q 2 hrs
  - NPO until alert
  - Normal Saline
  - Mild analgesia
  - Antiemetic- Tigan
Admission of TBI

- Moderate Head Injury GCS 9-13
  - Same as mild- to ICU
  - Repeat CT Head within 12-24 hrs if pt does not return to GCS 14 or 15 within 12 hrs.
Management of TBI

Principles:

Cerebral Perfusion Pressure = MAP - ICP
TBI Management

- Secondary Injury
- Intracranial Pressure vs Cerebral Perfusion Pressure
Cerebral Perfusion Pressure

- Normal CPP > 50 mm Hg

- As long as CPP>60 mm Hg, higher CPP does not protect brain against elevated ICP.
Intracranial Pressure

- Normal Brain: 1400 mL
- Cerebral Blood Volume: 150 mL
- Cerebral Spinal Fluid: 150 mL
- Closed Skull
- Pressure evenly distributed throughout the intracranial cavity
- Monroe-Kellie doctrine- a change in one of the above necessitates a change in another.
Indications

- Neurologic criteria
- Multiple systems injured that may affect ICP
- Traumatic Intracranial Mass (EDH, SDH)
- Fulminant Liver Failure with Factor VII
Complications of ICP Monitors

- Infection
- Hemorrhage
- Malfunction/obstruction
- Malposition
Intraventricular Catheters

- Most accurate
- Allows fluid release to treat ICP elevation
- Lower cost
Intraparenchymal Monitor

Camino or Honeywell/Phillips
More expensive
Measurement Drift
ICP Waveforms

- Normal:
  A wave increases with arterial pulse
  Varies with respiration

- Pathologic waves:
  - Lundberg A waves (plateau)
  - Lundberg B waves (pressure pulses)
  - Lundberg C waves
Intraventricular Catheters

- Check output every hour
- Check function every hour
- Overflow
- Set zero point
- Troubleshoot problems
Adjuncts to Intraventricular Monitoring

- Jugular Venous Oxygen Monitoring
- Brain Tissue Oxygen Tension Monitoring
- Bedside Monitoring of Regional CBF
Treating Elevated ICP

- For ICP > 20 mm Hg, and keep CPP > 70 mm Hg
Elevated ICP

- Elevate HOB 30-45 degrees
- Neck straight, no tight trach tape
- Syst BP > 90 mm Hg
- Control Hypertension
- Avoid hypoxia - PaO2 <60 mm Hg
- Ventilate to normocarbia
- Light sedation
- Hypothermia - controversial
- CT Head for uncontrolled ICP
Secondary Steps for High ICP

- Heavy sedation (fentanyl, morphine, and/or paralysis)
- Seizure Control
- Drain 3-5 cc CSF if Intraventricular catheter present
- Hyperventilate to PaCO2 30-35 mm Hg
- Mannitol, keep serum Osmol. <320
- Can add 23.5% Hypertonic Saline if Osmo allows
- Hyperventilate to PaCO2 25-30 mm Hg
- Check CT, EEG, proceed to next tier
Next Tier for Elevated ICP

- High dose barbiturates
- Hyperventilate to PaCO2 25-30 mm Hg
- Hypothermia- watch cardiac index, thrombocytopenia, pancreatitis, avoid shivering
- Decompressive surgery
- Lumbar Drainage
- HHH therapy
- IV Lidocaine- unproven
- High frequency ventilation- consider if high PEEP required
Mechanisms of Head Injury

More of these-
Mechanisms of Head Injury

Means less of these!!!
Mechanisms of Head Injury

And More of these
Mechanisms of Head Injury

Means less of these!!!