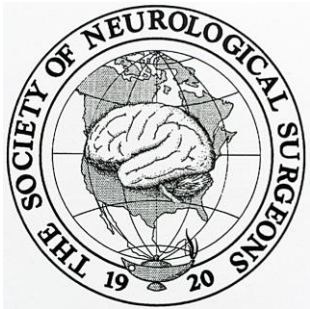


# Introduction to Neurosurgical Subspecialties:

## Trauma and Critical Care Neurosurgery

Brian L. Hoh, MD<sup>1</sup>, Gregory J. Zipfel, MD<sup>2</sup> and Stacey Q. Wolfe, MD<sup>3</sup>

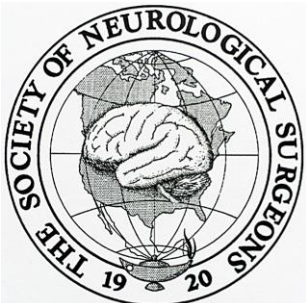
<sup>1</sup>University of Florida, <sup>2</sup>Washington University, Wake Forest University<sup>3</sup>



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# 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



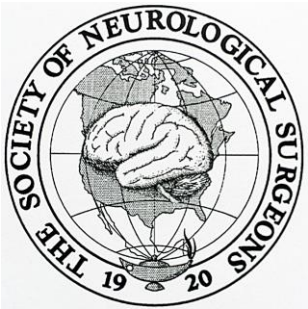
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# Trauma/Critical Care Neurosurgery

- 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

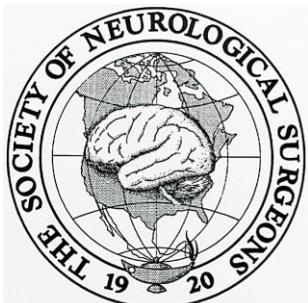
# Case Illustration #1

- 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)



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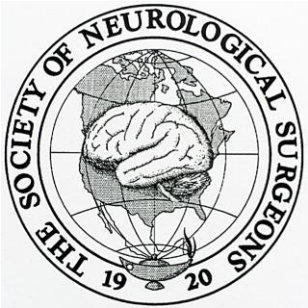
# Case Illustration #1



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# Case Illustration #1

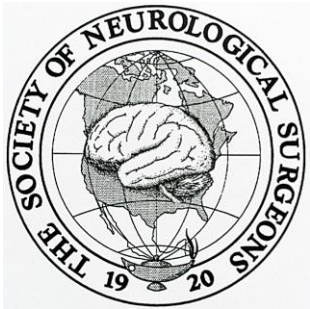
- Emergent craniotomy for evacuation of epidural hematoma. Small laceration of transverse sinus noted.
- Immediately regained consciousness. Discharged to home on POD#2.



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# EPIDURAL HEMATOMA

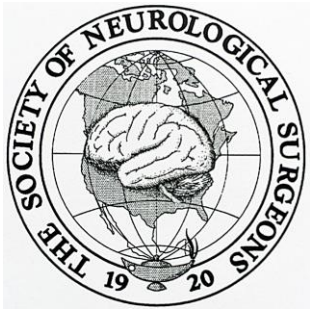
- Etiology
  - Skull fracture with laceration of middle meningeal artery
  - Skull fracture with dural venous sinus laceration
- High suspicion for early imaging
  - Lucent period prior to deterioration
- Without associated injuries, 100% good outcome with prompt care
  - Any mortality is a system failure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



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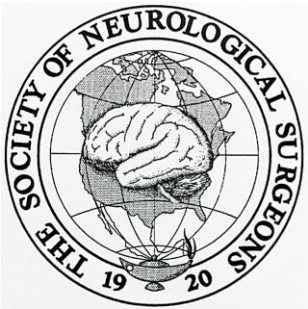
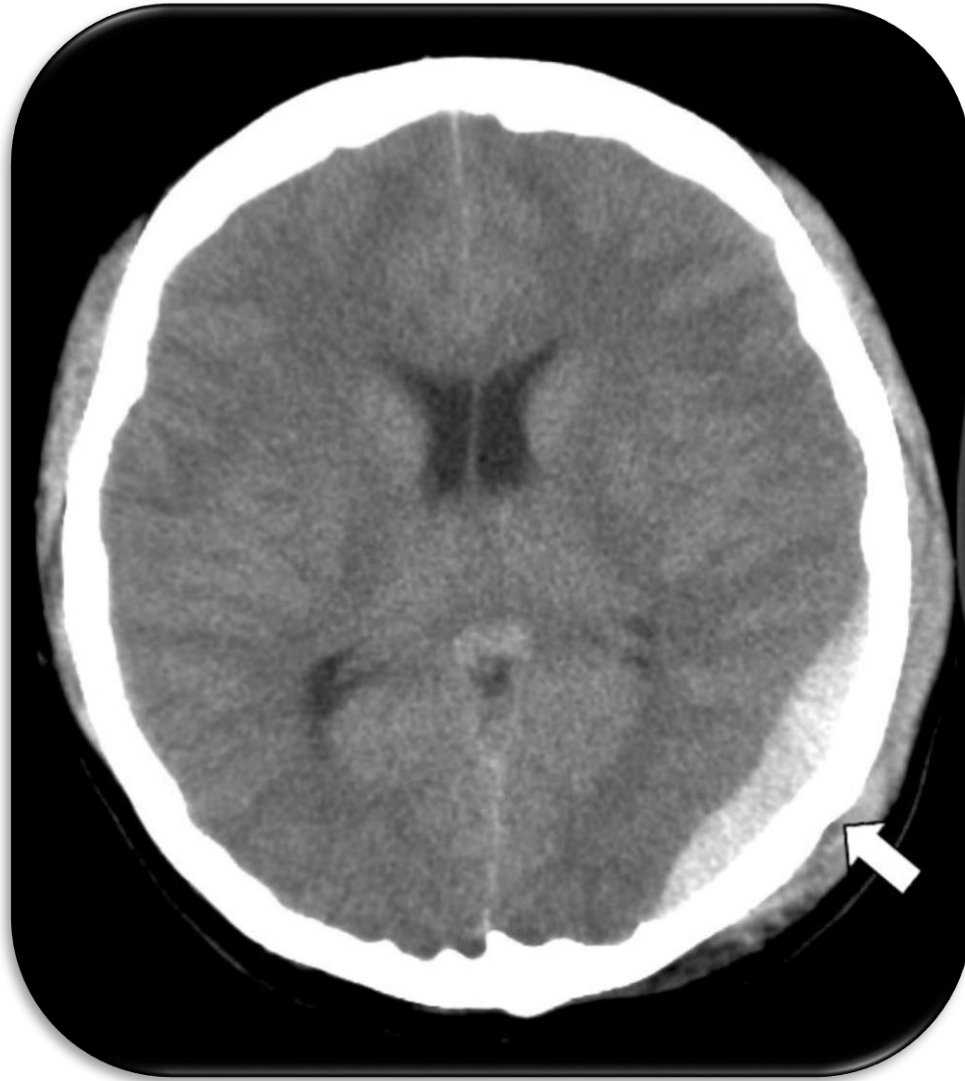
# Case Illustration #2

- 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



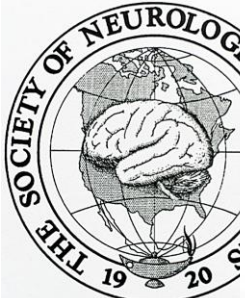
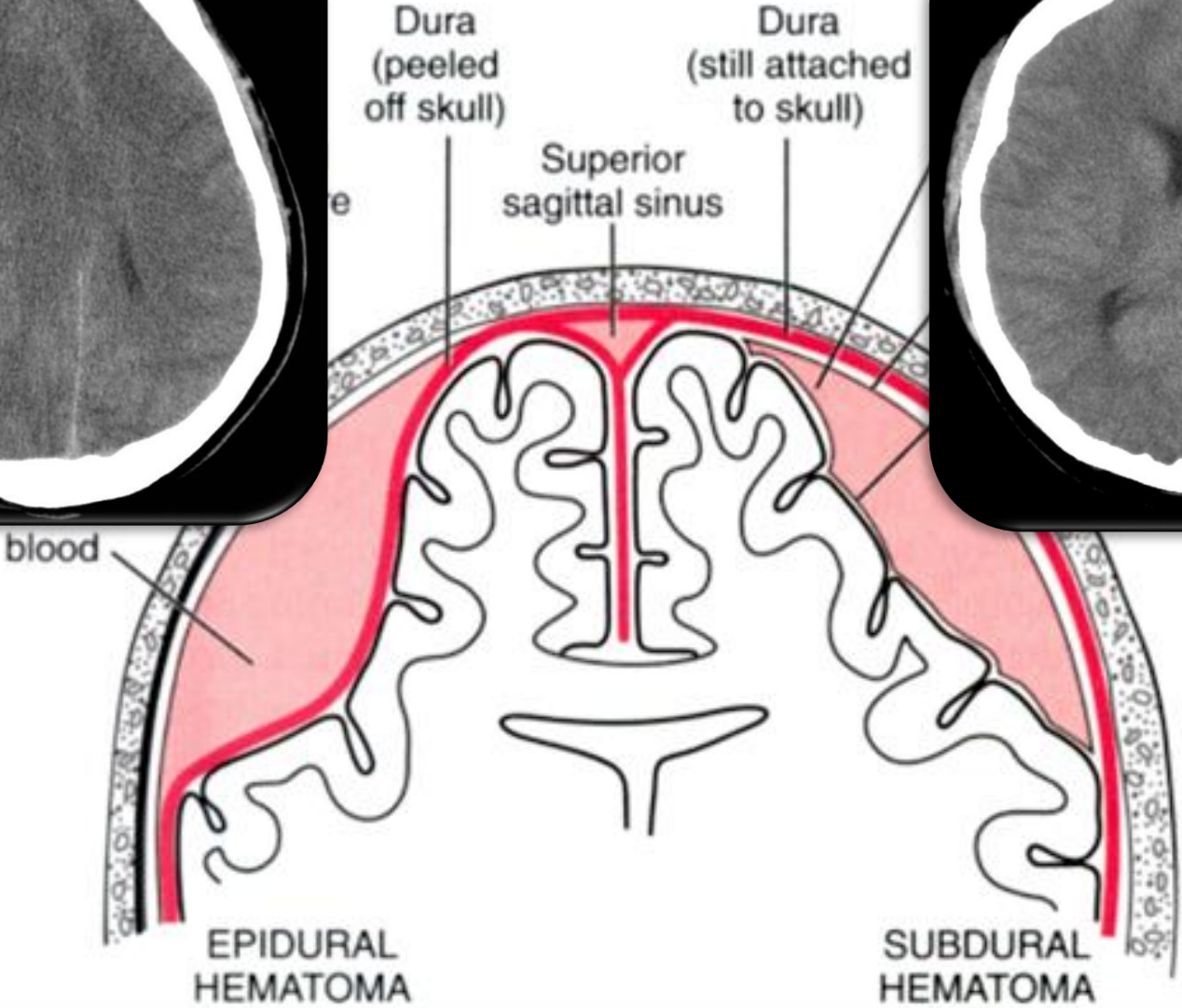
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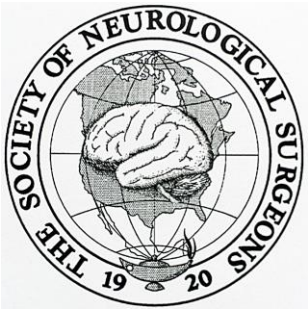
# Epidural vs Subdural hematoma



GEONS

# 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)



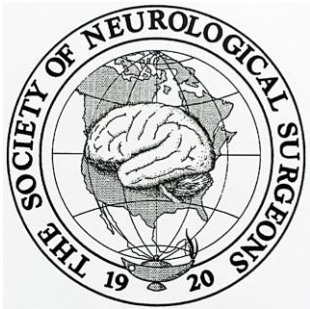
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# Case Illustration #3

- 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

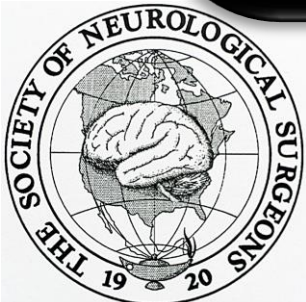
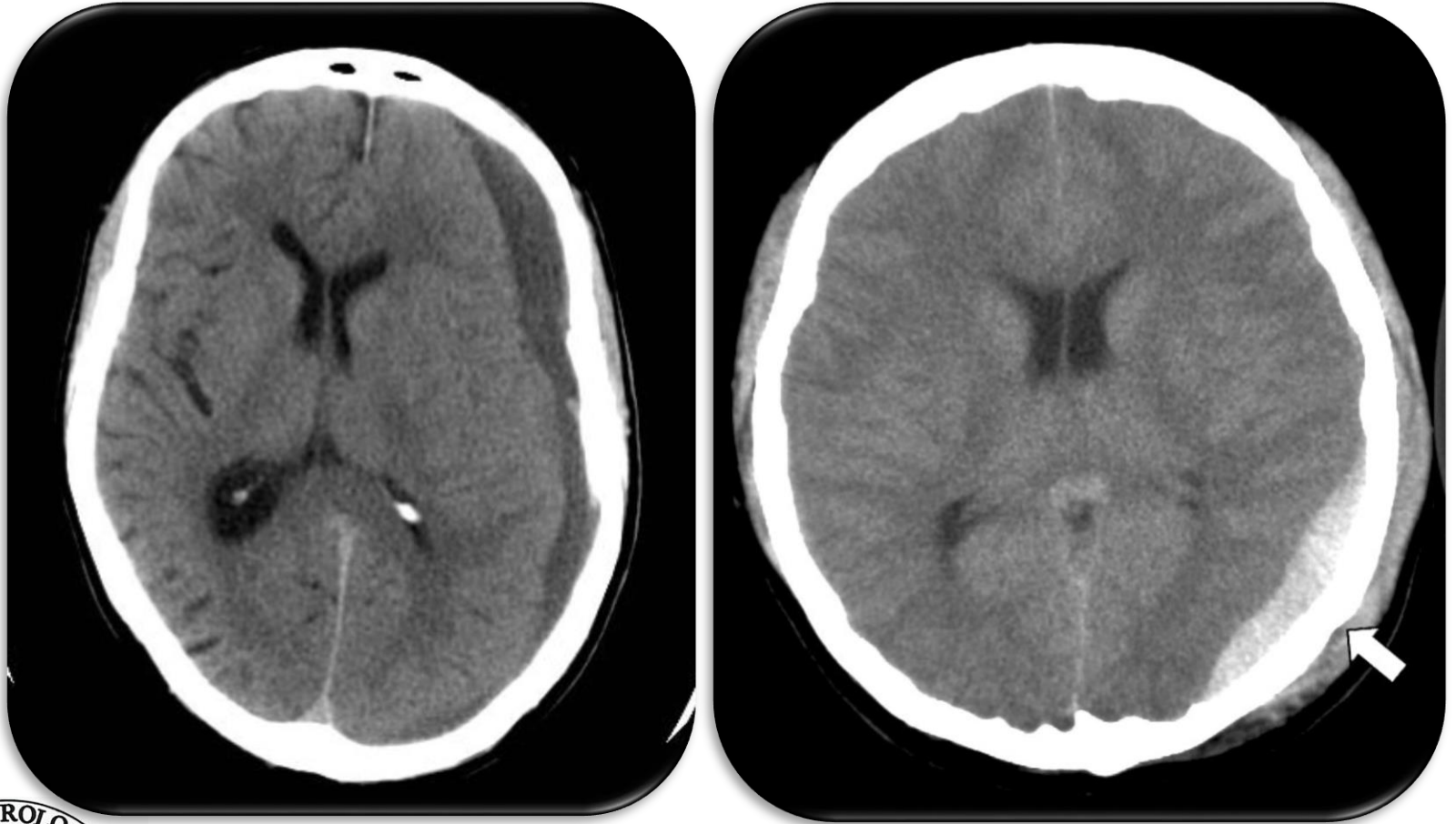
PERRLA, EOMI

5/5 all extremities, left drift



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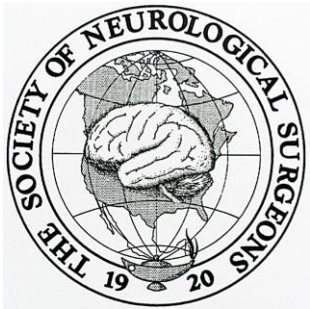
# Chronic Subdural Hematoma



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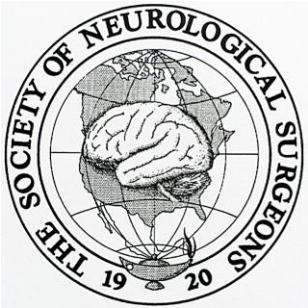
# Case Illustration #4

- 24 y/o male fell off bike
- Seizure at the scene
- Normal neurologic exam  
on arrival



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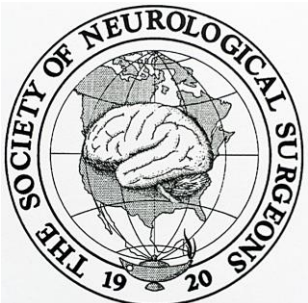
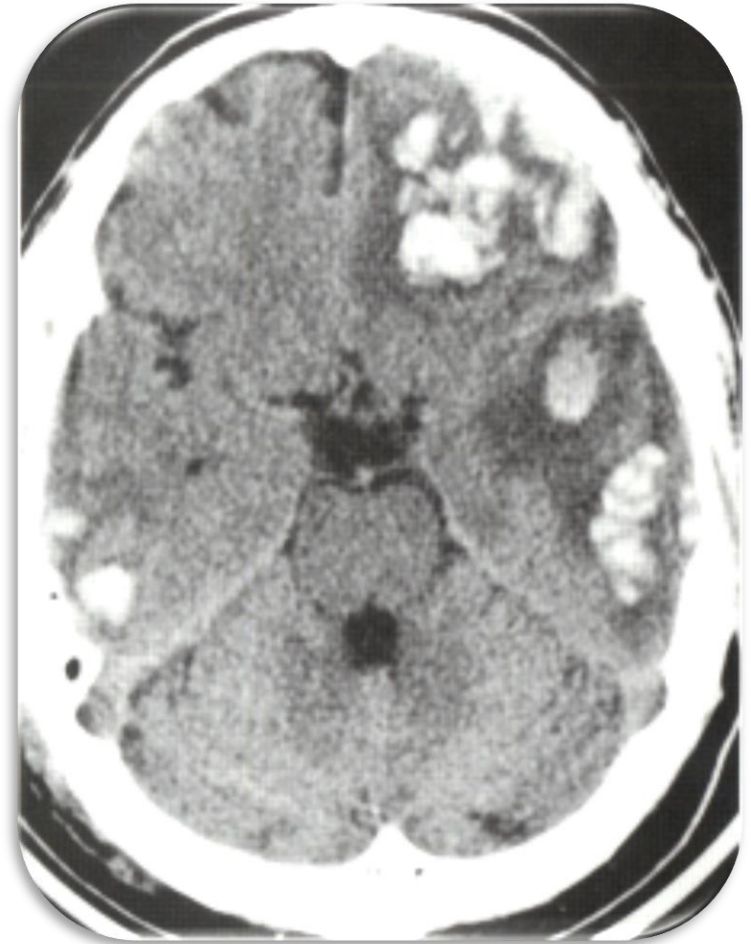
# Traumatic Subarachnoid Hemorrhage



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# Case Illustration #5

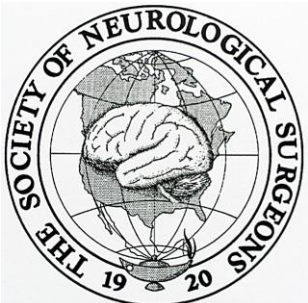
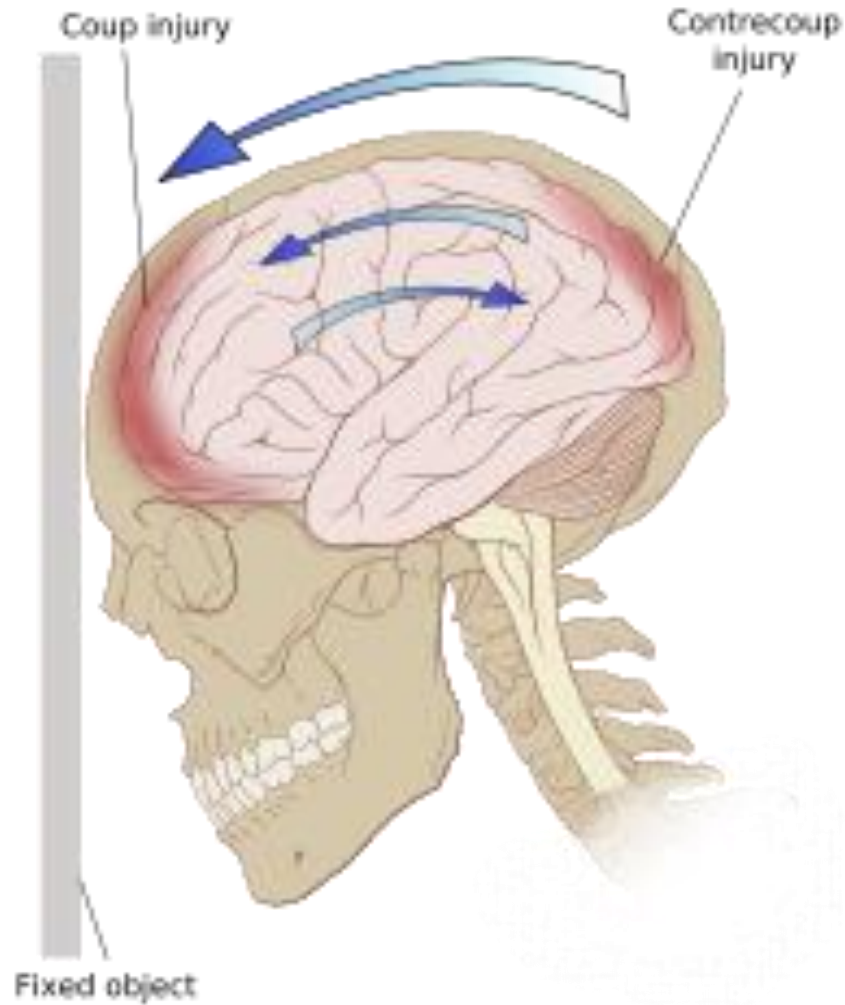
- 45 y/o male pedestrian hit by car
- +LOC
- PE: PERRLA
  - Moaning
  - No eye opening
  - Withdrawing



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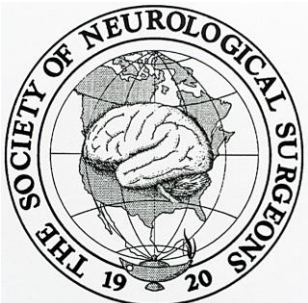
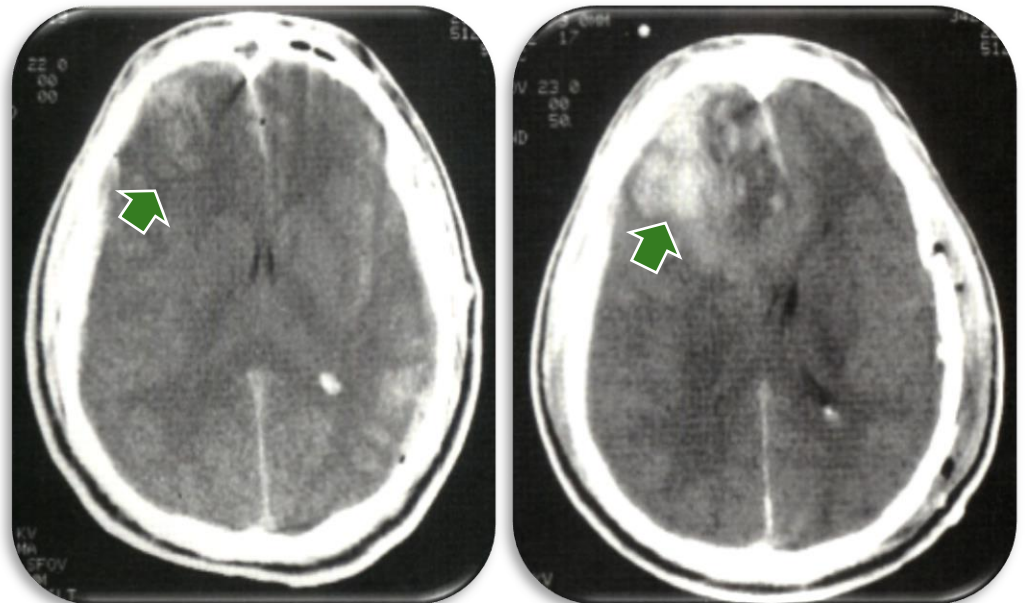
# TBI: Coup/Contrecoup



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# Contusions

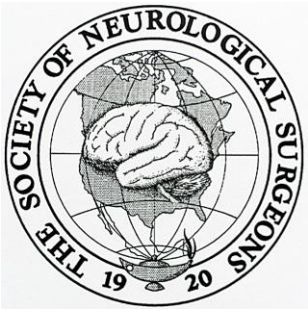
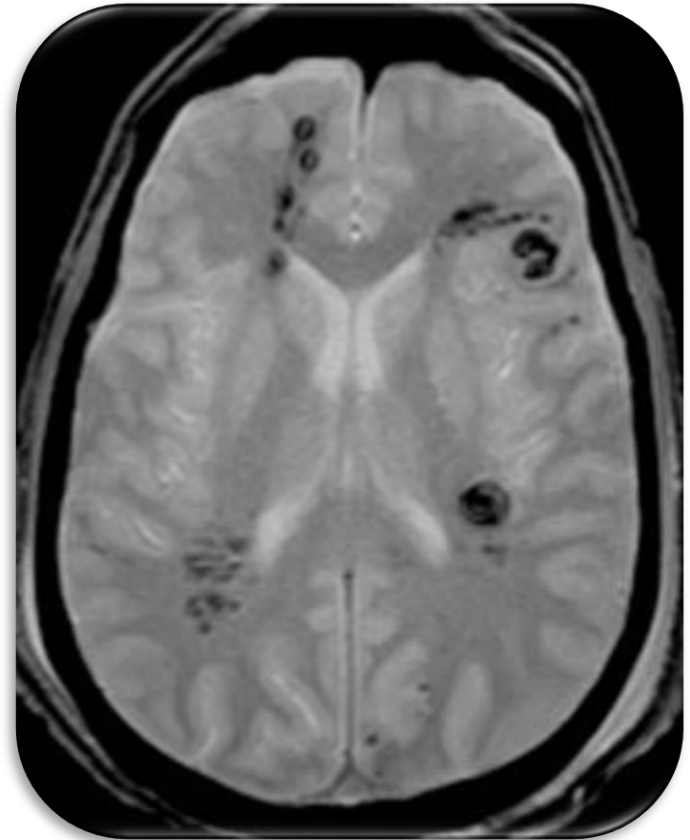
- Parenchymal damage from the bony ridges at base of the skull
  - Associated with edema
  - Worse prognosis
- Potential for “blossoming”
  - Repeat CT within 4-6 hours



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# Diffuse Axonal Injury

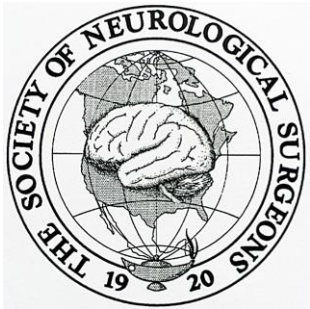
- Deceleration injury- usually MVA
- Shear-strain forces on the axons during rotation/deceleration of head
- Poor prognosis
  - 35% of all TBI deaths
  - Most common cause of coma and severe disability



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# Neurocritical Care: Treatment of Increased Intracranial Pressure

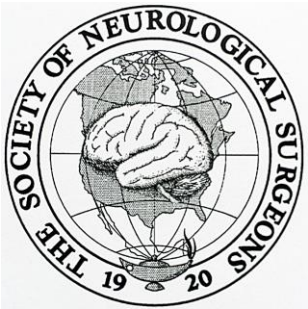
- Positioning
- Hyperventilation
- Hypertonic therapy (steroids not useful except in tumor swelling)
- CSF drainage
- Decrease brain metabolism
- Surgical decompression



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# Position Patient Correctly

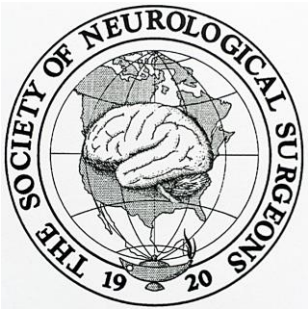
- Elevate head of bed to 30 degrees
- Maintain head and neck in straight alignment
- Prevent compression of jugular veins by circumferential endotracheal tape, trach ties or cervical collar
- Minimize endotracheal suction and gagging



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# Hyperventilation

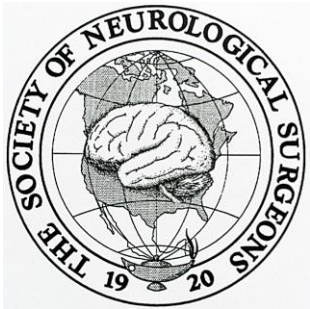
- Mechanism: CO<sub>2</sub> vasodilates, causing increased blood flow within the brain
  - If you blow off CO<sub>2</sub>, you decrease the blood volume of the brain
- Maintain CO<sub>2</sub> 30-35 for <24 hrs to prevent ischemia
- Never drop CO<sub>2</sub> below 30



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# Hypertonic Therapy

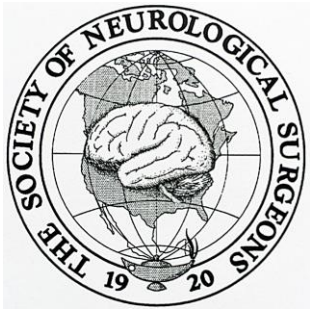
- Use osmotic gradient to pull fluid out of brain and into the vascular space, decreasing brain volume
  - Mannitol
  - Hypertonic saline
- Never use hypotonic fluid, such as 1/2NS or D5W- this causes brain swelling and can cause death
- Avoid Dextrose in fluids to decrease glutamate production



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# CSF drainage

- Placement of an external ventriculostomy (EVD) to drain CSF and monitor ICP

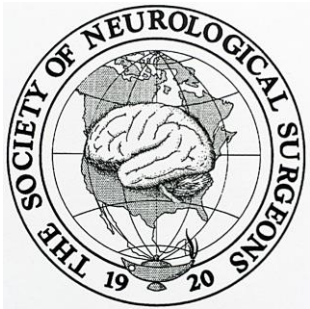


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# Decrease Cerebral Metabolic Rate

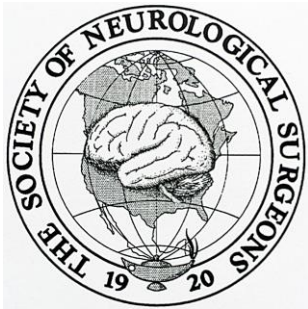
- Sedation (propofol or precedex for continual neurologic assessment)
- Paralytics
- Barbituate coma
- Control Seizures, Fever, Restlessness, Pain
- Normothermia
- Hypothermia- literature still controversial



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# 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



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