Traumatic Brain Injury: Assessment, Intervention, and Evolving Tools in Acute Care

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Wolfson Children's Hospital

Disclosers

I, Kristen Ray, do not have any disclosers.

Any equipment mentioned or pictures are just for general education, not brand specific.

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Objectives

By the end of this session, participants will be able to:

- Describe the pathophysiological mechanisms of traumatic brain injury and their clinical implications.
- Identify key assessment strategies for detecting early signs of neurological deterioration in TBI patients.
- Discuss the roles and responsibilities of EMS, nursing, and physician teams in the continuum of TBI care.
- Apply evidence-based interventions to support cerebral perfusion and minimize secondary brain injury.
- Recognize the potential benefits and limitations of emerging technologies, including automated pupillometry, in neurocritical assessment.

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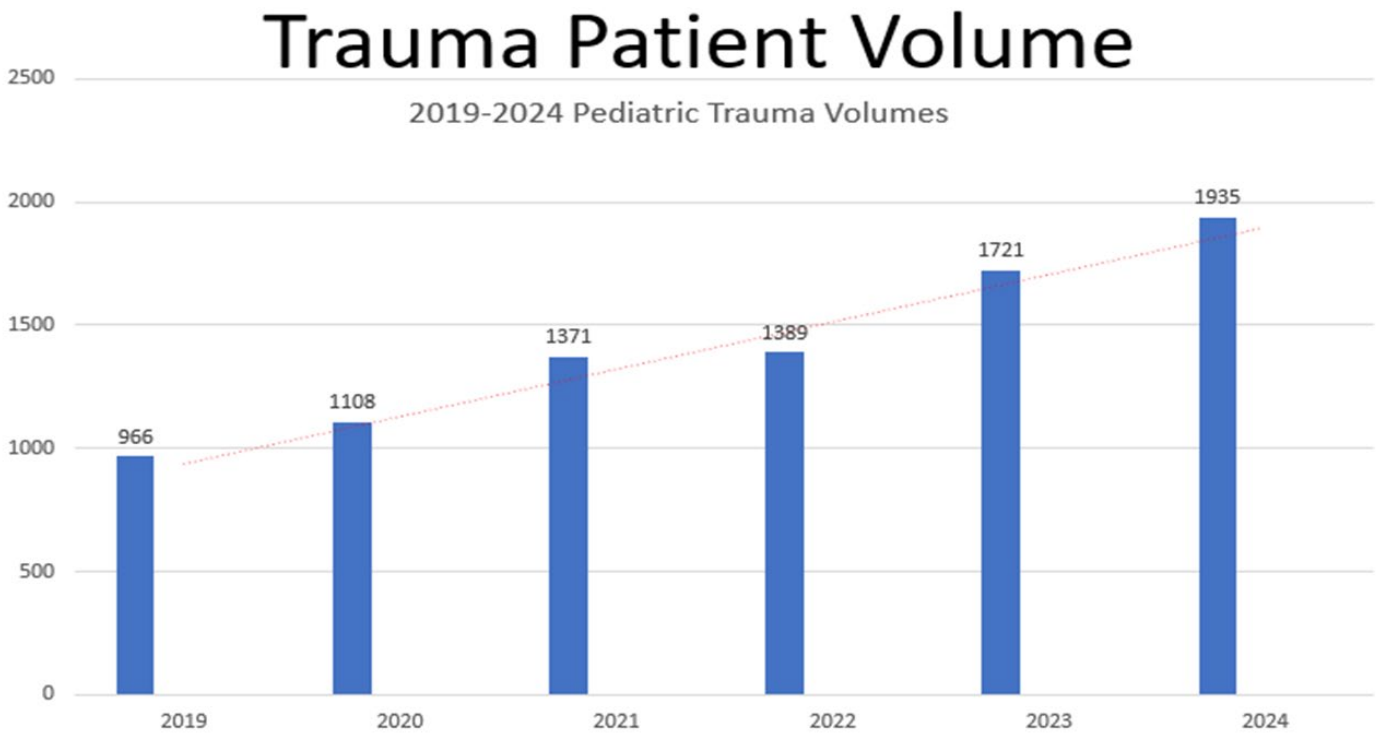
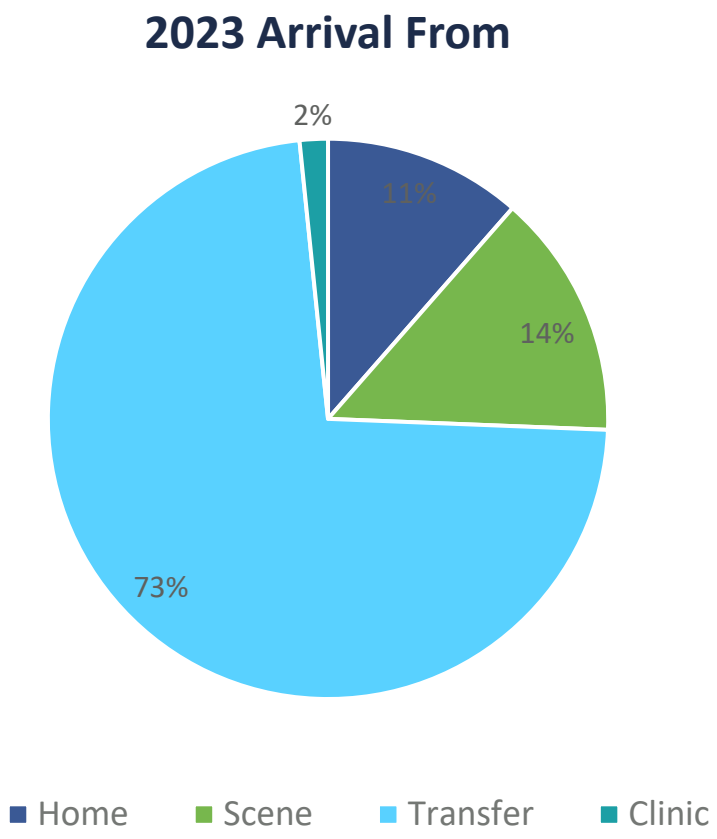
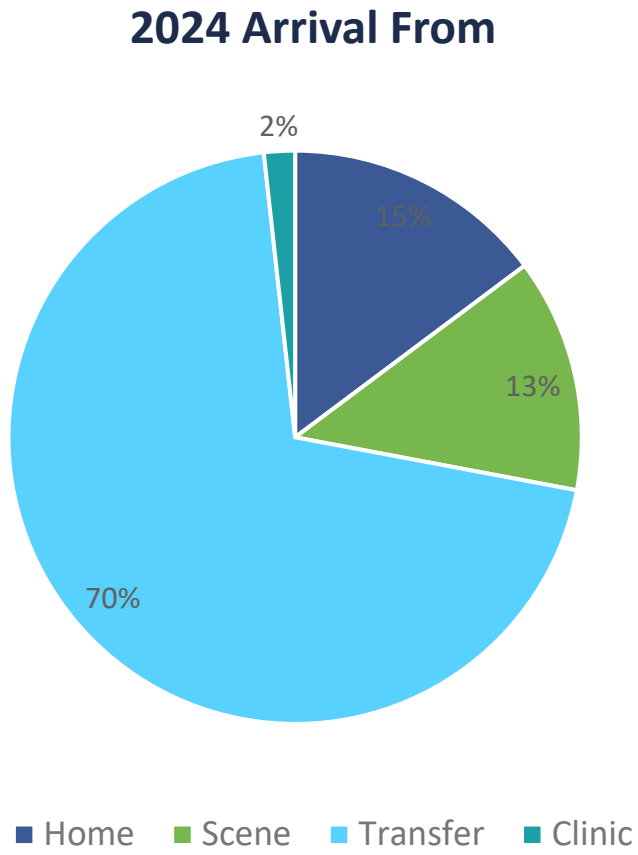


Scene vs. Transferred-In





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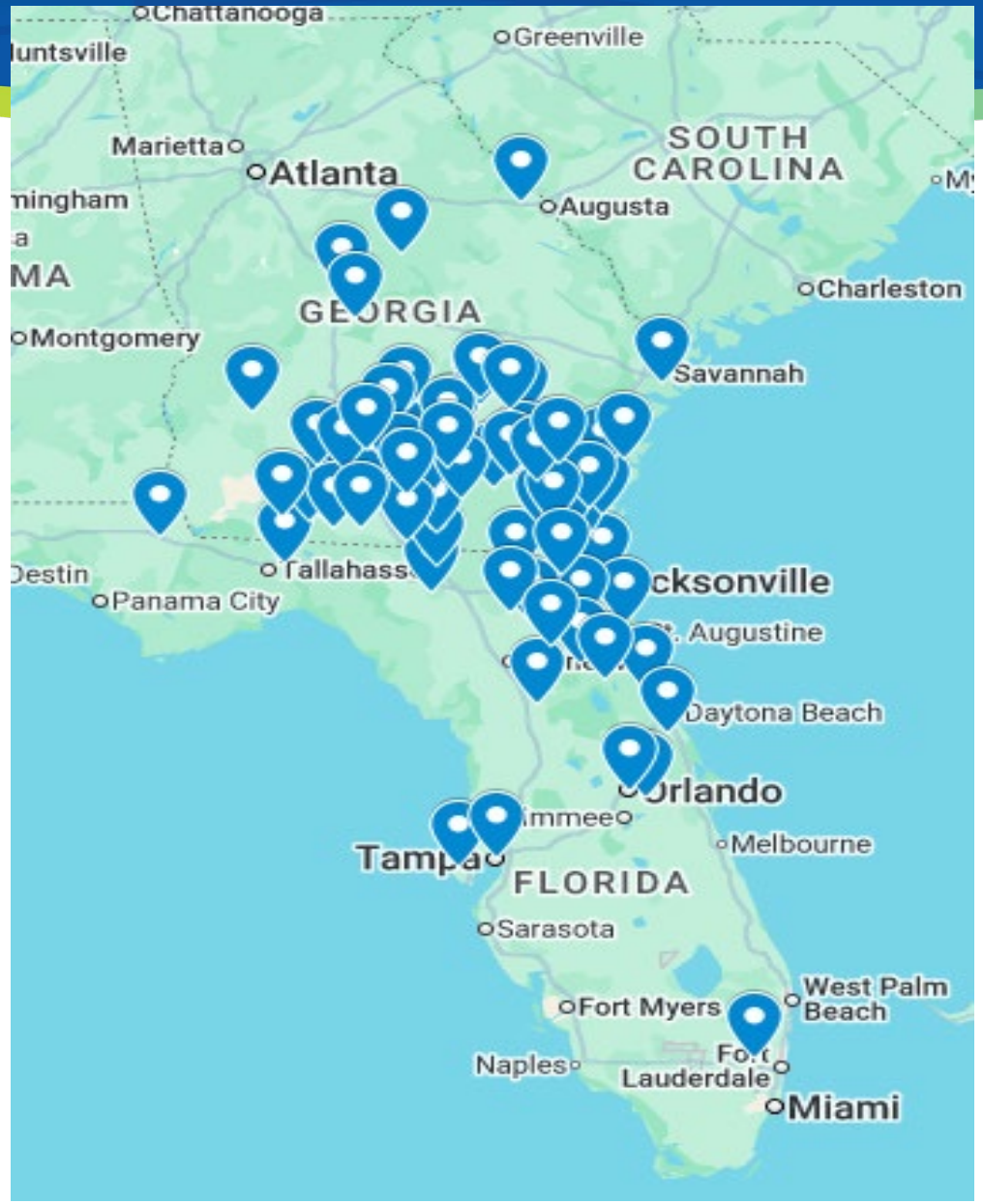
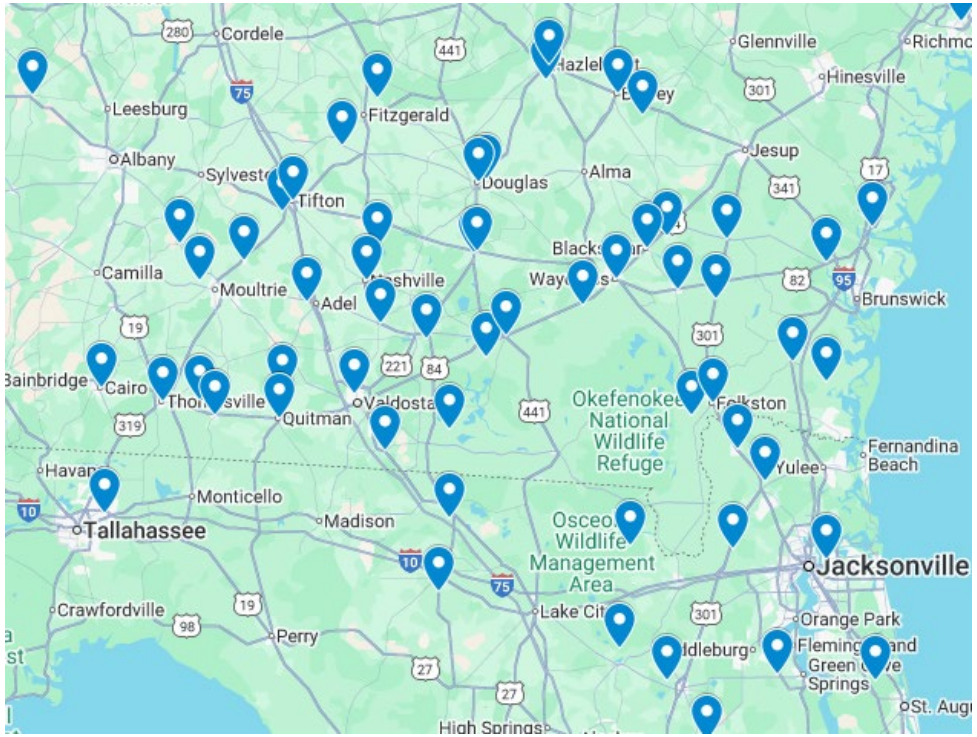
Transfers





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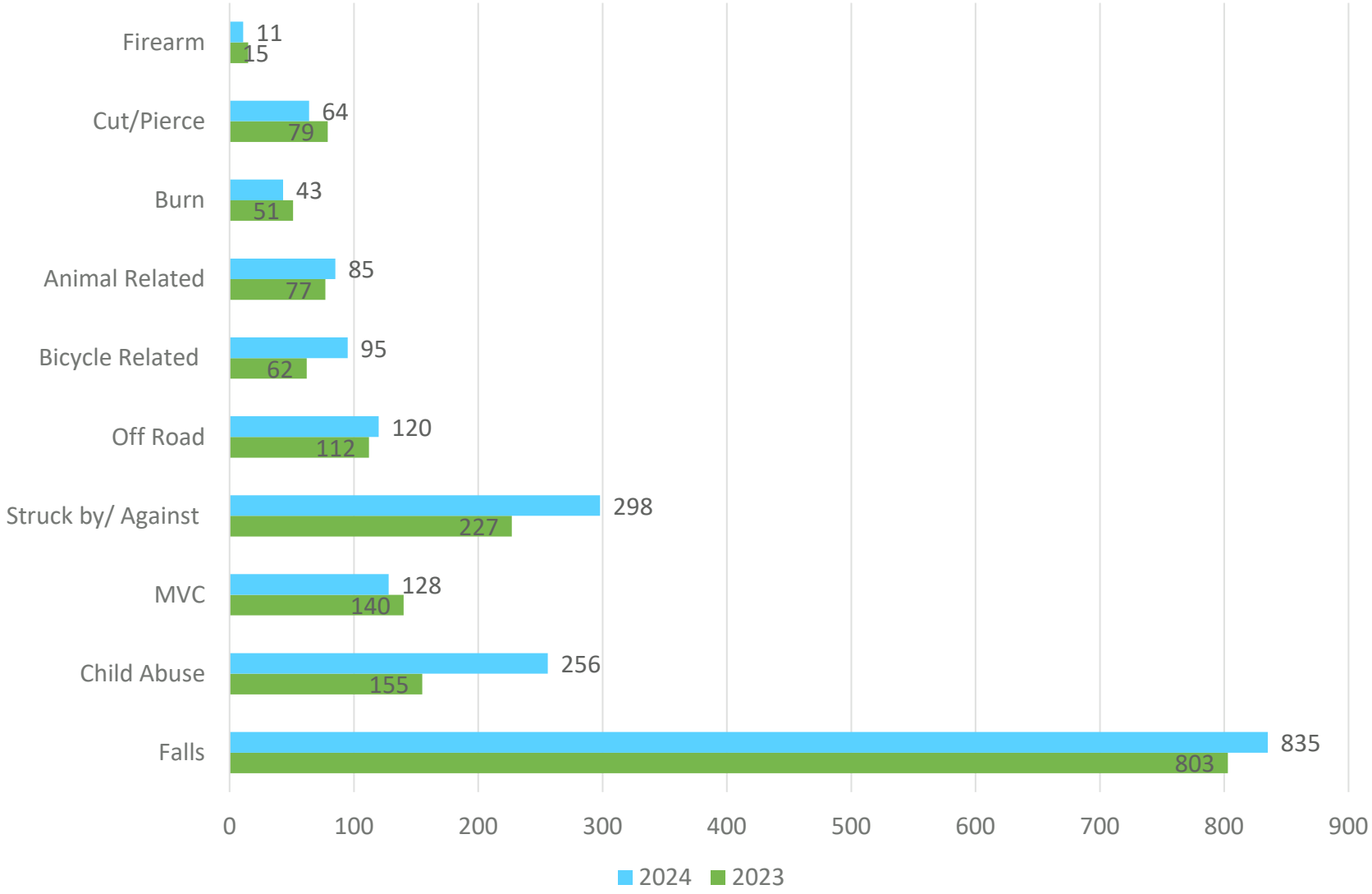
Injury Mechanism



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Prevalence of TBI's

- Globally: ~69 million people experience
- United States: ~ 2.8 million TBI-related emergency department visits, hospitalization and deaths annually
- Long- term disability: ~15% of TBI pts experience persistent neurological of functional impairments

- Age groups most affected:
  - Children under 4: falls cause nearly 70% of TBIs
  - Young Adults (15-24) highest incidence, especially males
  - Elderly (75+) sharp increase in TBI –related hospitalization and deaths due to falls
- Military personnel: ~ 50% of TBIs occur in combat or training
- US annual cost over $40 Billion
  - Direct healthcare
  - Rehab
  - Lost productivity and wages

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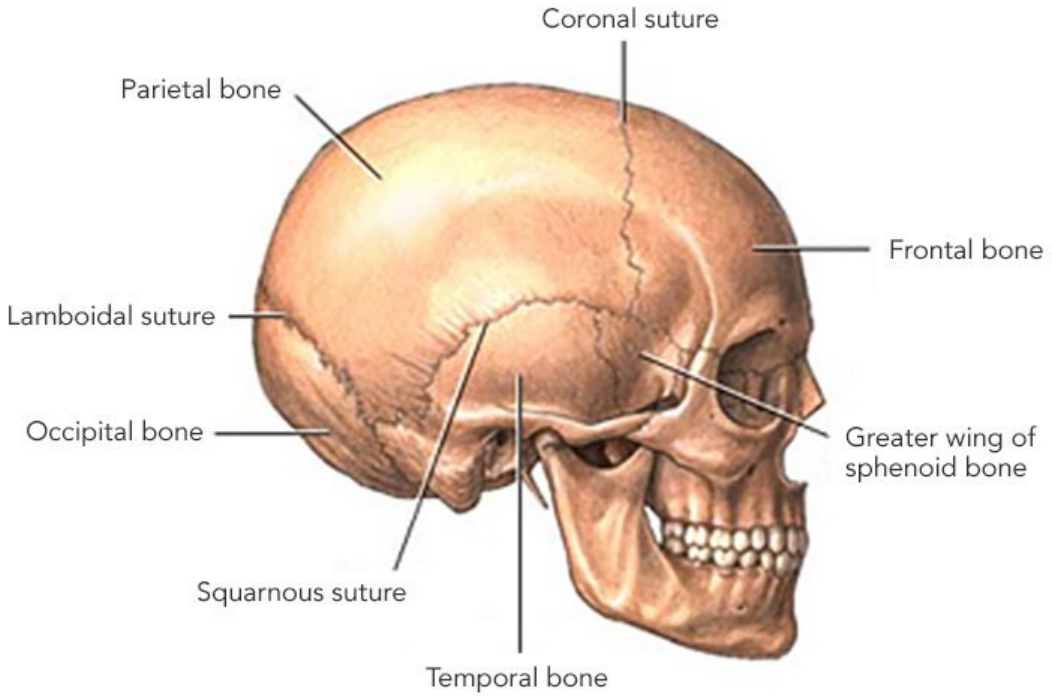
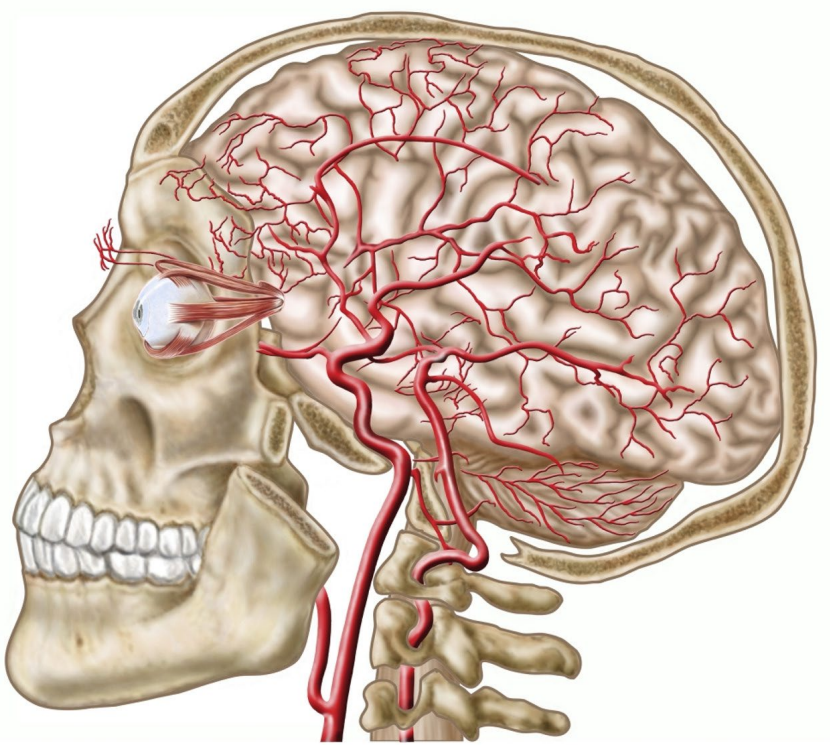
Anatomy Review





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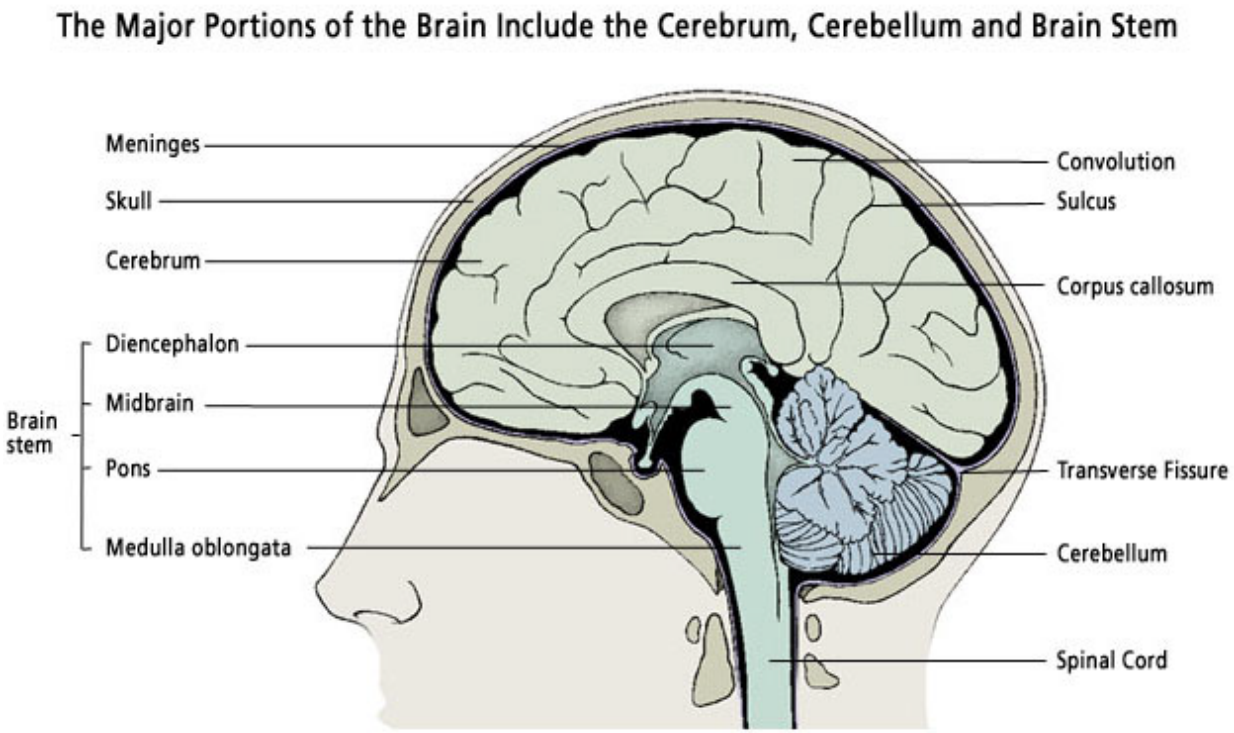
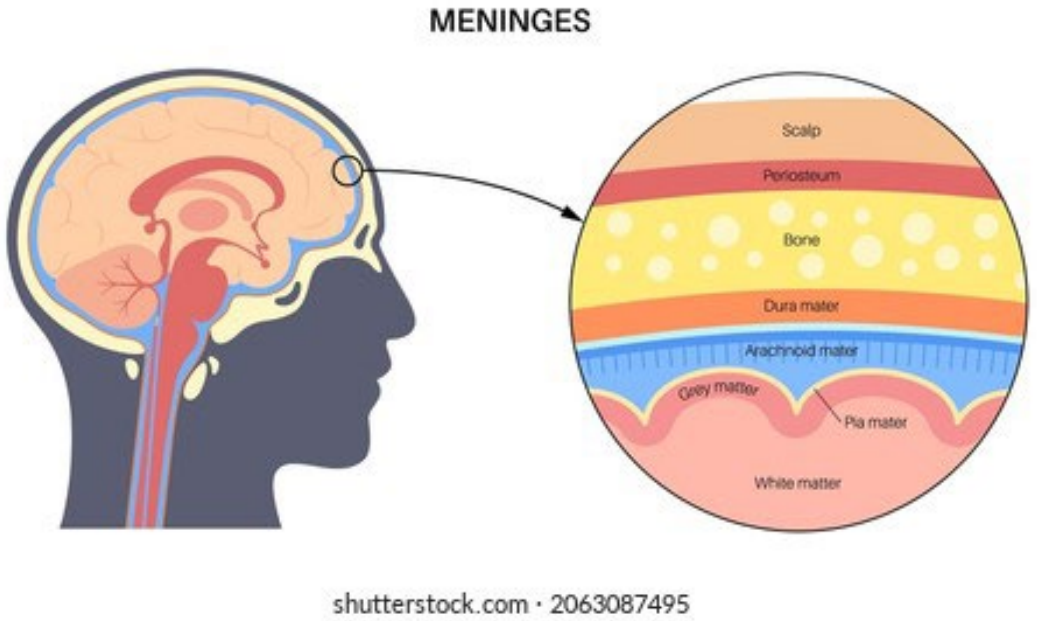
Anatomy Review





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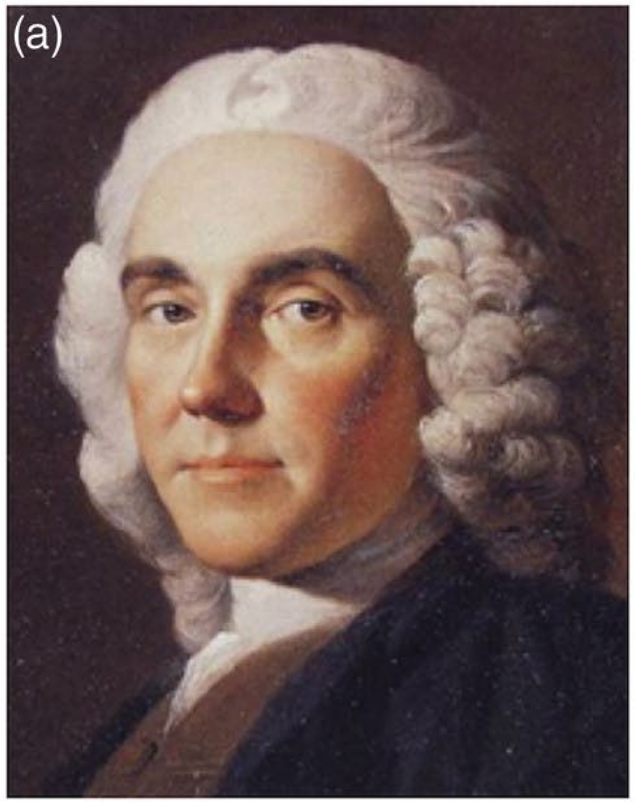
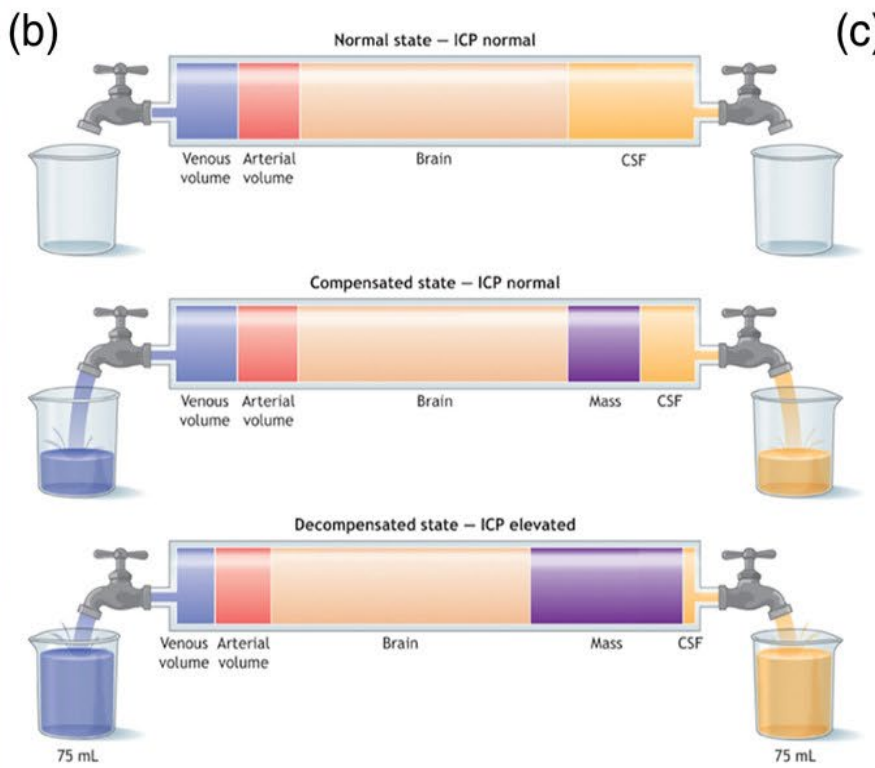
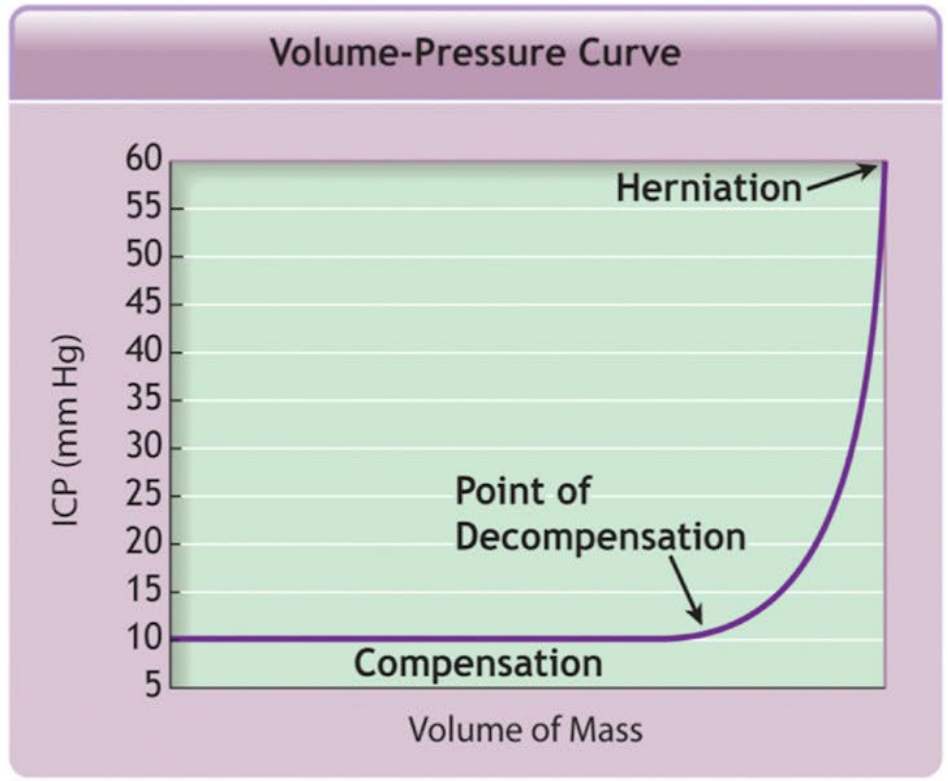
Monro- Kellie Doctrine







(Wilson, 2016)

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What is a Traumatic Brain Injury (TBI)

- An injury to the brain caused by an external physical force, such as a blow, hit or fall.

- Mild: temporary LOC, confusion or disorientation
- Moderate: LOC for more than 30 minutes, but less than 24 hours
- Severe: LOC more than 24 hours or GCS 8 or less

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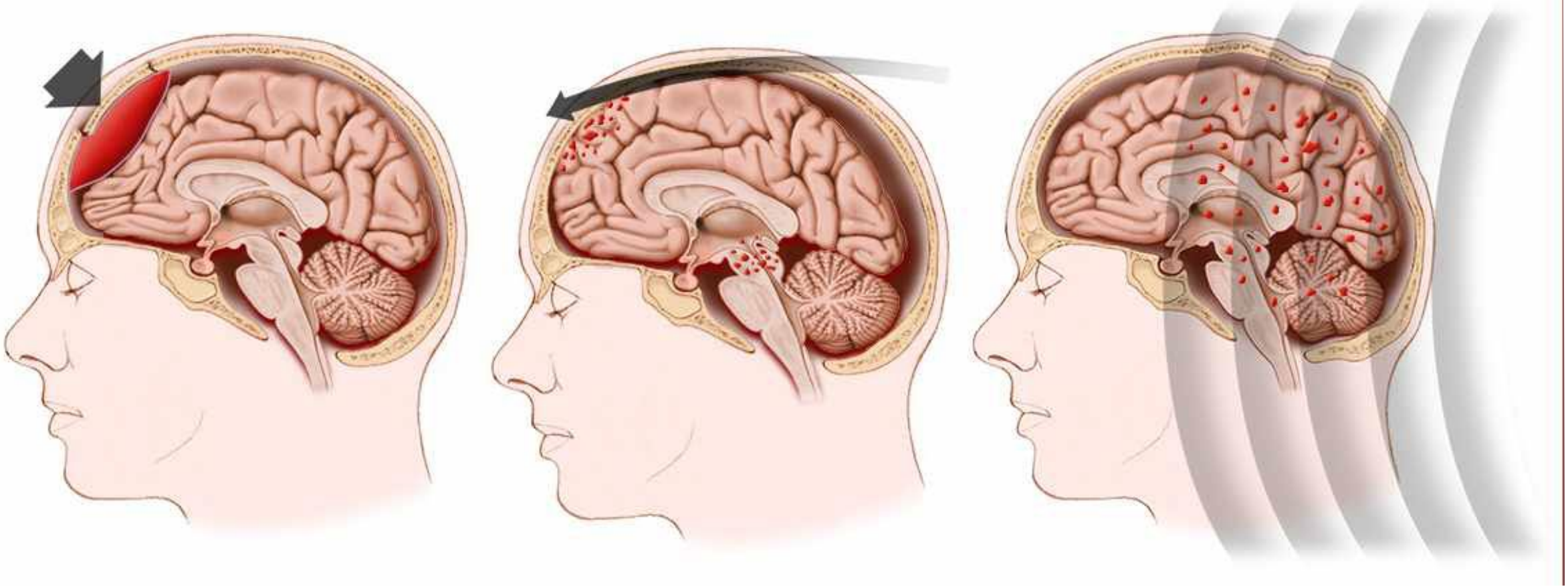
Types of traumatic brain injury



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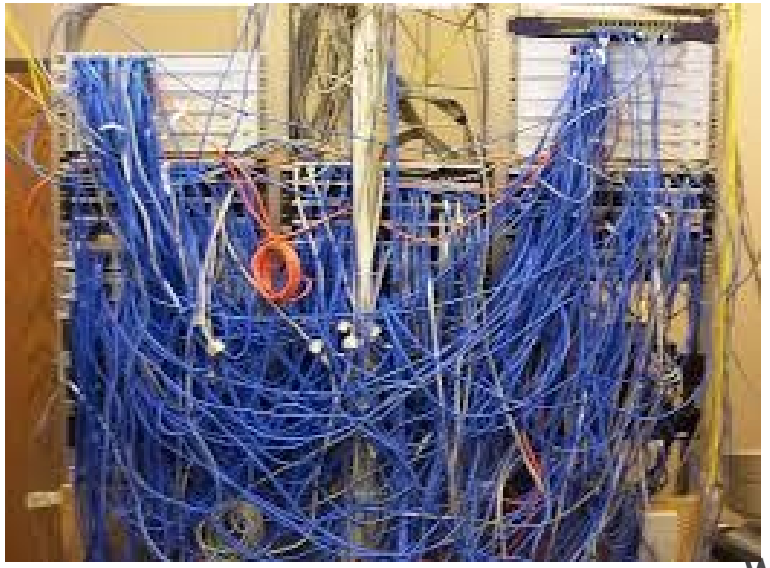
Mild TBI

- Concussion
- Caused by bump, blow or jolt to head/ body that causes brain to move rapidly within skull. This can cause chemical changes and damage to brain cells

- CT/ MRI scans are normal, but pt is symptomatic

- HA, dizziness, nausea, confusion, memory loss, visual disturbances



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Post-Concussion Care

Acute Care

- Rest physical and cognitive
- OTC pian relievers
- Take time returning to normal activities
- Avoid alcohol and drugs
- Seek medical care if symptoms become worse
- Concussion Clinics
- Neuropsychologist

Long Term

- Anxiety
- Depression
- Insomnia
- Memory problems
- Hormonal imbalances
- Visual changes
- Increased risk future concussion and developing conditions such as dementia

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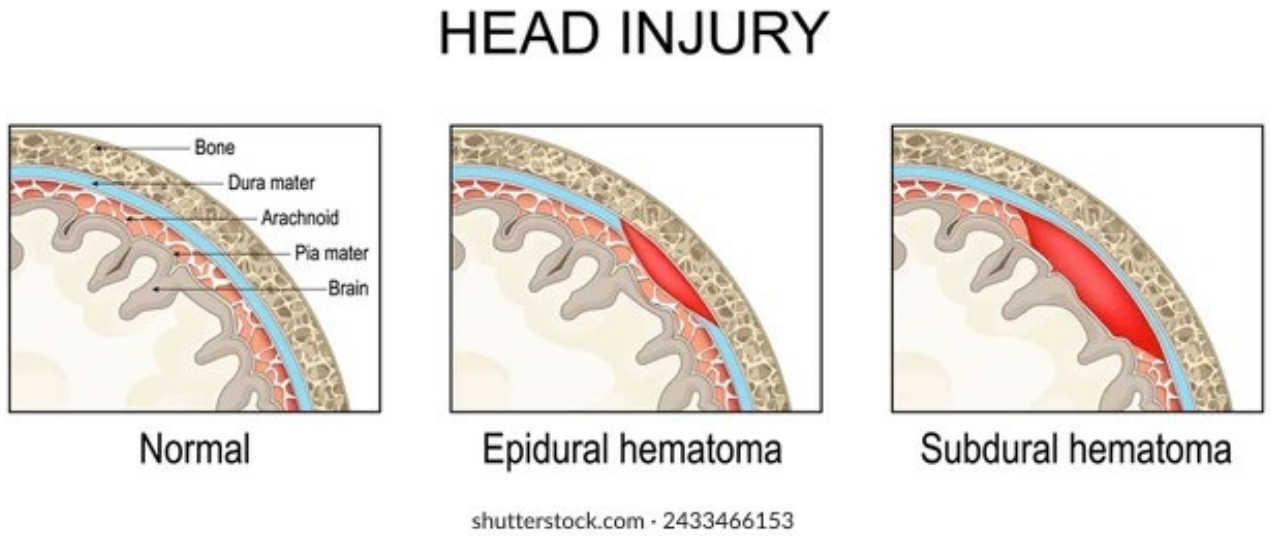
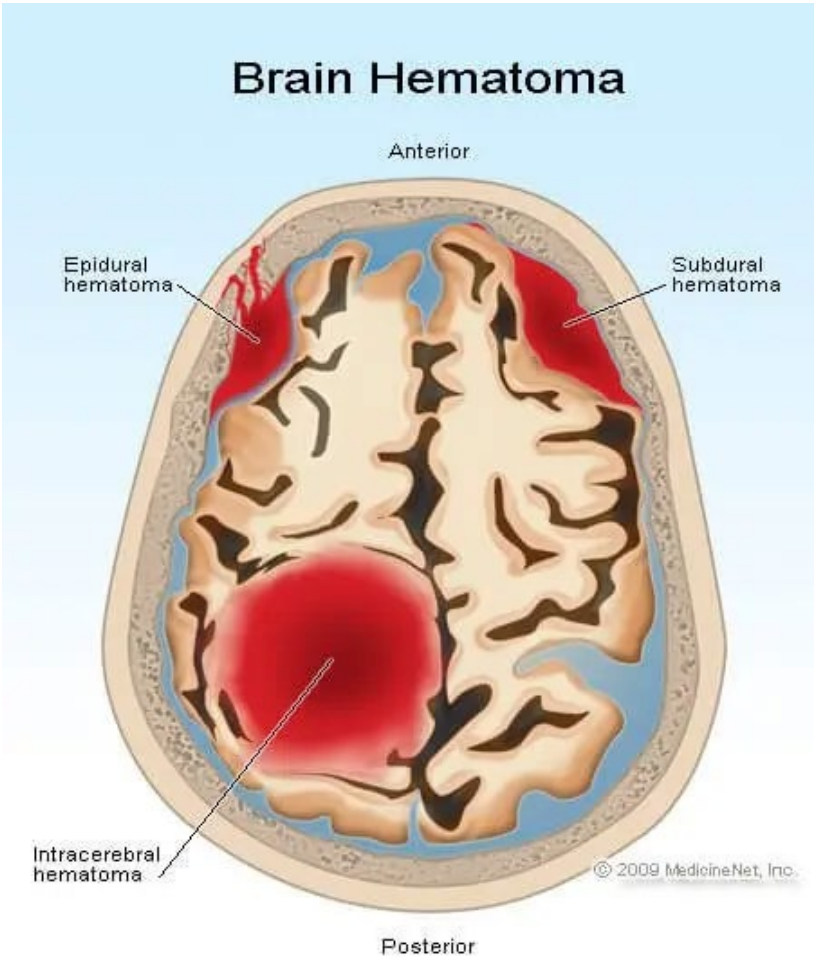
Moderate to Severe TBI





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Traumatic Epidural Hematoma (EDH)

- Blood between the dura mater and skull
- Middle meningeal artery associated with temporal bone fracture
- Period of lucid followed by rapid change in neurologic status
- Natasha Richardson/ Sonny Bono- fall while skiing; Bob Saget- fell hit his head

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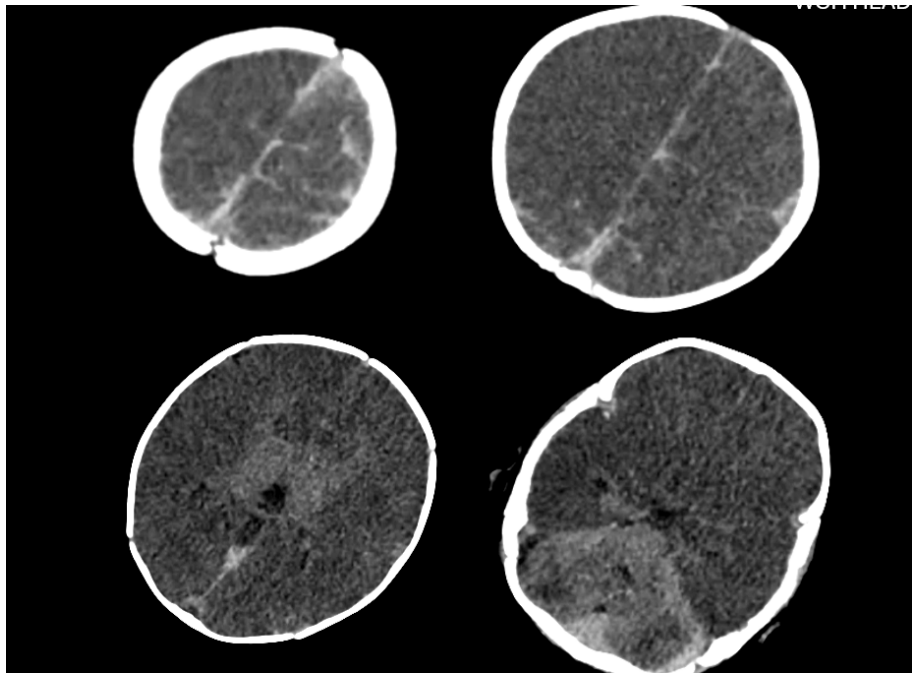
Traumatic Subdural Hematoma

- Collection of blood that forms between the brain and dura mater
- Venous
- Anticonvulsive medication
- Child physical abuse <2years old
- Elderly higher risk



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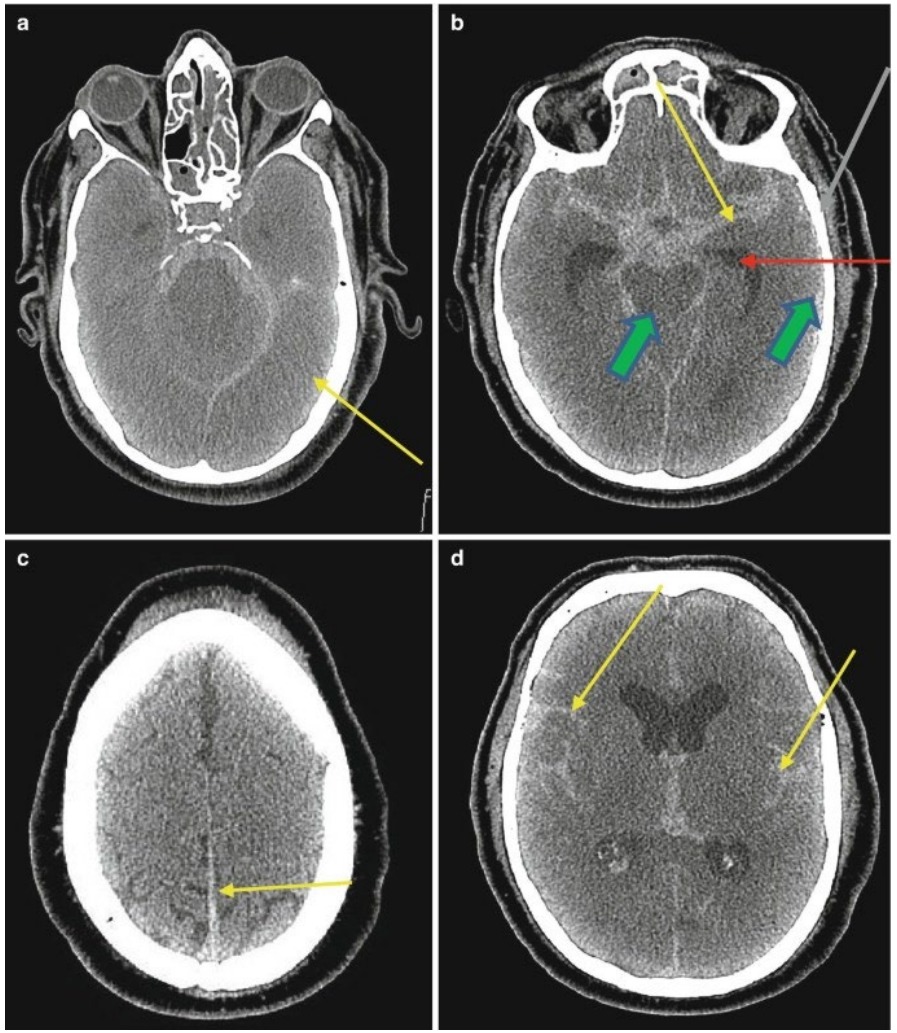
Traumatic Subarachnoid Hemorrhage

- Blood leaks into the subarachnoid space, area between the brain and meninges
- Venous
- Anticonvulsants medication
- Elderly- highest risk



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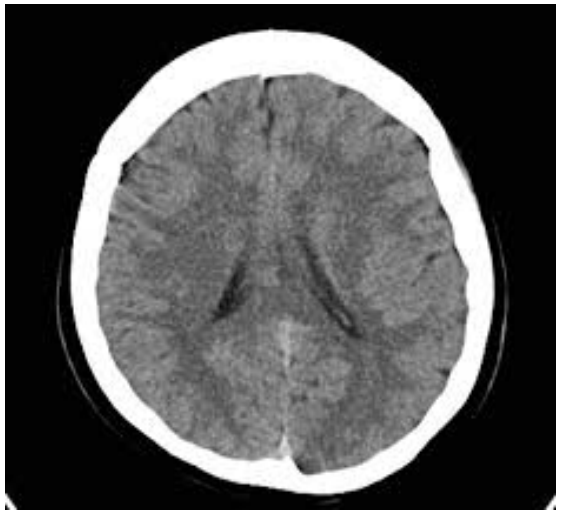
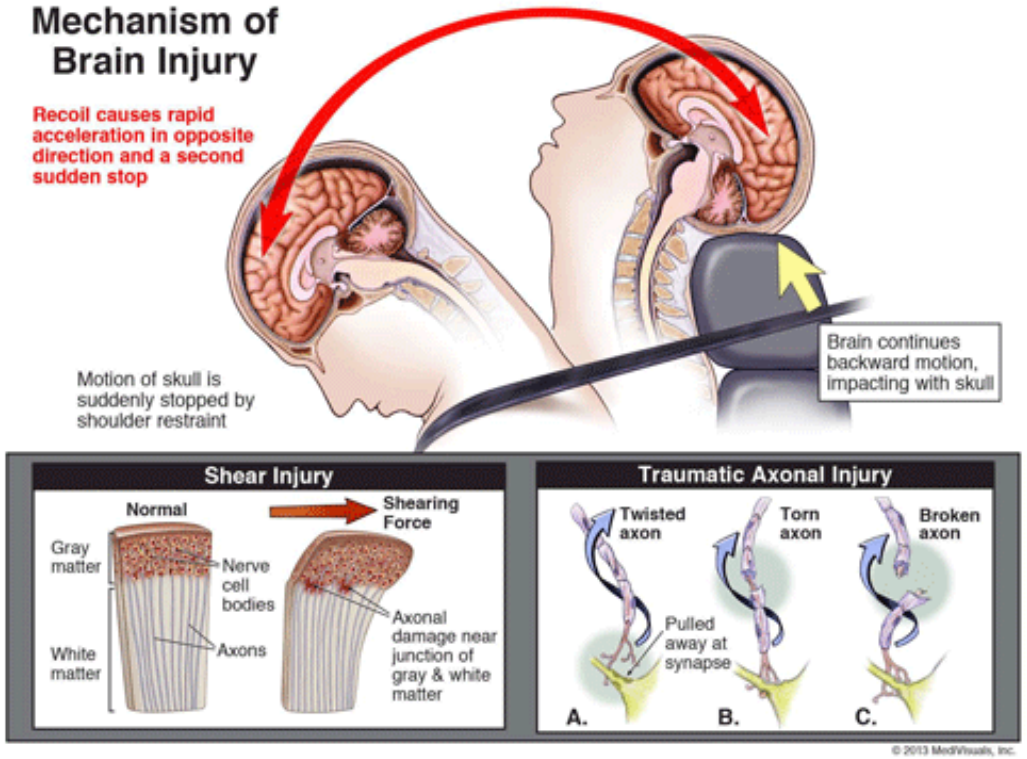
Diffuse Axonal Injury

- Axons are stretched, torn or damaged
- MRI, physical exam



Normal CT



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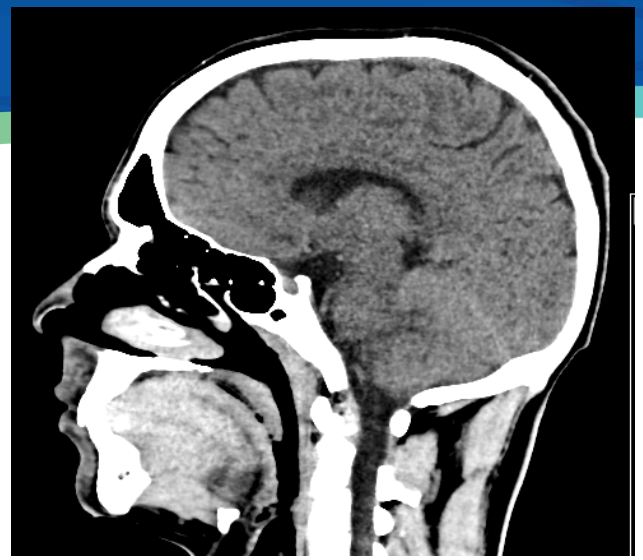
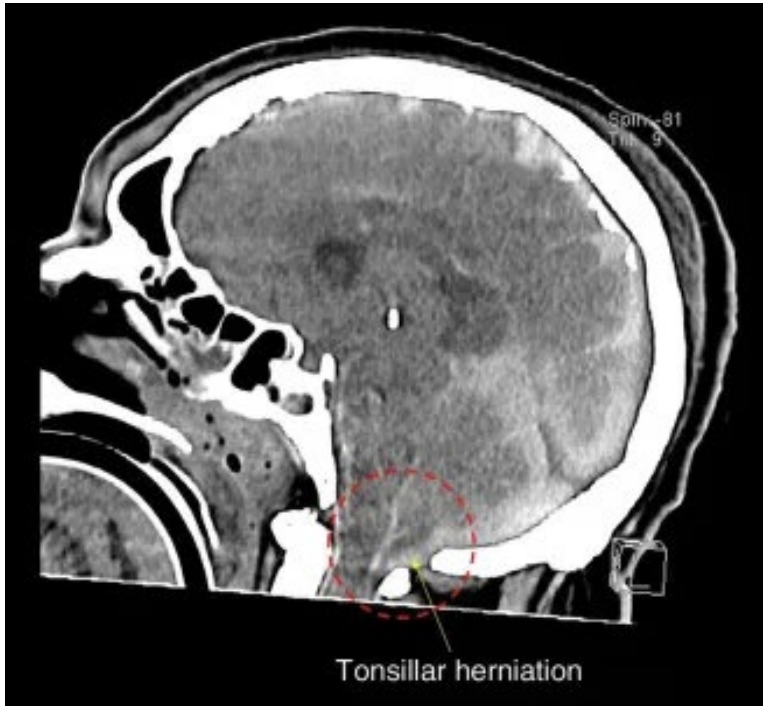
TBI Herniation

- Life threatening
- Monro- Kellie Doctrine
- Increased pressure in the skull pushes brain tissue
- Loss of brainstem reflexes
- Cushing Triad



Normal CT- sagittal view



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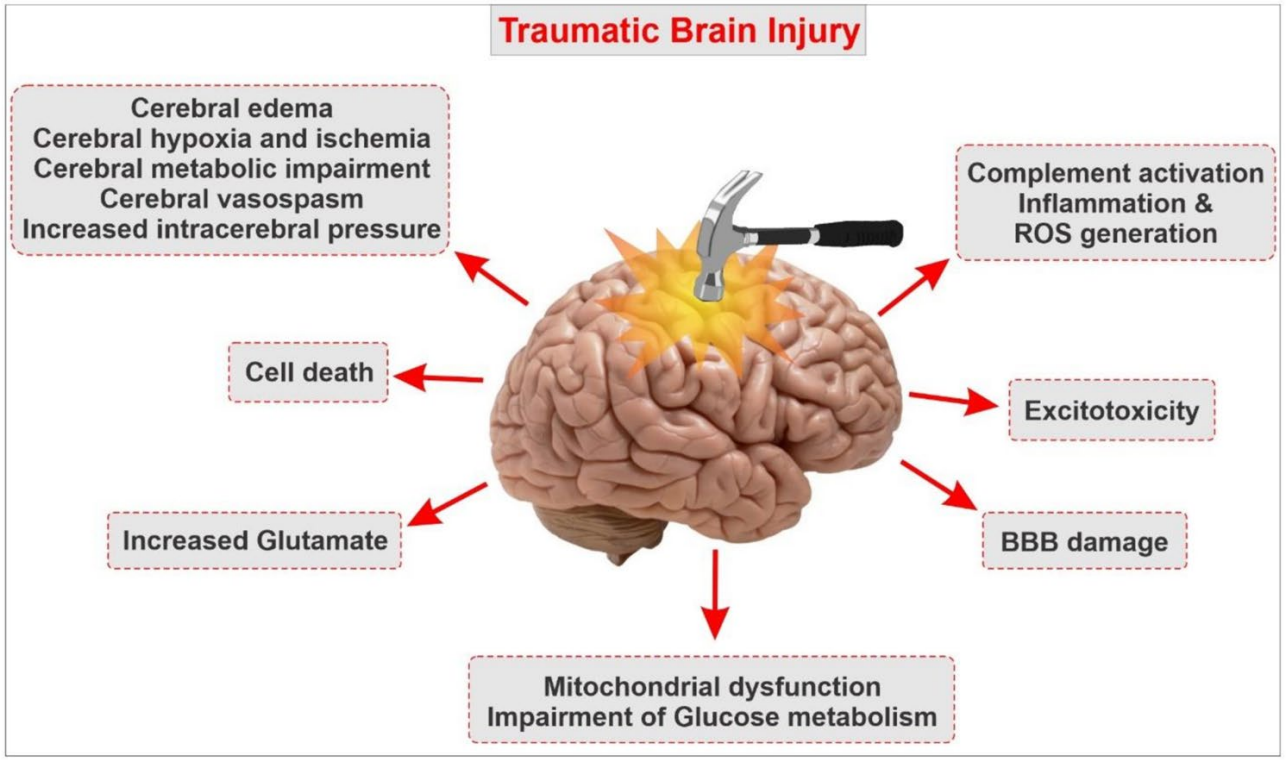
Secondary Injury



Secondary Injury

- Hypotension
- Hypoxia
- Ischemia
- Seizures
- Metabolic disturbances

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Goals of Care

- ATLS/ATCN/TNCC
  - ABCDs
- Frequent neurological assessment
  - GCS, Pupilometer
- ICP management

https://youtu.be/Ye9pdevokpk

Increased Intercranial Pressure

Signs and Symptoms

- Early
  - HA, N/V, blurred/ double vision, tinnitus, confusion, anxiety, seizures
- Late
  - LOC, weakness/paralysis, pupillary changes, posturing

Interventions

- ABCs
- Osmotic diuretic: Mannitol/ hypertonic saline
- Sedative/ analgesics
- Anticonvulsants
- Temperature management
- Positioning
- Environment

Emerging Technology

Nanotechnology: target drug therapy, support neural regeneration, and protect CNS by providing axon growth and regeneration

Brain- Machine Interfaces or Brain- Computer Interfaces: translating brain command activity into commands for external devices

Virtual Reality: using game exercise to motivate, learn to control and real-time tracking

Robot- assisted program: exoskeletons, gait movement

Case Study

23-Year-old male

Pedestrian struck by truck

EMS-

- GCS 3, HR 120, BP 80/54, agonal respiration, noted deformity to head, with large hematoma
- Intubated pt, 18g PIV with 500ml NS, fully packaged
- ETA 5 minutes

What do we think…. Possible injuries, preparation

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Case Study

- Trauma team was activated as level 1
- Pt arrived with trauma team at bedside
- EMS provided report
- ACLS/ATCN/TNCC- completed
  - Primary and secondary survey
- Noted head injury- GCS 3, Pupils fixed and dilated
- CT scan- head, c-spine, chest, abd/ pelvis

CT scan

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Conclusion

- Understanding anatomy, mechanism of injury, and type of injury
- Preventing secondary brain injuries
- Interventions- nursing lead
- Utilizing latest technology- pupilometer
- Discharge education for patient and family

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QR Code for References

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