Introduction to Neurosurgical Subspecialties:

Trauma and Critical Care Neurosurgery

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THE SOCIETY OF NEUROLOGICAL SURGEONS
Trauma/Critical Care Neurosurgery

• Trauma/critical care neurosurgeons treat patients with:
  • Traumatic brain injury
    • Closed head injury
    • Open head injury: gunshot wounds, knife wounds, projectiles
  • Spine fractures
  • Nontraumatic intracranial hemorrhage
  • Ischemic stroke
  • Manage critical care issues on neurosurgery patients
  • Direct a Neurocritical Care ICU
Trauma/Critical Care Neurosurgery

- Medical and surgical management of patients with traumatic brain injury, spine fractures, and other acute neurosurgical care
- Direct a Neurocritical Care ICU
  - Neurocritical care neurosurgeons
  - Neurocritical trained neurologists
  - Other neurocritical care-trained ICU physicians
  - Residents and medical students
- Fellowship for trauma/critical care neurosurgeons is not required but some may opt for specialized training via fellowship
Case Illustration #1

- 25 yo male fell onto back of head while riding his bike
- Initially brief loss of consciousness, then awoke. 3 hours later acutely lost consciousness.
- Presents to ED with GCS 9 (E2,M5,V2)
Case Illustration #1
Case Illustration #1

- Emergent craniotomy for evacuation of epidural hematoma. Small laceration of transverse sinus noted.
- Immediately regained consciousness. Discharged to home on POD#2.
EPIDURAL HEMATOMA

- Etiology
  - Skull fracture with laceration of middle meningeal artery
  - Skull fracture with dural venous sinus laceration
- High suspicion for early imaging
  - Lucent period prior to deterioration
- Without associated injuries, 100% good outcome with prompt care
  - Any mortality is a system failure or delay in care
- True neurosurgical emergency
Case Illustration #2

• 65 y/o male who fell backward off the back of a golf cart while drinking
• On ASA for CAD
• PE: Confused and combative, yelling
  • Opens eyes to voice
  • Follows commands all extremities
Epidural vs Subdural hematoma
SUBDURAL HEMATOMA

• Associated with underlying brain injury
  • Worse prognosis
• If asymptomatic, may watch if <1cm in diameter
• Treatment
  • Acute- Hyperintense- craniotomy
  • Subacute- Isointense- bur holes
  • Chronic- Hypointense- SEPS (twist drill/suction)
Case Illustration #3

• 83 y/o man s/p drug eluting coronary stent
  • On Plavix and ASA
• Tripped in the driveway 4 weeks ago (No LOC)
• Now with HA and difficulty walking
• PE: Awake with mild STM deficit
  PERRLA, EOMI
  5/5 all extremities, left drift
Chronic Subdural Hematoma
Case Illustration #4

- 24 y/o male fell off bike
- Seizure at the scene
- Normal neurologic exam on arrival
Traumatic Subarachnoid Hemorrhage
Case Illustration #5

- 45 y/o male pedestrian hit by car
- +LOC
- PE: PERRLA
  - Moaning
  - No eye opening
  - Withdrawing
TBI: Coup/Contrecoup

The image illustrates the concepts of coup and contrecoup injuries in traumatic brain injury (TBI). In a coup injury, the brain impacts the skull at the point of impact, while in a contrecoup injury, the brain reacts to the impact by moving the opposite direction.
Contusions

• Parenchymal damage from the bony ridges at base of the skull
  • Associated with edema
  • Worse prognosis
• Potential for “blossoming”
  • Repeat CT within 4-6 hours
Diffuse Axonal Injury

- Deceleration injury - usually MVA
- Shear-strain forces on the axons during rotation/deceleration of head
- Poor prognosis
  - 35% of all TBI deaths
  - Most common cause of coma and severe disability
Neurocritical Care: Treatment of Increased Intracranial Pressure

- Positioning
- Hyperventilation
- Hypertonic therapy (steroids not useful except in tumor swelling)
- CSF drainage
- Decrease brain metabolism
- Surgical decompression
Position Patient Correctly

- Elevate head of bed to 30 degrees
- Maintain head and neck in straight alignment
- Prevent compression of jugular veins by circumferential endotracheal tape, trach ties or cervical collar
- Minimize endotracheal suction and gagging
Hyperventilation

• Mechanism: CO2 vasodilates, causing increased blood flow within the brain
  • If you blow off CO2, you decrease the blood volume of the brain
• Maintain CO2 30-35 for <24 hrs to prevent ischemia
• Never drop CO2 below 30
Hypertonic Therapy

• Use osmotic gradient to pull fluid out of brain and into the vascular space, decreasing brain volume
  • Mannitol
  • Hypertonic saline

• Never use hypotonic fluid, such as 1/2NS or D5W - this causes brain swelling and can cause death

• Avoid Dextrose in fluids to decrease glutamate production
CSF drainage

• Placement of an external ventriculostomy (EVD) to drain CSF and monitor ICP
Decrease Cerebral Metabolic Rate

- Sedation (propofol or precedex for continual neurologic assessment)
- Paralytics
- Barbituate coma
- Control Seizures, Fever, Restlessness, Pain
- Normothermia
- Hypothermia - literature still controversial
Conclusions

• Trauma neurosurgery is one of the central components of a neurosurgical career
• Trauma neurosurgery can be highly rewarding when a preterminal patient can be returned to a normal or near normal life
• Neurocritical care of ICU patients is distinctly different from critical care management of other patient populations
• In addition to cranial and spine trauma, stroke and intracranial hemorrhage are other large critical care populations