

Management of the Head Injury Patient

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Epidemiology

- 1.6 million head injury patients in the U.S. annually
- 250,000 head injury hospital admissions annually
- 60,000 deaths
- 70-90,000 permanent disability
- Estimated cost: \$100 billion per year



Causes of Brain Injury

- Motor Vehicle Accidents
- Falls
- Anoxic Encephalopathy
- Penetrating Trauma
- Air Embolus after blast injury
- Ischemia
- Intracerebral hemorrhage from Htn/aneurysm
- Infection
- tumor



Brain Injury

- Primary Brain Injury
- Secondary Brain Injury



Primary Brain Injury

- Focal Brain Injury
 - Skull Fracture
 - Epidural Hematoma
 - Subdural Hematoma
 - Subarachnoid Hemorrhage
 - Intracerebral Hematoma
 - Cerebral Contusion
- Diffuse Axonal Injury



Fracture at the Base of the Skull

Battle's Sign



- Periorbital Hematoma
- Battle's Sign
- CSF Rhinorrhea
- CSF Otorrhea
- Hemotympanum
- Possible cranial nerve palsy

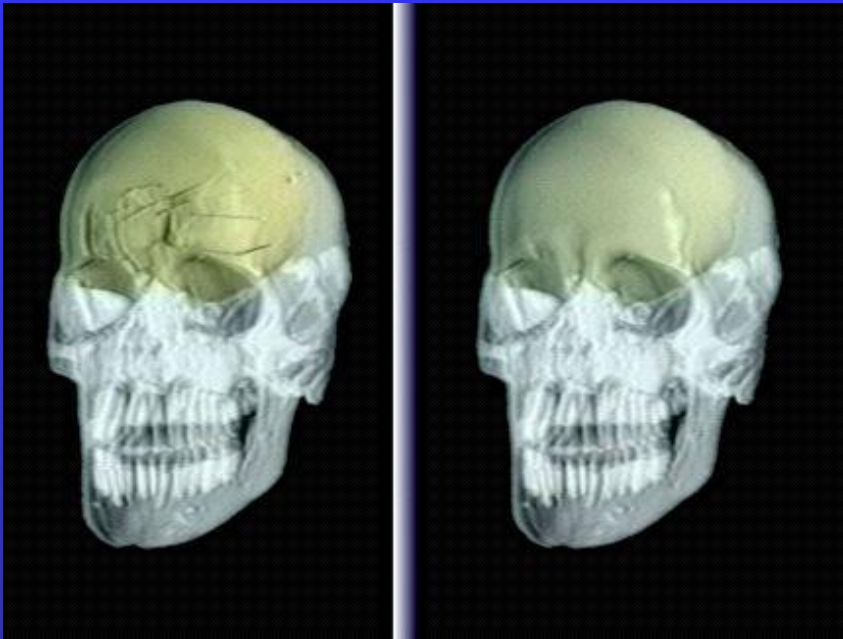
Fracture of maxillary sinus causing CSF Rhinorrhea

<http://health.allrefer.com/pictures-images/battles-sign-behind-the-ear.html>



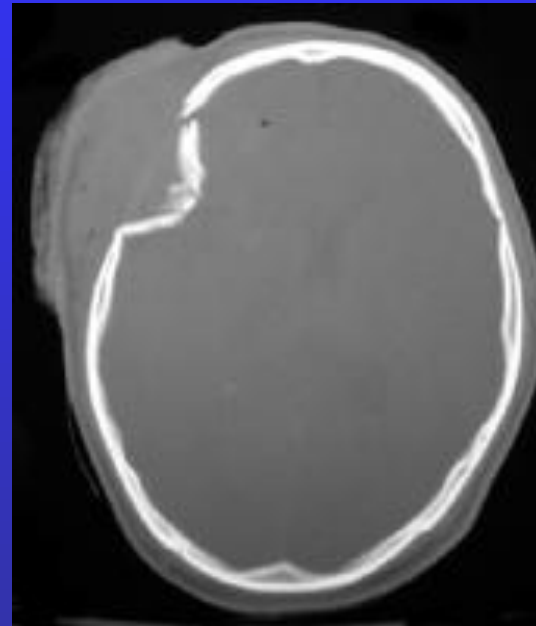
Skull Fractures

Non-depressed vs Depressed
Open vs Closed
Linear vs Egg Shell



Linear and Depressed

Normal



Depressed

<http://www.emedicine.com/med/topic2894.htm>



Temporal Bone Fracture

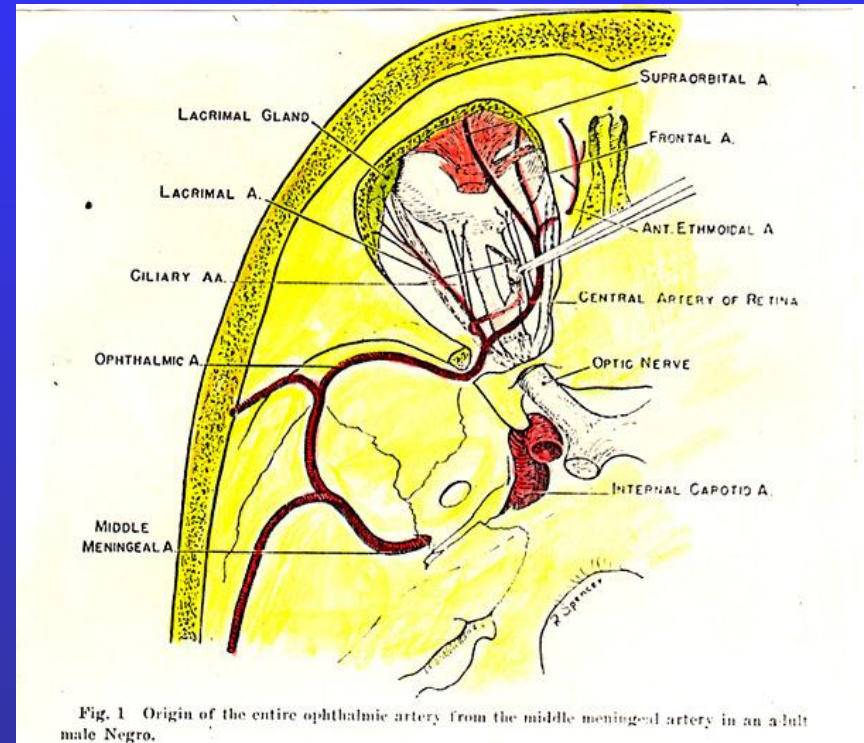
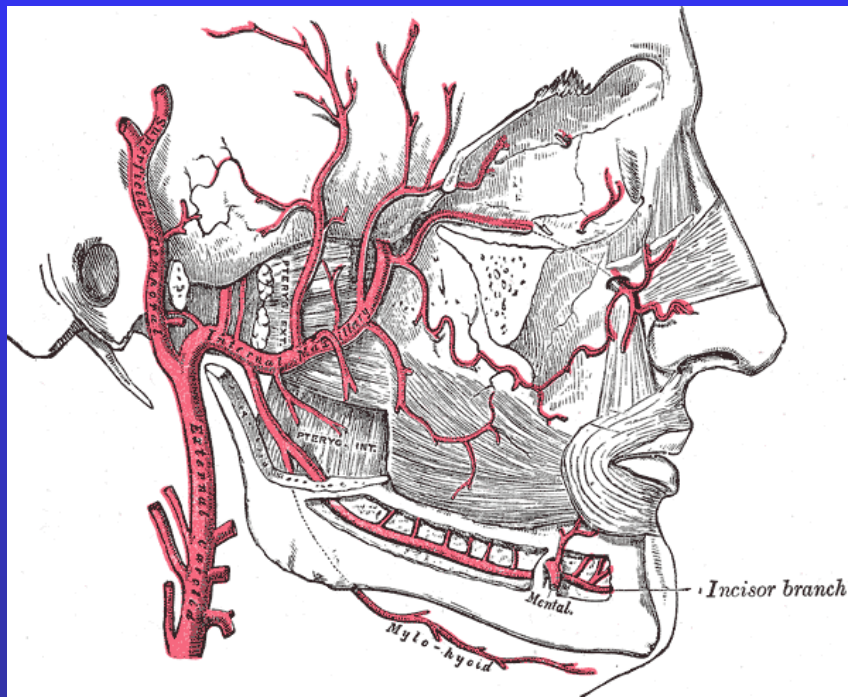


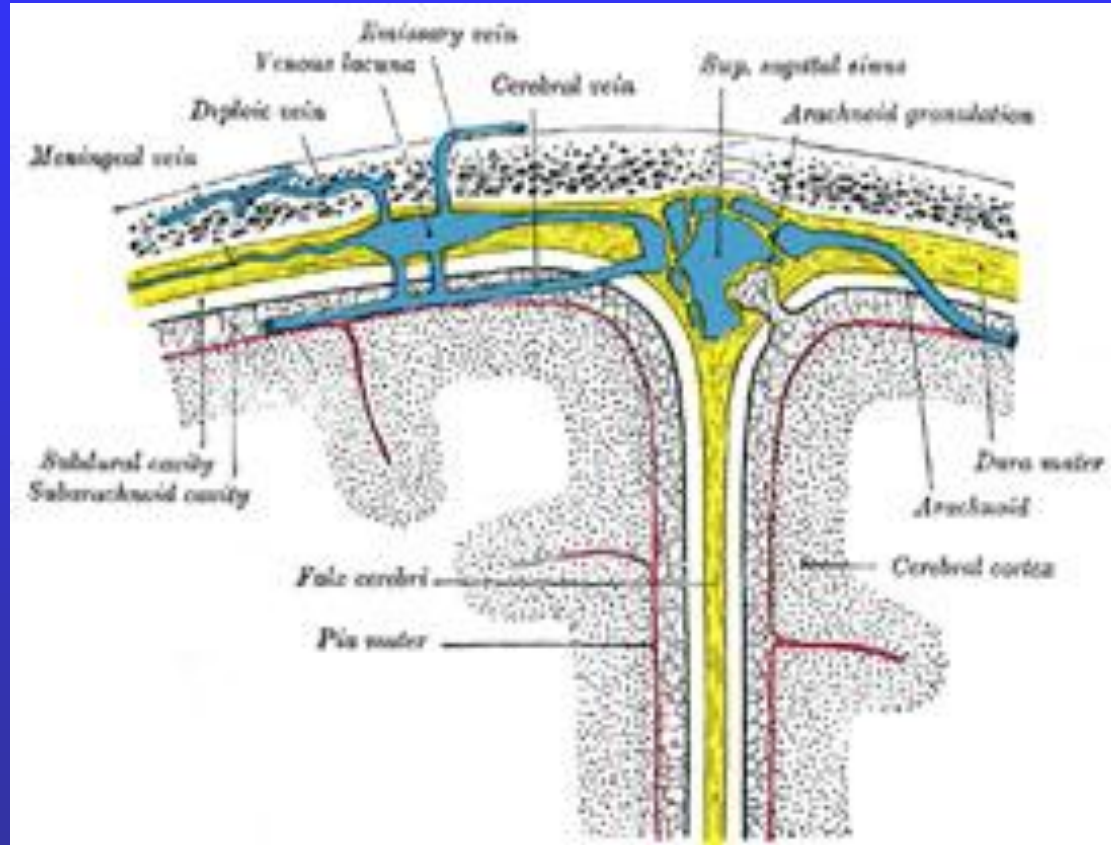
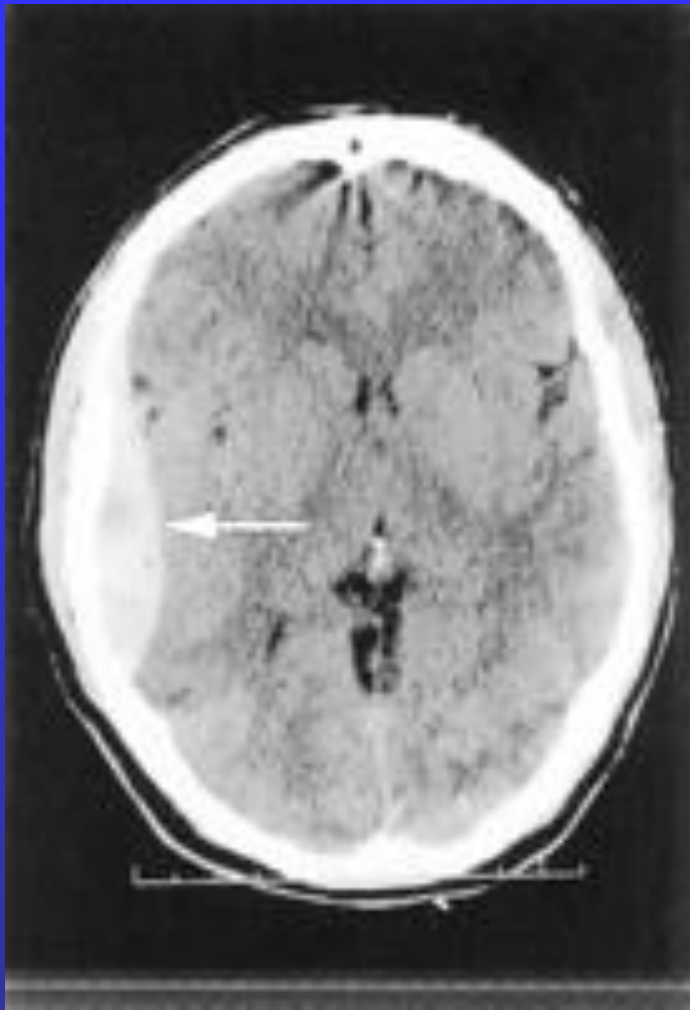
Fig. 1 Origin of the entire ophthalmic artery from the middle meningeal artery in an adult male Negro.

<http://www.bartleby.com/107/illus510.html>

<http://www.vh.org/adult/provider/anatomy/AnatomicVariants/Cardiovascular/Images0300/0386.html>



Epidural Hematoma

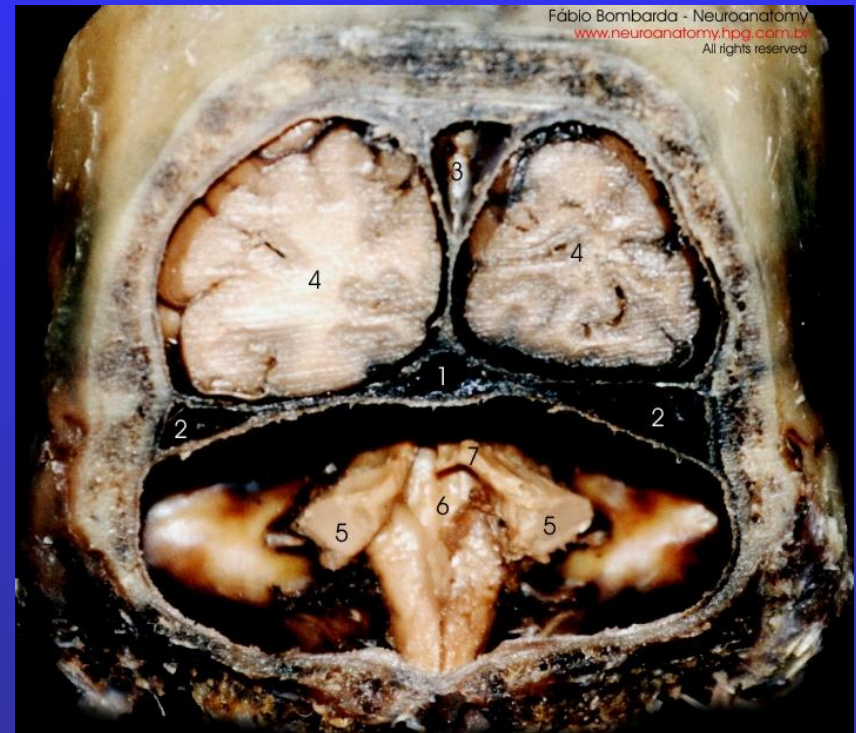
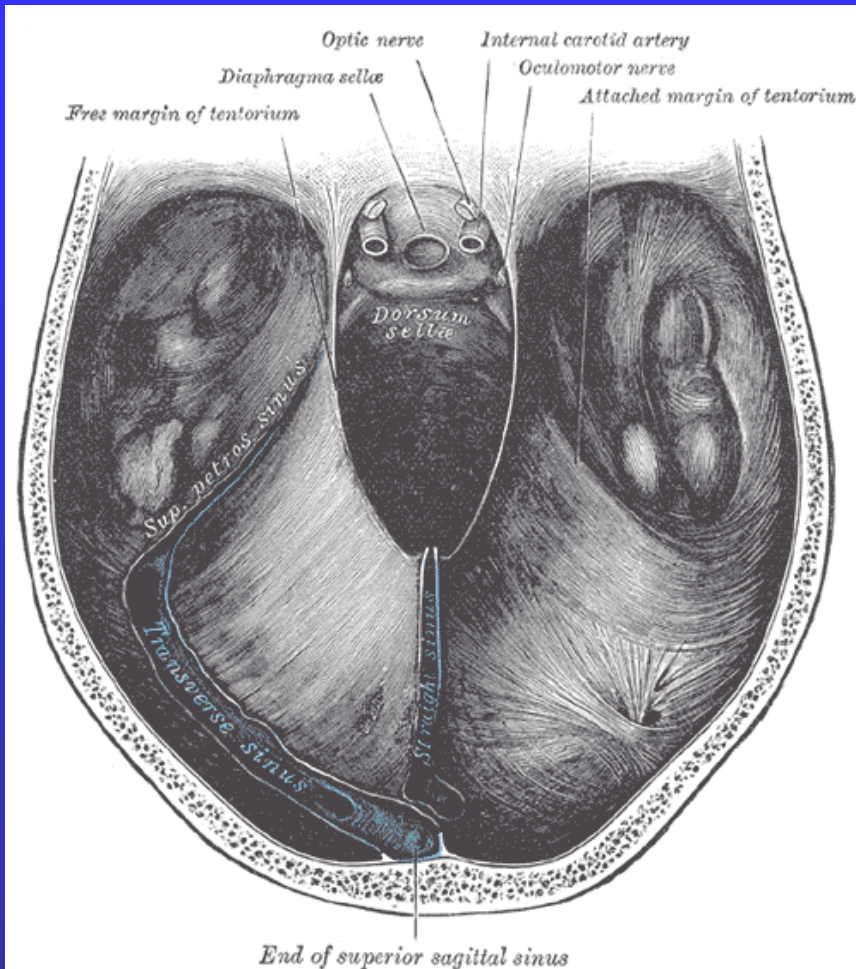


Epidural Hematoma

- Uncommon (<1% of all head injuries, 10% of post traumatic coma patients)
- Located between the dura and the skull
- Often associated with temporal bone fracture
- “Classic Presentation” = Unconsciousness followed by a lucid period followed by deterioration
- Look for ipsilateral pupillary dilation



Uncal Herniation causing third nerve palsey



Third Nerve Palsy

Function of Third Nerve

- Constricts pupil
- Innervates levator palpebrae of the eyelid
- Innervates superior, medial and inferior rectus muscles of eye

Physical Finding

- Pupillary Dilation
- Drooping eyelid



Third Nerve Palsy

- Physical Findings
 - Dilated Pupil
 - Drooping Eyelid
- Look for Cushing's Reflex (elevated ICP)
 - Hypertension
 - Bradycardia



Case Presentation

- 17 year old girl stuck by a car. Transient loss of consciousness at the scene. Scalp laceration.
- Awake and responding in the ER. No CT available. To OR for repair of scalp laceration under local anesthesia.
- The next morning speaking in English and Samoan
- Drowsy at 16:00
- 16:45: Bilateral dilated pupils and respiratory distress



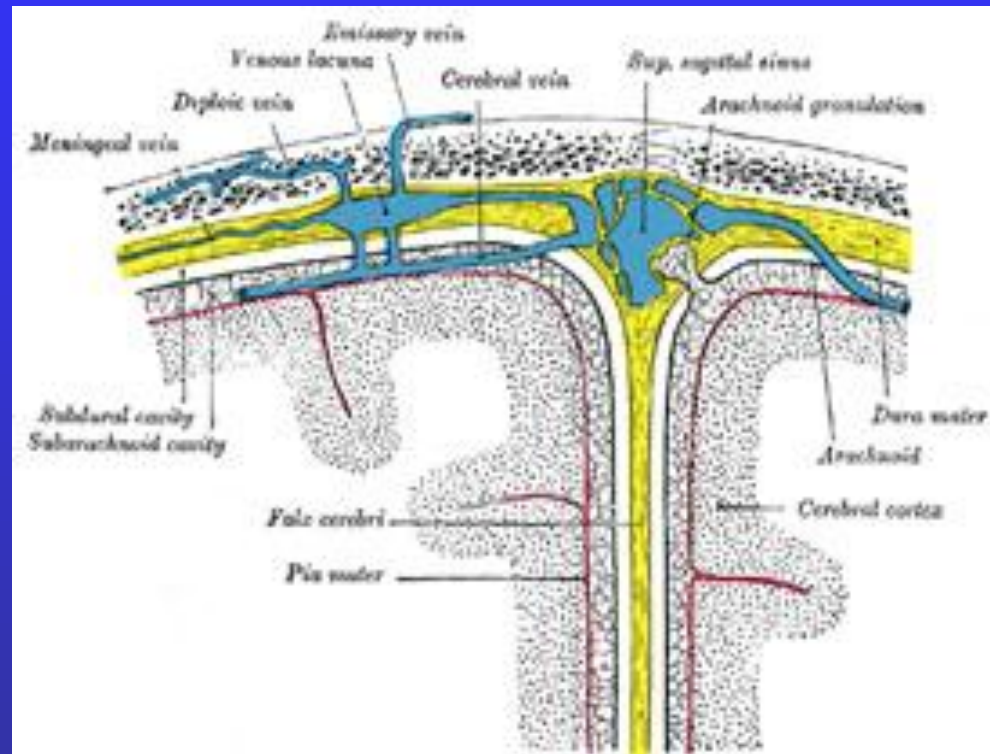
Epidural Hematoma

- Uncommon (less than 5% of cases)
- Classic Findings
 - Initial Loss of Consciousness
 - Lucid Interval
 - Neurological Deterioration
- Associated with tear of Middle Meningeal Artery
- Prognosis good if timely diagnosis and treatment



Subdural Hematoma

- Bleeding between the dura and the brain
- Results from tearing of “bridging veins”
- Subdural hematoma may be
 - Acute
 - chronic

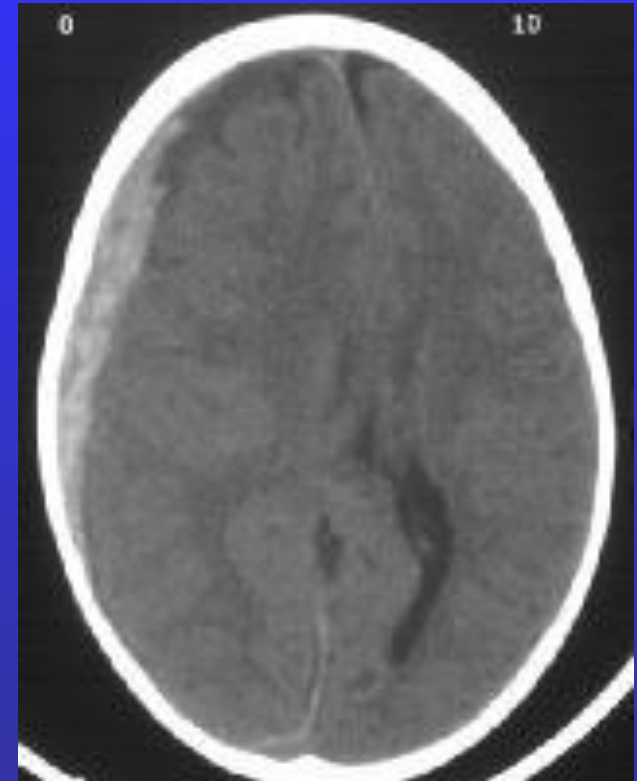


Case Presentation

- 35 year old man involved in an automobile accident on a Sunday afternoon at approximately 12:00 noon. Admitted with altered mental status, hemodynamically stable. No major injuries except acute SDH
- No neurosurgeon available. Transferred to 2 other hospitals w/o neurosurgeons
- 6 hours after accident arrives at San Francisco General Hospital with bilateral fixed and dilated pupils



Acute Subdural Hematoma



<http://www.neuroanatomy.hpg.ig.com.br/brain.htm>

<http://www.emedicine.com/EMERG/topic560.htm>



Acute Subdural Hematoma

- 50% Mortality
- Return to normal function limited in survivors
- More common in older patients
- Prevention of Secondary Brain Injury essential

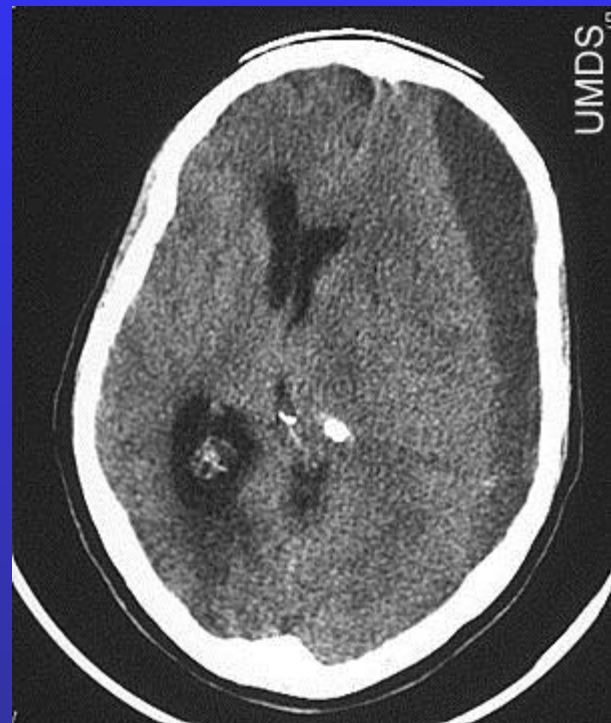
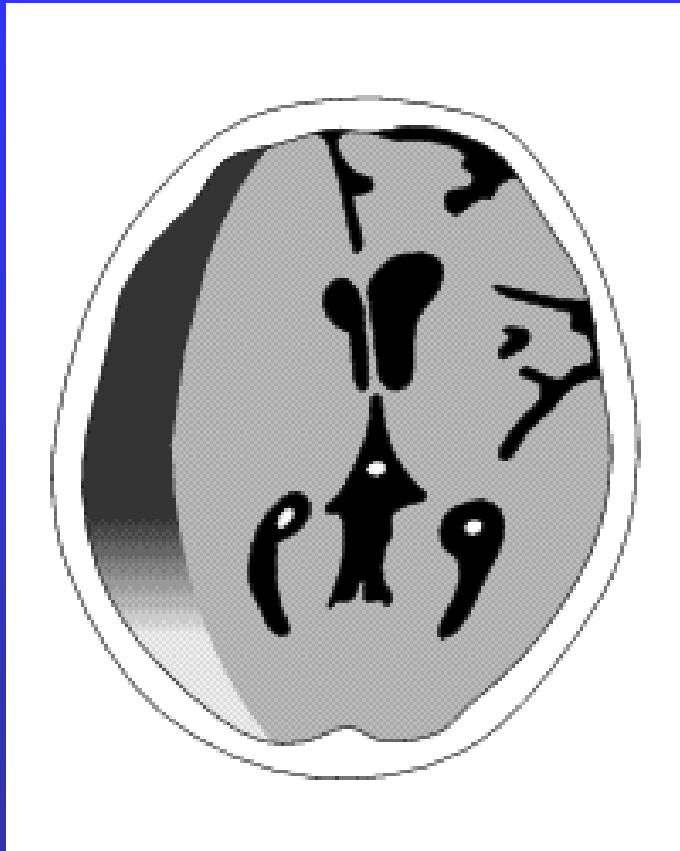


Case Presentation

- 45 year old radiologist arrives for dinner at colleagues' house for dinner complaining of head ache. Neurological exam normal.
- Admitted later in the evening for dizziness. Signs out of hospital AMA the next morning. No CT available.
- Returns that afternoon. The next day unconscious with slightly dilated left pupil.



Chronic Subdural Hematoma



<http://www.radiology.co.uk/srs-x/tutors/cttrauma/tutor.htm#subdural>



Chronic Subdural Hematoma

- 3-6% Mortality Rate
- Normal return to neurologic function if diagnosis made early in 65-75% of cases
- High index of suspicion in chronic alcoholics, the elderly, patients on anticoagulant therapy



Subarachnoid Hemorrhage



Subarachnoid Hemorrhage
After Karate Kick to the Head
40-70% of patients with
post traumatic subarachnoid
hemorrhage results in severe
neurologic disability or death

<http://bmj.bmjournals.com/cgi/content/full/308/6944/1620/F11>



Cerebral Contusion

- Ipsilateral - Coup
- Contralateral – Contrecoup
- Clinical Findings depend on location and severity of the contusion
- CT Findings
 - No findings
 - Localized swelling of the gyri

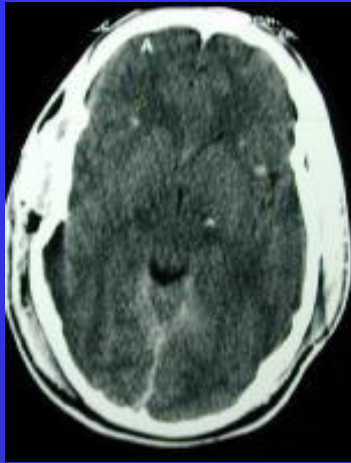


Intraparenchymal Hematoma

- Similar to CNS mass lesion
- Decision to evacuate vs observe difficult



Diffuse Axonal Injury



- Mechanical Shearing as a result of deceleration resulting in tearing of axons
- Almost 50% of patients with severe head injury have DAI
- Process may extend due to Secondary brain injury
- 90% of survivors remain in a persistent vegetative state



Primary Brain Injury

- Epidural Hematoma
- Subdural Hematoma
- Subarachnoid Hemorrhage
- Cerebral Contusion
- Intracerebral Hematoma
- Diffuse Axonal InjuryS



Secondary Brain Injury

- Area of original injury extended due to
 - Cerebral edema
 - Ischemia
 - Infection
 - Herniation



Goal

Prevention of Secondary
Brain Injury by Controlling
Intracranial Pressure,
Maintaining Cerebral
Perfusion and Oxygenation



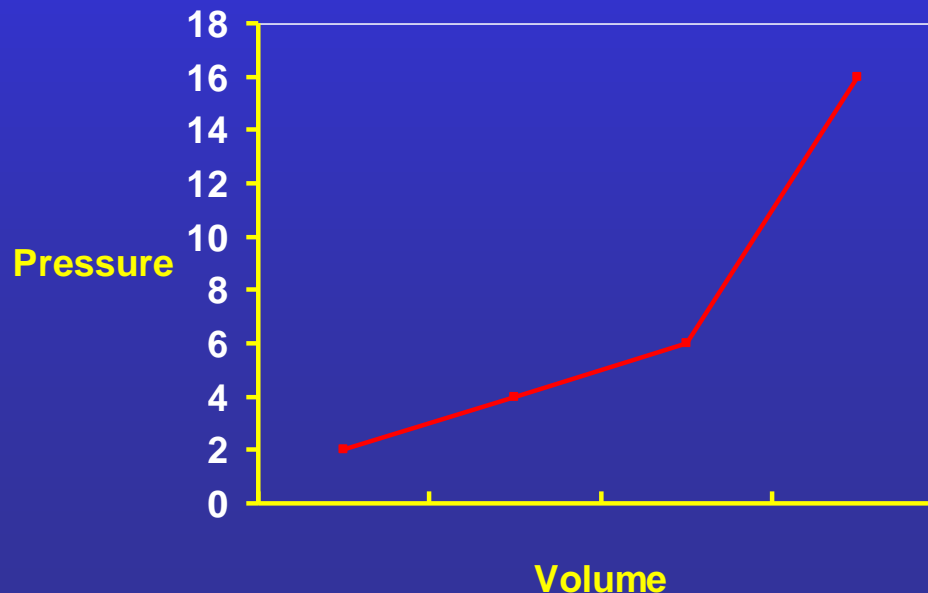
Cerebral Perfusion Pressure

- Adequate CPP essential for prevention of Secondary Brain Injury
- $CPP = MAP - ICP$
- CPP should be $> 70-80$ mm Hg
- Systemic Hypotension leads to poor neurological outcome



Intracranial Pressure

- Monroe-Kelly Doctrine (early 19th century)
 - intracranial volume (constant) = brain volume + CSF volume + blood volume + mass lesion volume



Signs of increased ICP

- Headache
- Nausea and vomiting
- Change in level of consciousness
- Seizures
- Change in pattern of ventilation
- Papilledema (not after acute trauma)
- Change in motor function



Indications for ICP Monitoring

- Severe Head Injury (GCS 3-8)
- Moderate Head Injury (GCS 9-12)
 - Particularly if abnormal CT Scan
- Mild Head Injury (GCS 13-15) – little indication for ICP Monitoring



Methods to Control ICP

- Elevate Blood Pressure

 - Judicious volume expansion

 - Vasoactive drugs

- Hyperventilation—NO!!!!

 - Maintain pCO₂ around 35 mmHg

- Diuretics

 - Mannitol

 - Use with caution after neurosurgical consultation

- Drainage of CSF from Ventriculostomy Catheter



Maintain CPP

- Raise MAP
 - Volume
 - Vasopressors
- Decrease ICP (if > 20 mm Hg)
 - Hyperventilation (not recommended)
 - CSF Drainage
 - Mannitol (use with caution) 1 gram/kg over 30 minutes



Management of the Head Injury Patient

- Primary Survey
 - Airway
 - CERVICAL SPINE CONTROL (5-10% of head injuries associated with cervical spine fracture)
 - Glasgow Coma Scale < 8 – indication for intubation
 - Circulation
 - Rapidly treat hypotension
 - Disability
 - Glasgow Coma Scale
 - Pupils
 - ? Moves all 4 extremities



Glascow Coma Scale

Eyes	Open Spontaneously	4
	To verbal command	3
	To pain	2
	No response	1
Best Verbal Response	Oriented and converses	5
	Disoriented and converses	4
	Inappropriate words	3
	Incomprehensible sounds	2
	No response	1
Best Motor Response	Obeys	6
	Localizes pain	5
	Withdraws from pain	4
	Abnormal Flexion	3
	Abnormal Extension	2
No Response	1	



Eyes

- Open spontaneously – 4 •
- Open to verbal stimulus – 3 •
- Open to Pain -- 2 •
- Unresponsive -- 1 •



Verbal Response

- Converses appropriately – 5 •
- Converses but confused – 4 •
- Speaks only words but not sentences – 3 •
- Sounds but no words – 2 •
- No verbal response – 1 •



Motor Response

- Responds to commands – 6 •
- Responds to pain with localization – 5 •
- Responds to pain with withdrawal – 4 •
- Responds to pain with flexion – 3 •
- Responds to pain with extension – 2 •
- Unresponsive – 1 •



Neurologic Exam during Secondary Survery

- (GCS) Mental Status
- Cranial Nerve Exam (pupils!!)
- Motor Exam of Upper and Lower Extremities
- Sensory Exam
- Reflexes (Babinski Sign?)
- Gait and Station/Ataxia (rarely done in the acute situation)



Potential Abnormalities in Secondary Survey

- Hypertension and Bradycardia— Cushing's Reflex •
- Cheyne Stokes Respiration in comatose patient—abnormal function of the Medulla Oblongata •
- Asymmetric pupils—Uncal herniation vs Direct blow to the orbit •



Potential Abnormalities in Secondary Survey

Asymmetric movement of the left vs the right extremities— intracranial mass lesion vs local injury •

Asymmetric movement of the upper vs the lower extremities--? Spinal cord injury •



Deterioration in Neurologic
Exam?

Repeat CT Scan



Additional Therapy for the Head Injury Patient

- Phenytoin 15 mg/kg over 30 minutes with EKG monitor if signs of seizure activity. Prophylactic Treatment to prevent seizures not recommended
- Steroids: Not recommended
- Barbiturate Coma: In selected cases with uncontrollable Intracranial Hypertension



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