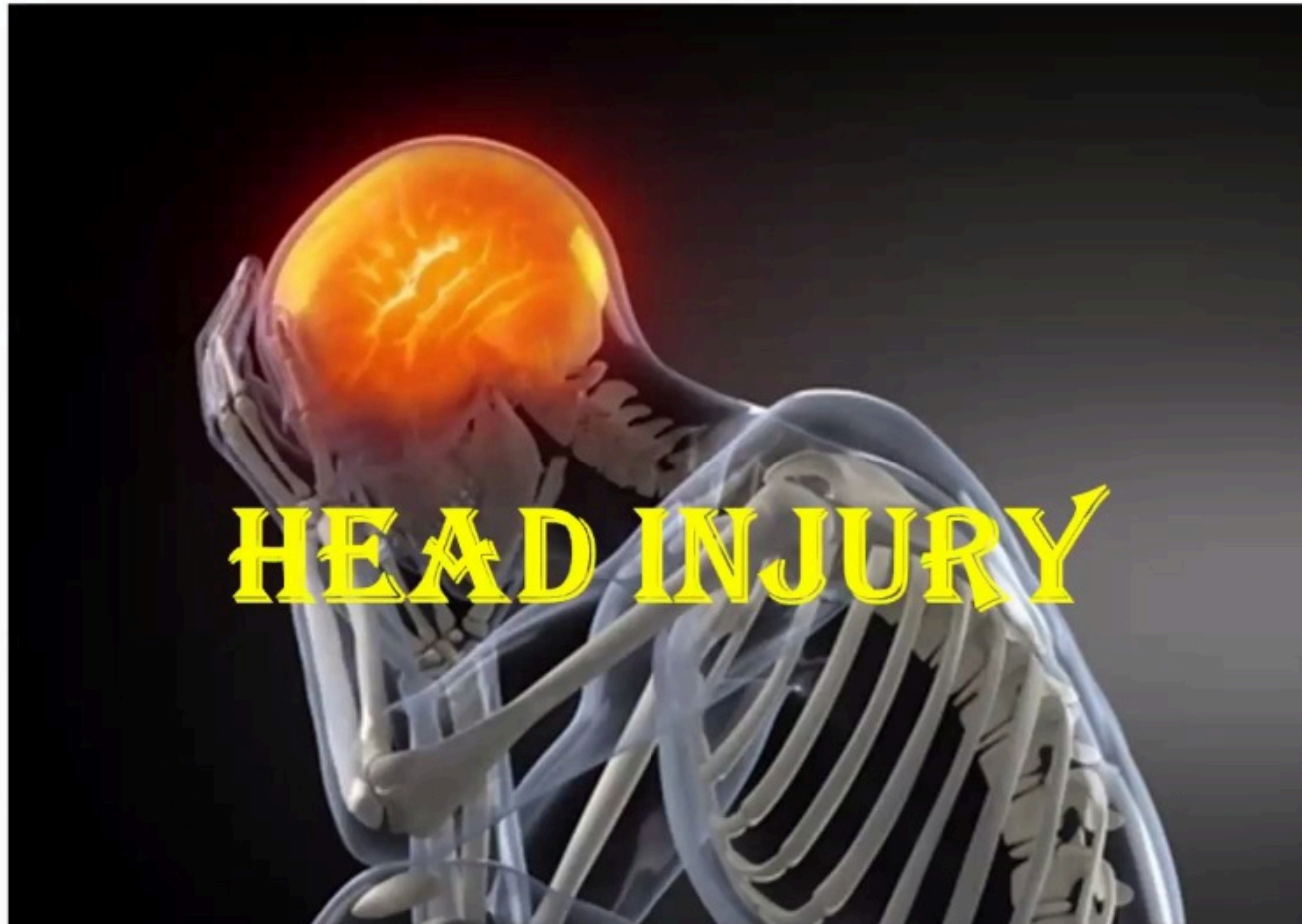




Dr Peter Kitunguu

BSc Anat (Hons), MBChB, MMed (NS)

Consultant Neurosurgeon

Lecturer, Division of Neurosurgery, University of Nairobi



Objectives

- Define
- Causes
- Describe basic intracranial physiology.
- Recognize the importance of limiting secondary brain injury.
- Perform a focused neurologic exam.
- Stabilize and arrange for definitive care.

What?

- Any trauma to the scalp, skull, or brain
- *Head trauma* includes an alteration in consciousness no matter how brief

Head Injuries

- Causes
 - Motor vehicle accidents
 - Firearm-related injuries
 - Falls
 - Assaults
 - Sports-related injuries
 - Recreational accidents



Head Injuries





Classifications of Brain Injury

By Morphology: Brain

Focal

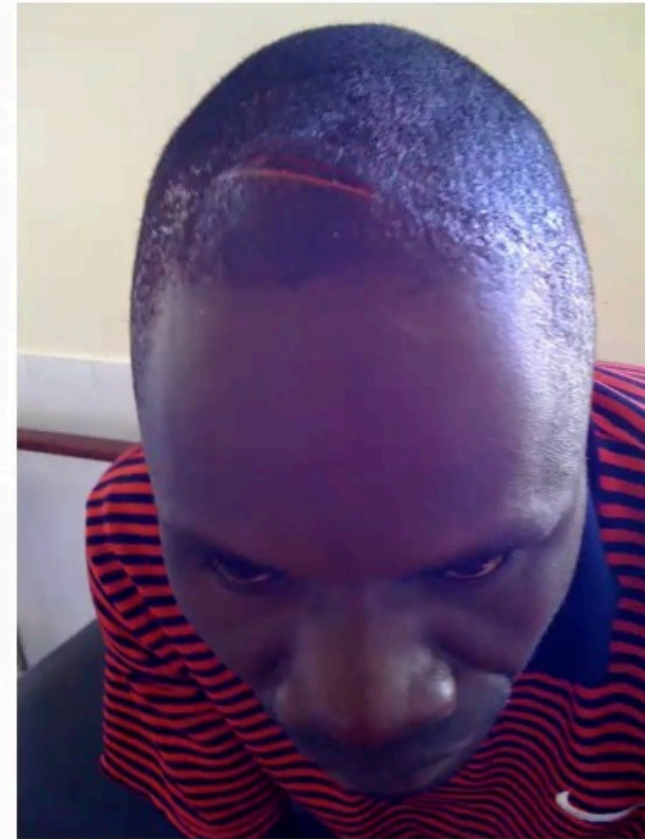
- **Epidural (extradural)**
- **Subdural**
- **Intracerebral**

Diffuse

- **Concussion**
- **Multiple contusions**
- **Hypoxic / ischemic injury**

Types of Head Injuries

- **Scalp lacerations**
 - Minor type of head trauma
 - Scalp is highly vascular → profuse bleeding
 - Major complication is infection



SCALP INJURIES



- Scalp Laceration.
- Scalp Abrasions.
- Scalp Haematomas.



Types of Head Injuries

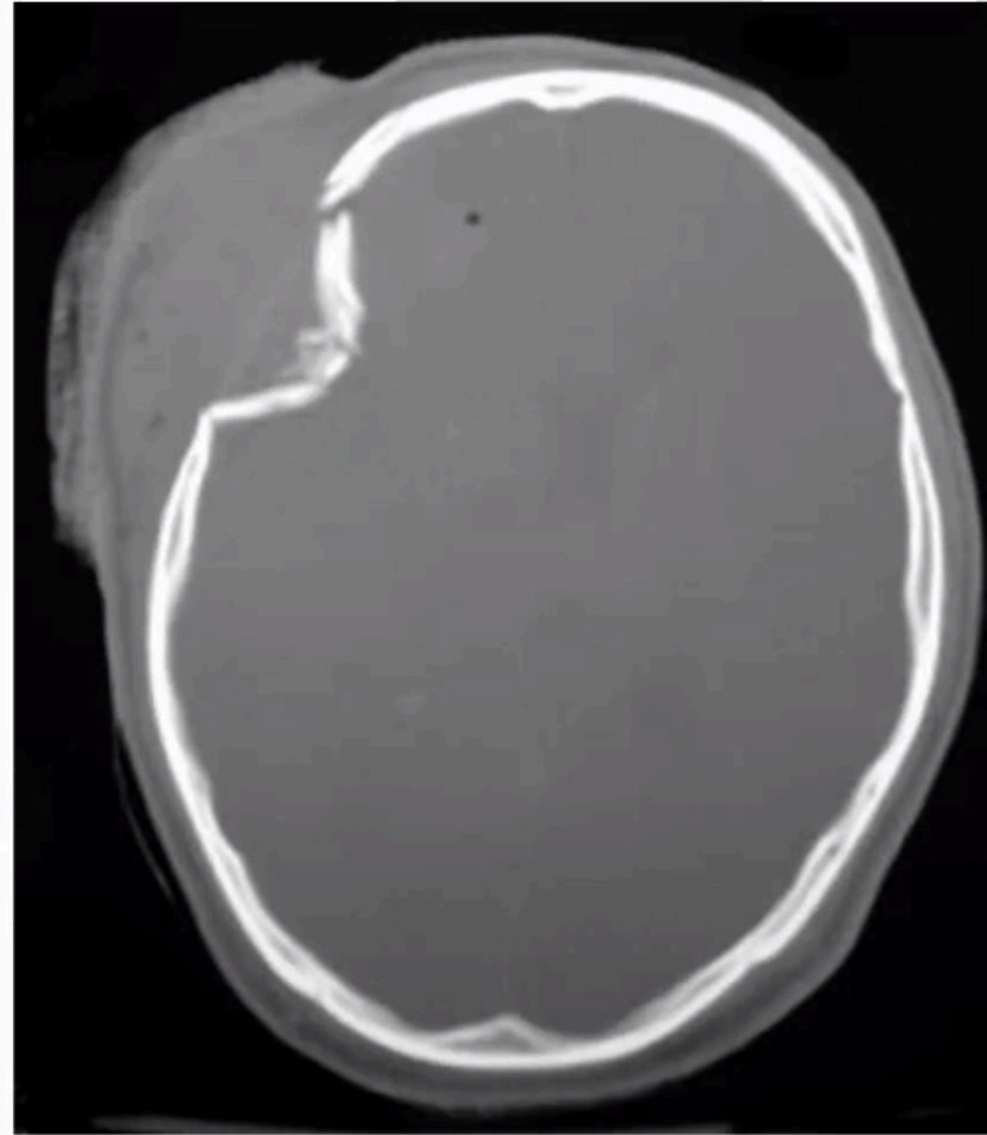
- **Skull fractures**

- Linear or depressed
- Simple, comminuted, or compound
- Closed or open
- Basal skull fractures



Types of Head Injuries

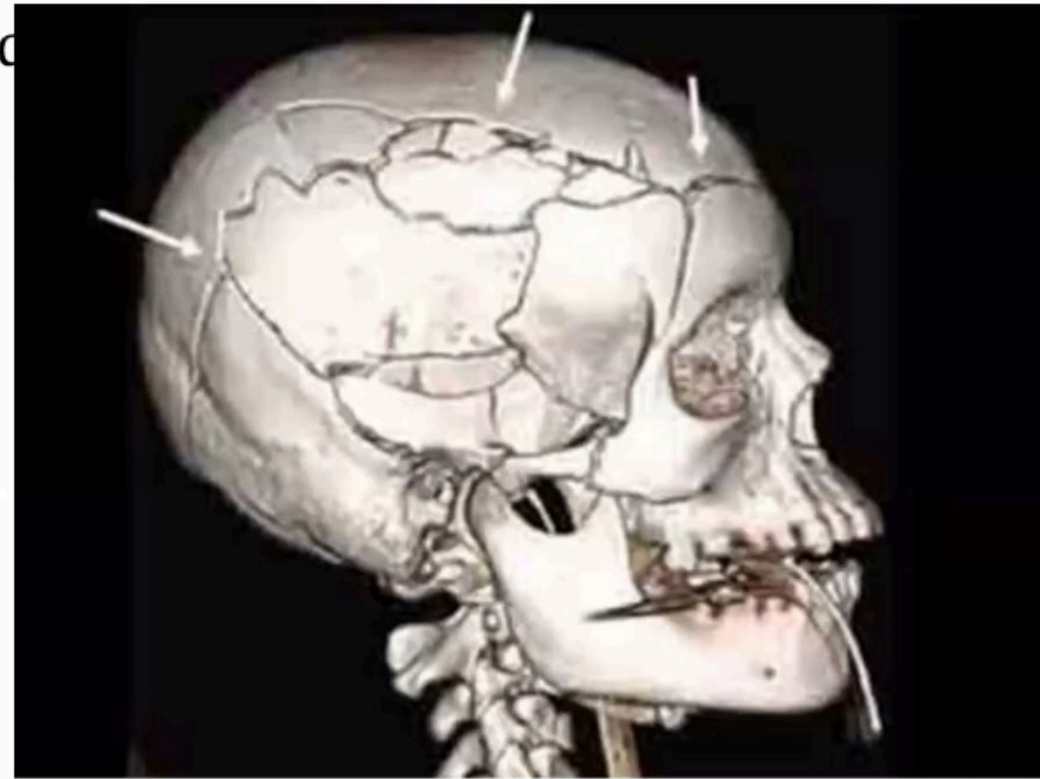
- **Skull fractures**
 - Linear or depressed
 - Simple, comminuted, or compound
 - Closed or open
 - Basal skull fractures



Types of Head Injuries

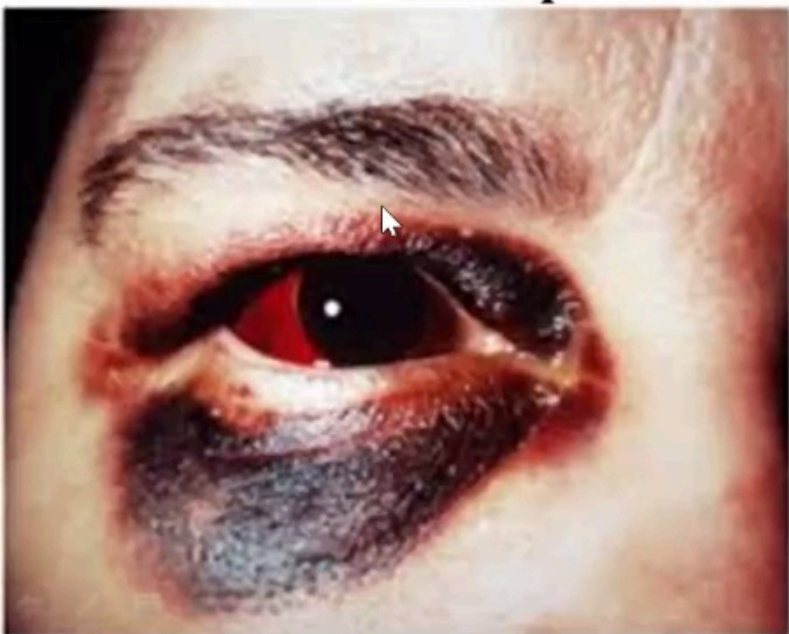
- **Skull fractures**

- Linear or depressed
- Simple, comminuted, or compound
- Closed or open
- Basal skull fractures



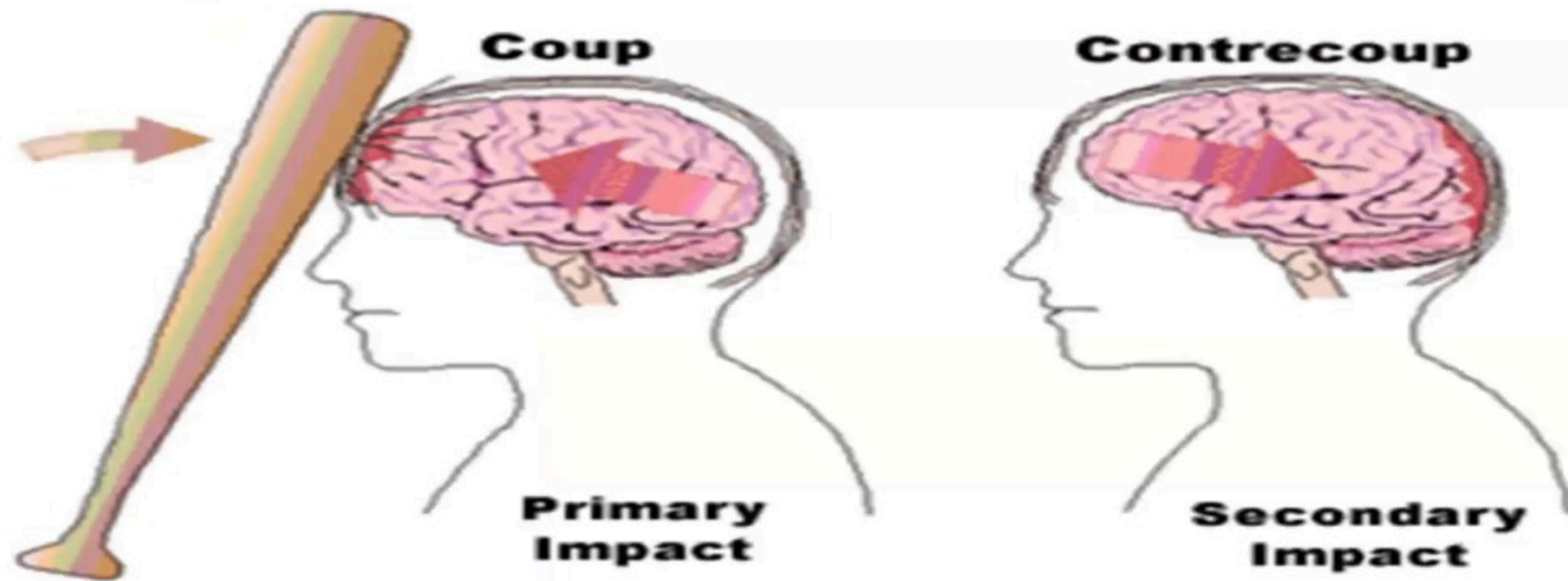
Types of Head Injuries

- **Skull fractures**
 - Linear or depressed
 - Simple, comminuted, or compound
 - Closed or open



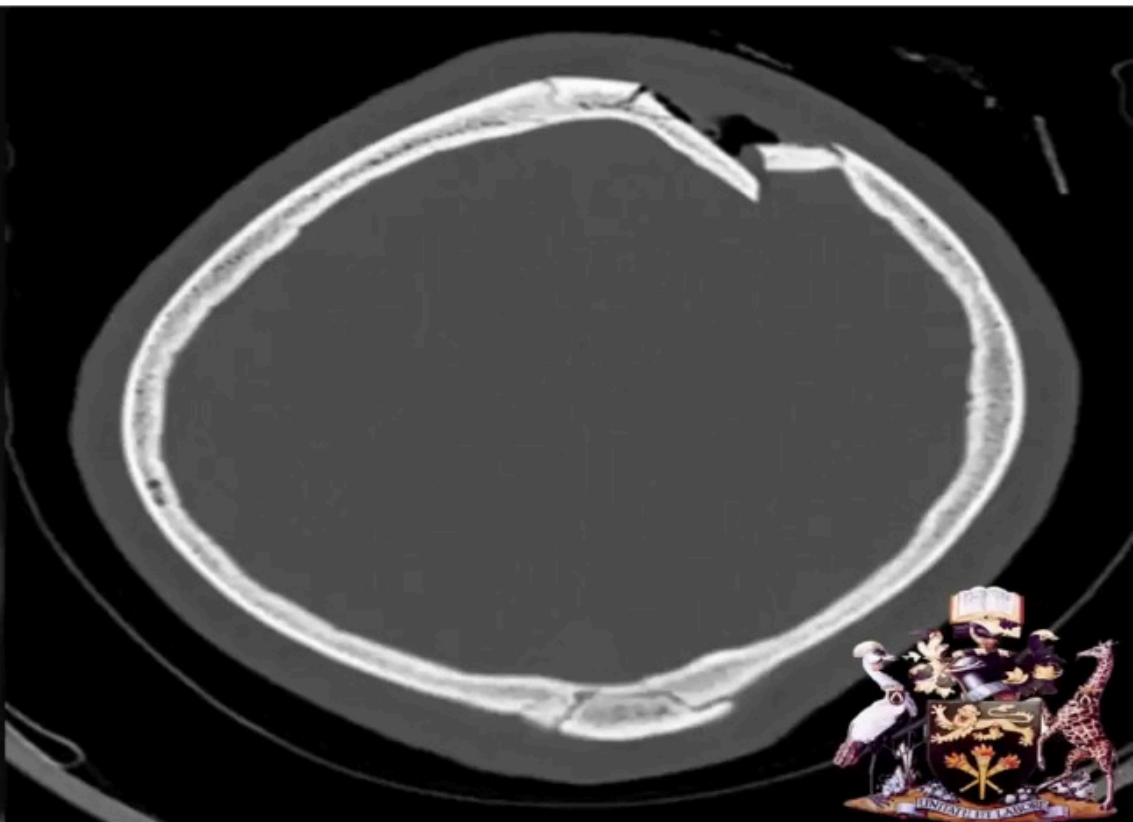
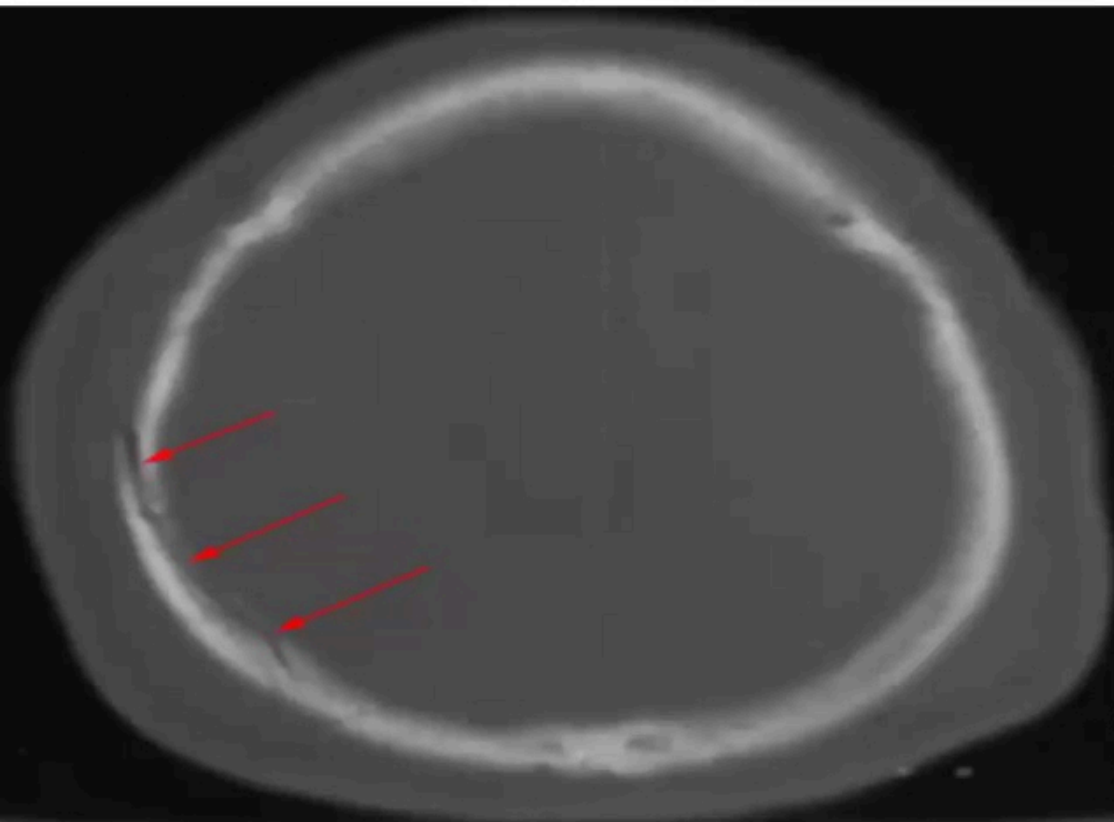
SKULL FRACTURES

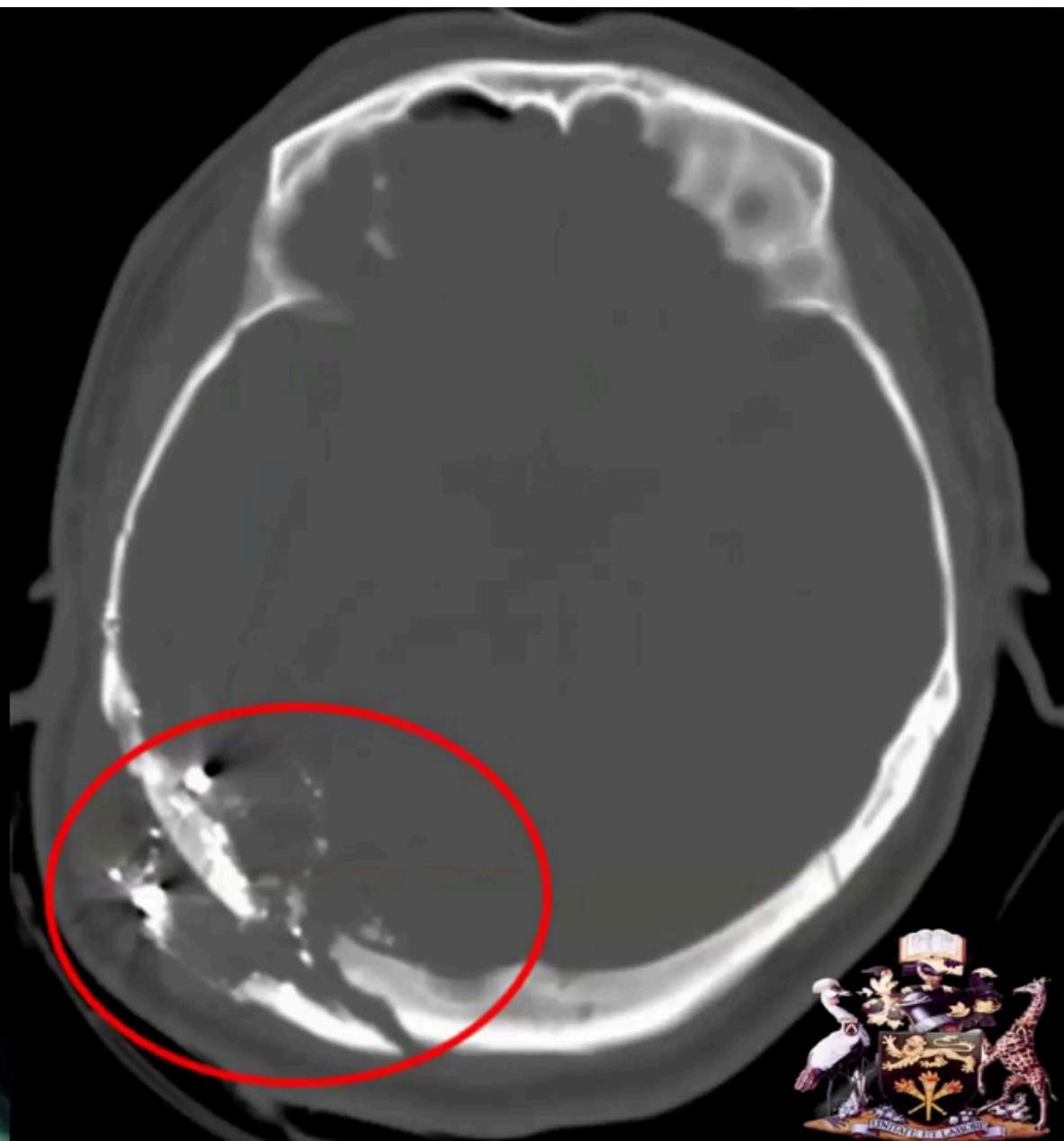
- Can Vault or Base of skull.
- Can be Open or Closed.
- Coup or Contre coup.



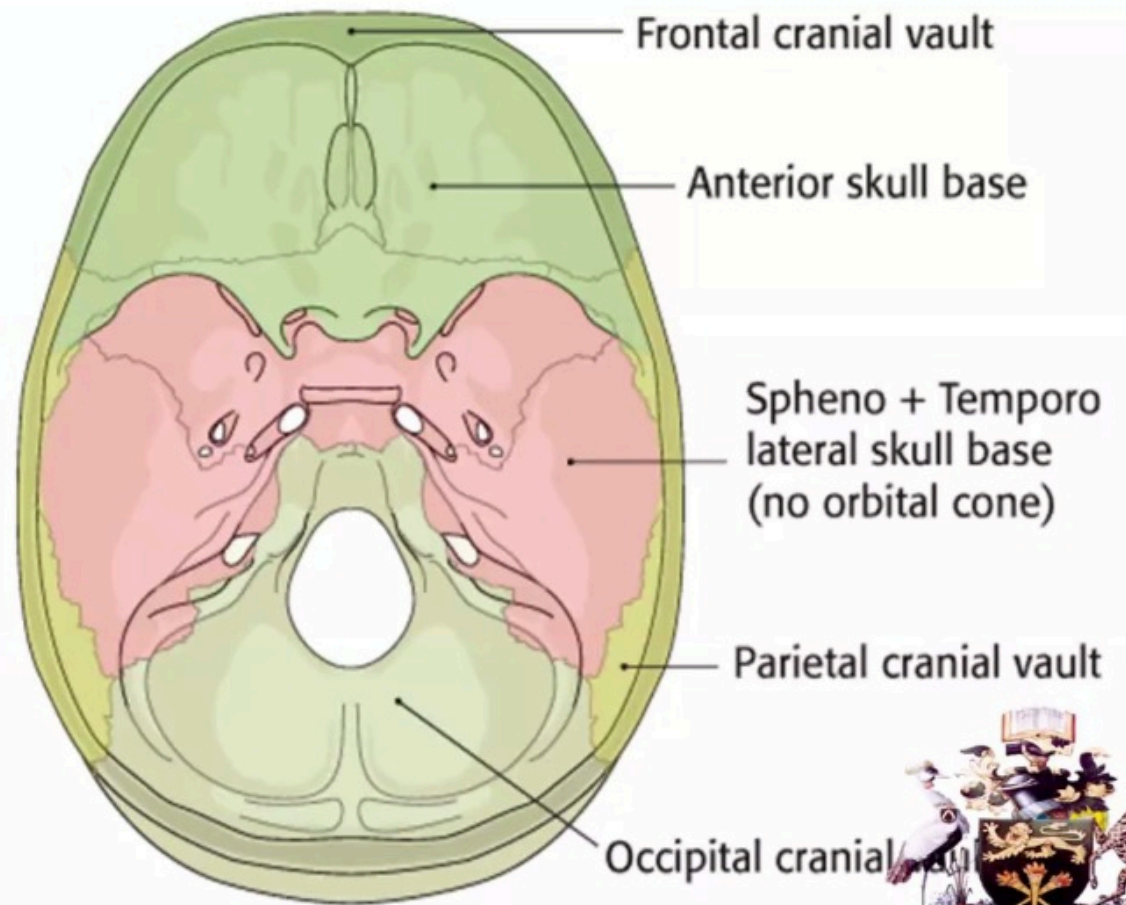
VAULT FRACTURES

- Linear, Depressed or comminuted.





BASE OF SKULL FRACTURE



Types of Head Injuries

- Basal Skull fractures
 - CSF leak (extravasation) into ear (Otorrhea) or nose (Rhinorrhea)- HALO Sign
- High risk infection or meningitis
- Battle Sign



Types of Head Injuries

- ***Concussion***

- A sudden transient mechanical head injury with disruption of neural activity and a change in LOC
- Brief disruption in LOC
- Amnesia
- Headache
- Short duration



- *Postconcussion syndrome*
 - 2 weeks to 2 months
 - Persistent headache
 - Lethargy
 - Personality and behavior changes

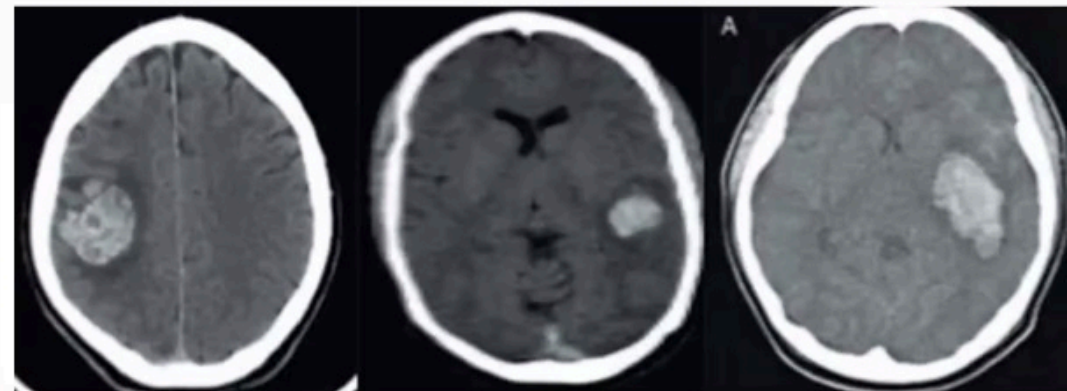


Types of Head Injuries

- Cerebral contusions and lacerations
- Diffuse axonal injury
- Focal intracranial hematoma (Epi and subdural)

Types of Head Injuries

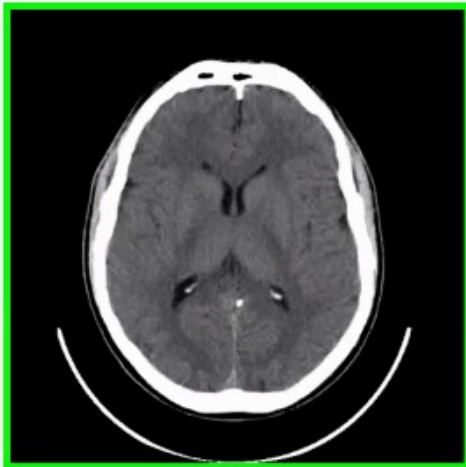
- *Contusion*
 - The bruising of brain tissue within a focal area that maintains the integrity of the pia mater and arachnoid layers
- *Lacerations*
 - Involve actual tearing of the brain tissue



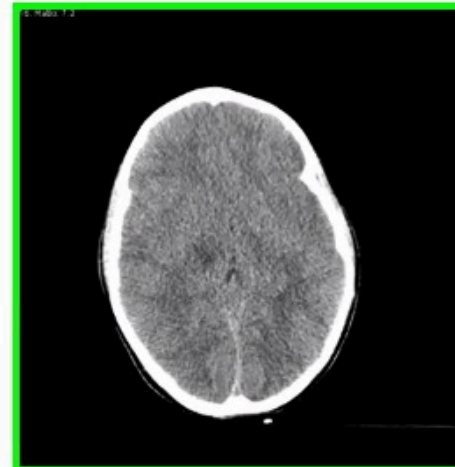


Diffuse Brain Injury

- **Mild concussion → Severe, ischemic insult**



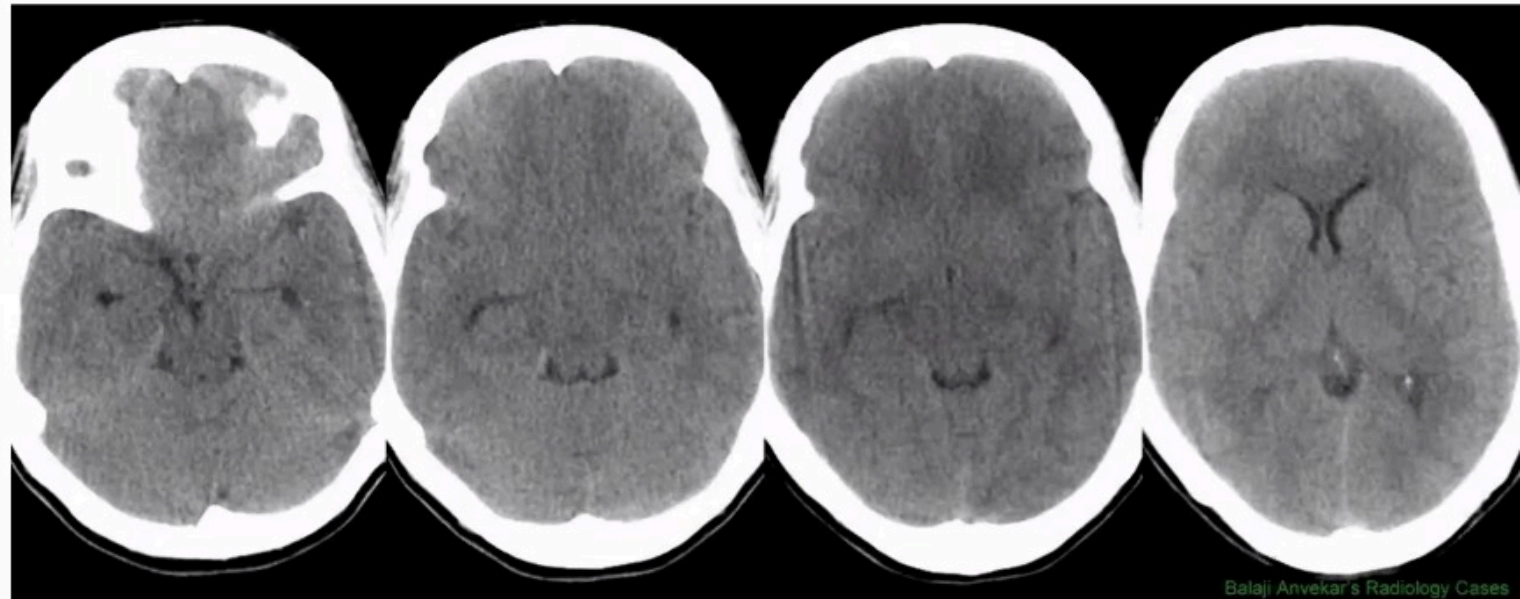
Normal CT



Diffuse Injury

Types of Head Injuries

- *Diffuse axonal injury (DAI)*
 - Widespread axonal damage
 - Process takes approximately 12-24 hours

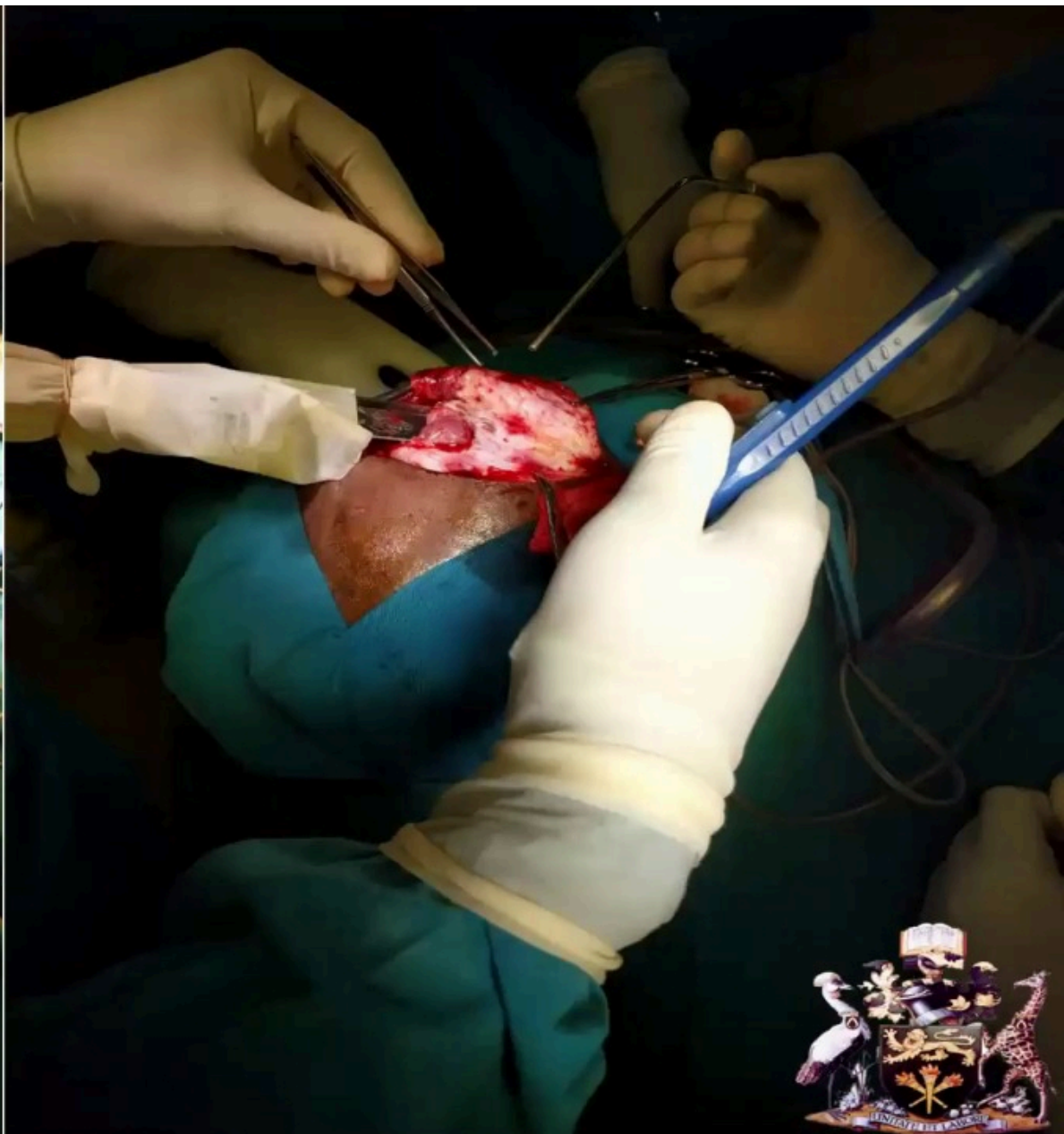
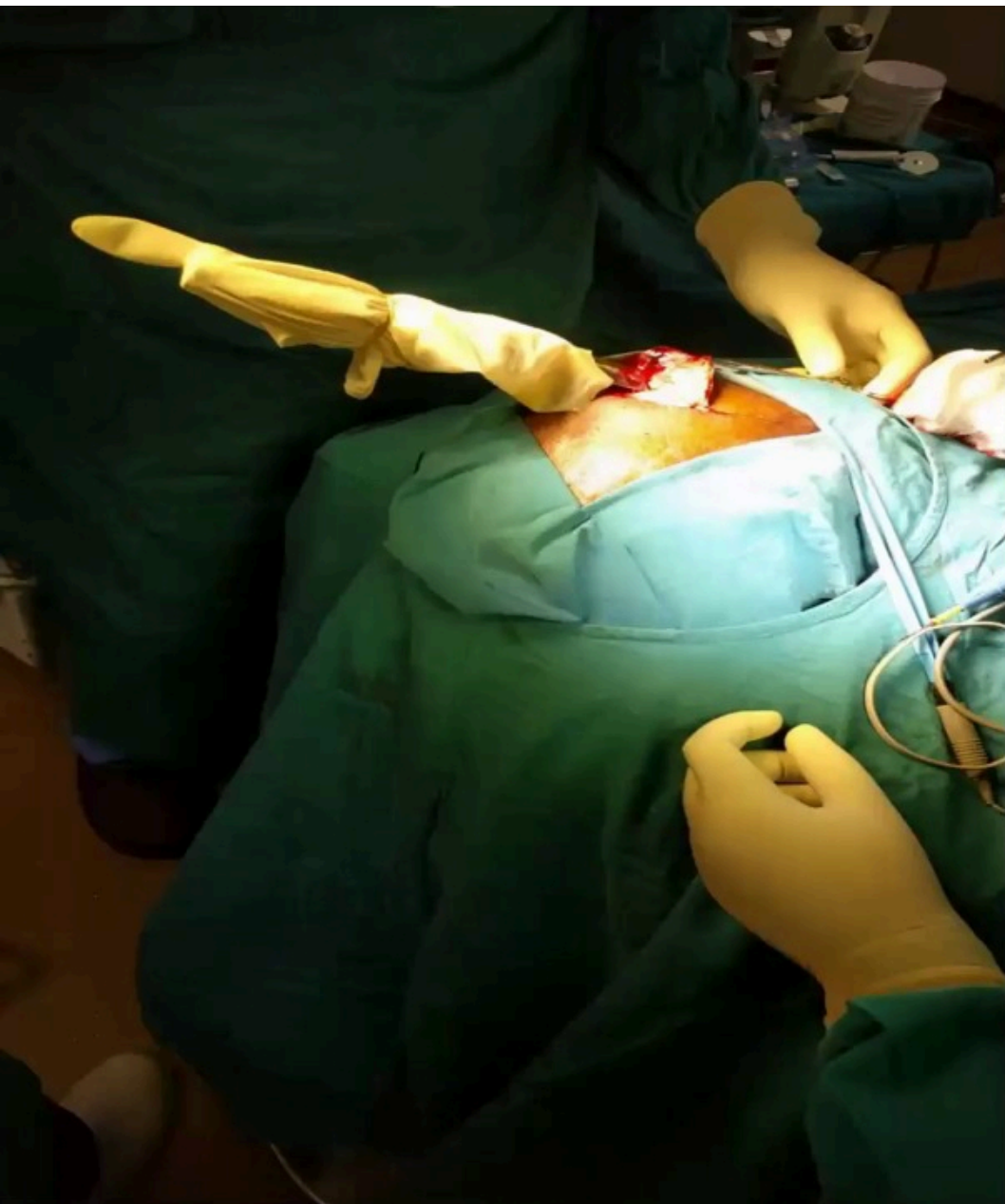


PENETRATING HEAD INJURY.

- High velocity or low velocity injury as a result of penetration with sharp objects.
- The base of the skull is thin bone and could easily be penetrated especially in children.
- This result in skull base fracture and damage to the brain overlying that area.

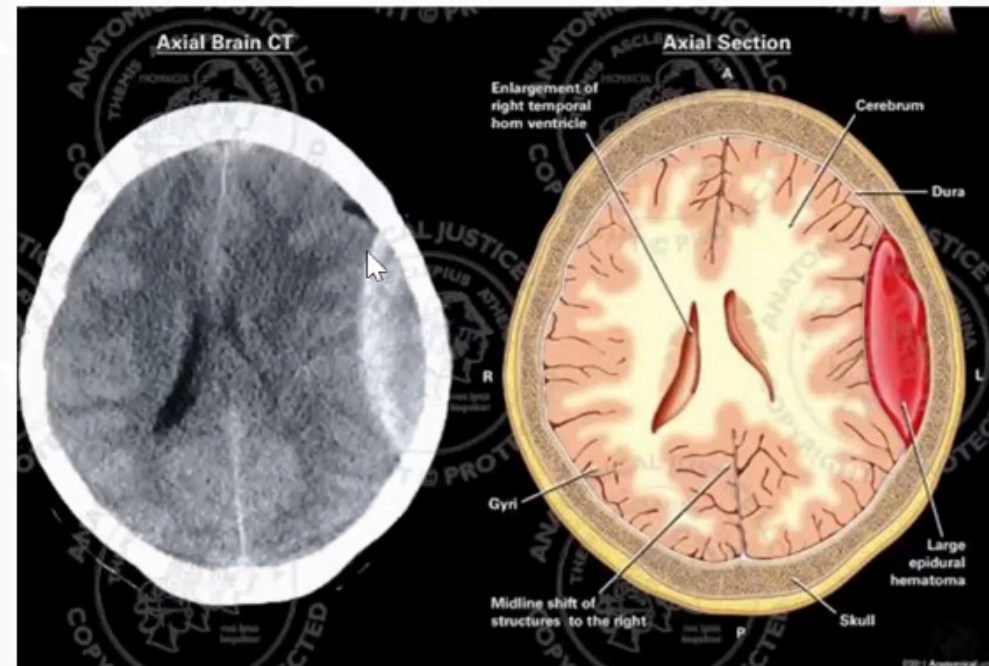






Types of Head Injuries

- *Epidural hematoma*
 - Results from bleeding between the dura and the inner surface of the skull
 - A neurologic emergency
 - Arterial



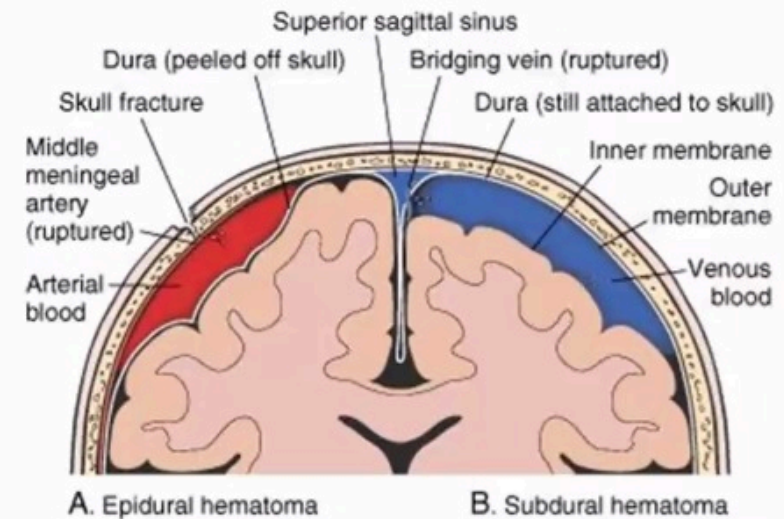
Types of Head Injuries

- *Epidural hematoma*
 - Results from bleeding between the dura and the inner surface of the skull
 - A neurologic emergency
 - Arterial



Types of Head Injuries

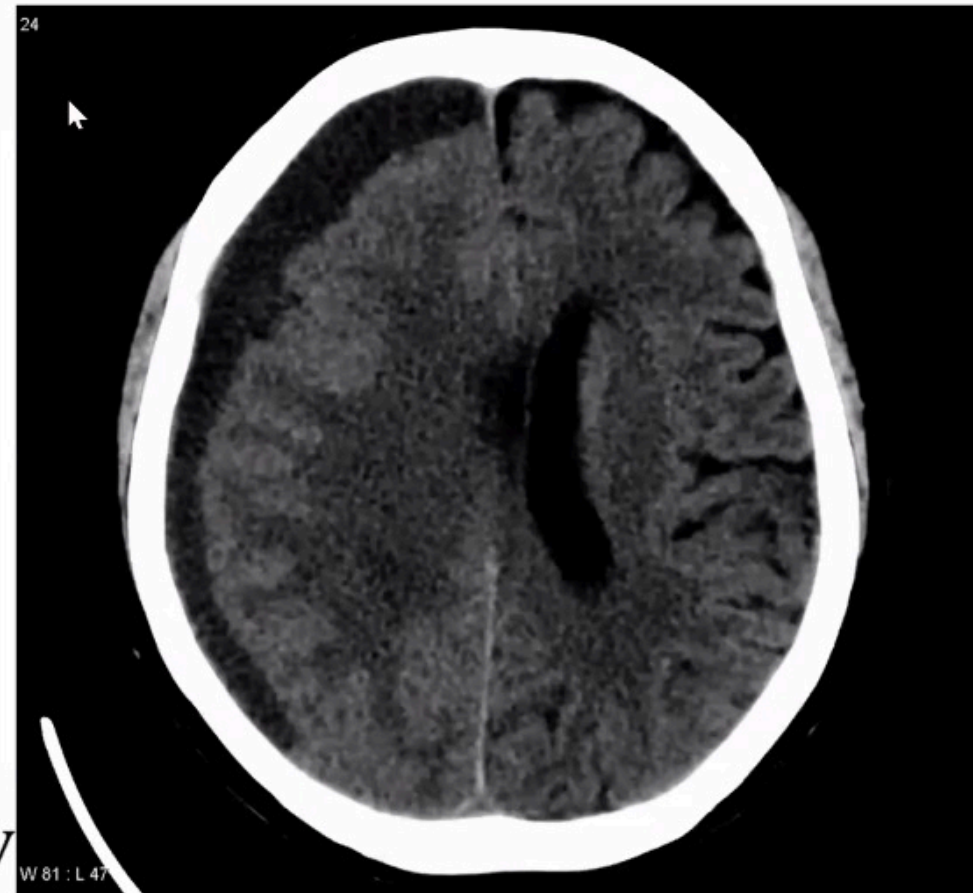
- *Subdural hematoma*
 - Occurs from bleeding between the dura mater and arachnoid layer of the meningeal covering of the brain
 - Usually venous (maybe arterial)



- *Acute subdural hematoma*
 - High morbidity, mortality
 - Associated with major trauma
- *Subacute subdural hematoma*
 - 2-14 days of the injury
- *Chronic subdural hematoma*
 - Weeks or months after a seeming head injury



- *Acute subdural hematoma*
 - High morbidity, mortality
 - Associated with major trauma
- *Subacute subdural hematoma*
 - 2-14 days of the injury
- *Chronic subdural hematoma*
 - Weeks or months after a seemingly head injury



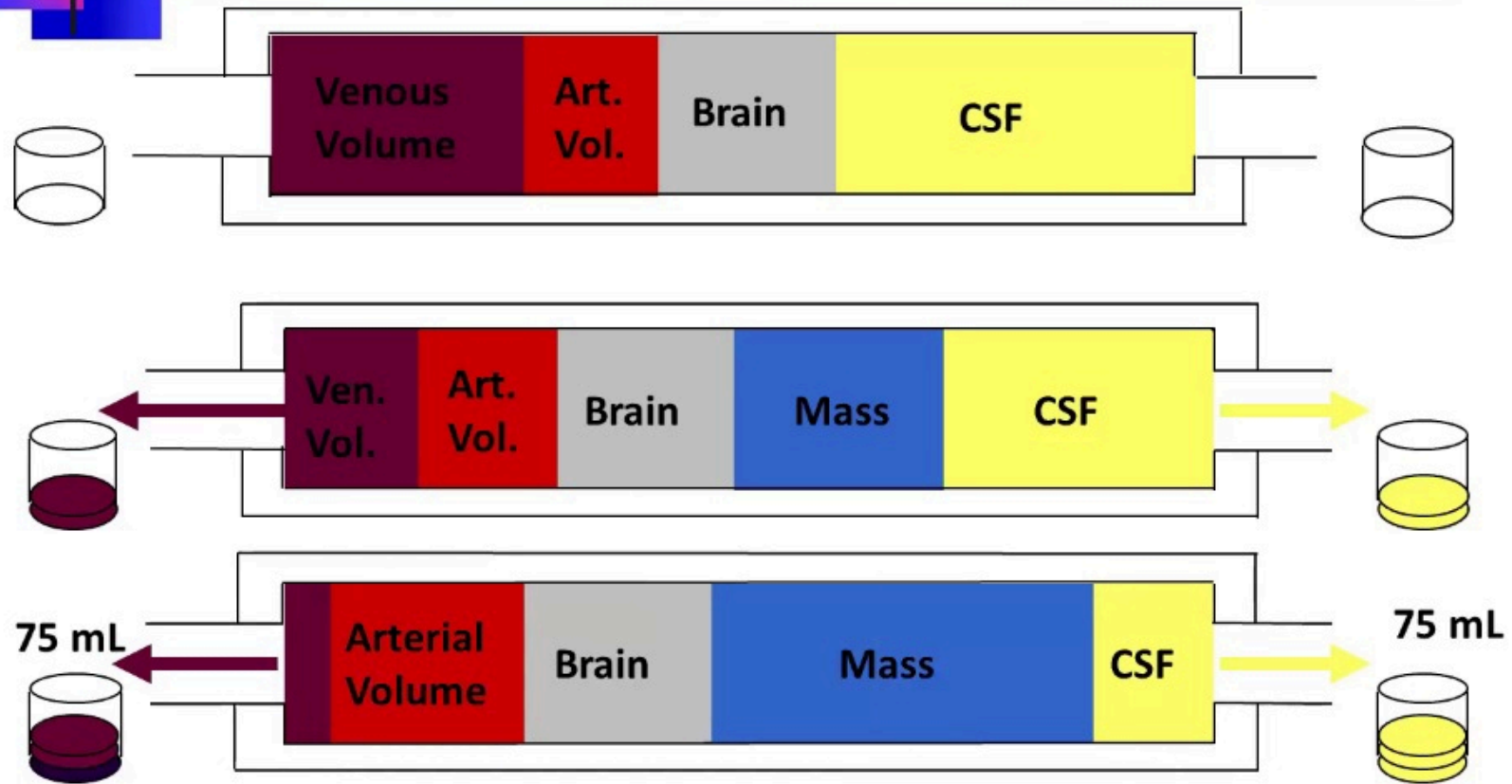


Anatomy and physiology effects?

- Rigid, nonexpansile skull filled with brain, CSF, and blood
- CBF autoregulation
- Autoregulatory compensation disrupted by brain injury
- Mass effect of intracranial hemorrhage

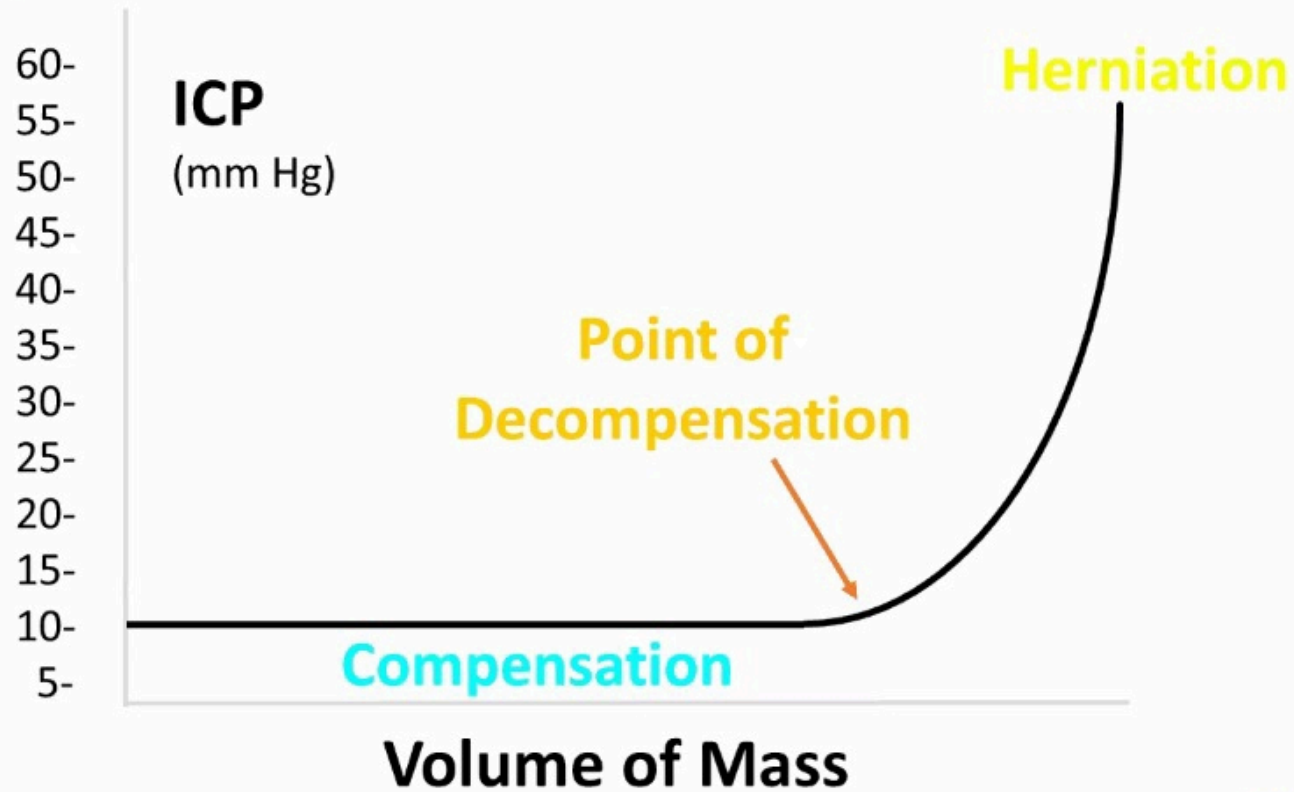


Monro-Kellie Doctrine





Volume – Pressure Curve



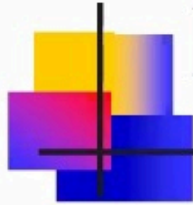


Intracranial Pressure (ICP)

- 10 mm Hg = Normal
- > 20 mm Hg = Abnormal
- > 40 mm Hg = Severe
- Many pathologic processes affect outcome
- Sustained ↑ ICP leads to ↓ brain function and outcome

GLASGOW COMA SCALE

Eye opening	4	eyes open spontaneously
	3	open to speech
	2	open to pain
	1	no opening
Motor response	6	obeys commands
	5	localizes to pain
	4	flexion
	3	abnormal flexion
	2	extension
	1	no movement
Verbal response	5	orientated
	4	confused
	3	inappropriate words
	2	incomprehensible sounds
	1	no speech



Mild Brain Injury

- GCS Score = 14–15
- History
- Exclude systemic injuries
- Neurologic exam
- X-rays as indicated
- Alcohol / drug screens as indicated
- Liberal use of head CT

Observe or discharge based on findings

Admission or Discharge?

- GCS < 15
- GCS 15, but
 - Continuing amnesia
 - Continuing nausea/vomiting
 - Severe headache
 - Any seizure
 - Focal neurological signs
 - Skull fracture
 - Abnormal CT
- Significant medical problems
- Social problems/no supervision at home

Discharge from A/E

- None of the above exclusion criteria
- Patient must be given head injury advice
- Responsible adult to supervise the patient
- Easy access to a telephone
- Reasonable access to a hospital
- Easy access to transport

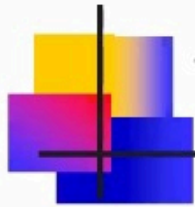
Indications for referral to hospital

- GCS < 15 at any time since the injury
- Amnesia
- Neurological symptoms
- Clinical evidence of a skull fracture injuries



Moderate Brain Injury

- **GCS Score = 9–13**
- **Initial evaluation same as for mild injury**
- **CT scan for all**
- **Admit and observe**
 - Frequent neurologic exams
 - Repeat CT scan
- **Deterioration:
Manage as severe head injury**



Severe Brain Injury

- **GCS Score = 3–8**
- **Evaluate and resuscitate**
- **Intubate for airway protection**
- **Focused neurologic exam**
- **Frequent reevaluation**
- **Identify associated injuries**



Priorities

➤ ABCDE

➤ **Minimize secondary brain injury**

- Administer O₂
- Maintain blood pressure
(systolic > 90 mm Hg)



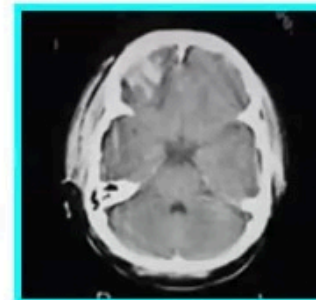
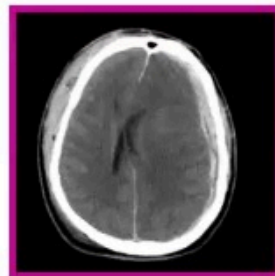
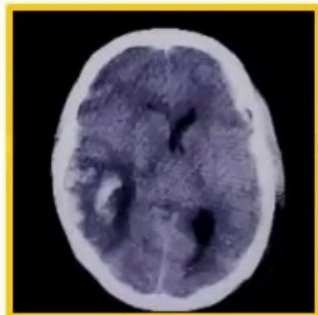
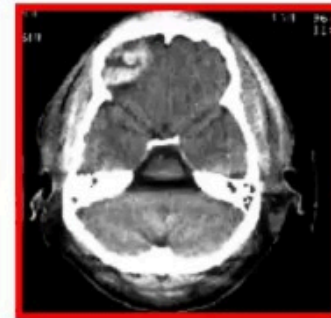
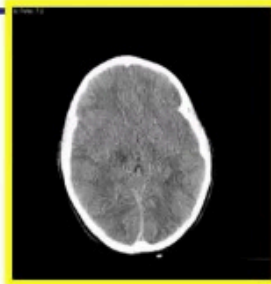
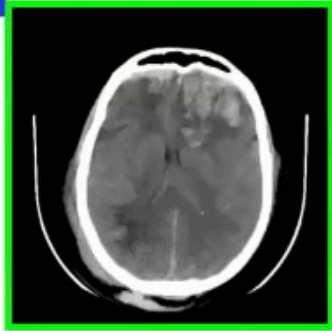
Focused Neurologic Exam?

- **GCS Score**
- **Pupils**
- **Lateralizing signs**



Consult neurosurgeon early

Indications for CT Scan?





Indications for CT Scan?

**All patients with
suspicion of brain
injury**

CT Indications - NICE

- GCS less than 13 at any point since the injury
- GCS 13 or 14 at 2 hours after the injury
- Suspected open or depressed skull fracture
- Any sign of BOS fracture
- Post-traumatic seizure
- Focal neurological deficit
- >1 episode of vomiting
- Amnesia > 30 minutes before impact

In patients with some LOC or amnesia since the injury:

- Age > 65
- Coagulopathy
- Dangerous MOI



Medical Management

- **Intravenous fluids**
 - Euvolemia
 - Isotonic
- **Controlled ventilation**
 - Goal: Paco_2 at 35 mm Hg



Medical Management

➤ Mannitol

- **Use with signs of tentorial herniation**
- **Dose: 1.0 g / kg IV bolus**
- **Consult with neurosurgeon first**



Medical Management

➤ Other medications

- **Anticonvulsants**
- **Sedation**
- **Paralytics**
- **Analgesics**
- **Antiemetic**
- **PPIs**



Surgical Management

Intracranial Mass Lesion

- **May be life-threatening if expanding rapidly**
- **Immediate neurosurgical consult**
- **Hyperventilation / Mannitol**
- **Damage control craniotomy: Transfer to neurosurgeon**



Surgical Management





Summary: What should I do?

- **Maintain mean BP > 90 mm Hg**
- **Maintain $Paco_2$ near / at 35 mm Hg**
- **Use isotonic solution for euvolemia**
- **Frequent neurologic exams**
- **Liberal use of CT scans**
- **Early neurosurgical consult**



Summary: What should I not do?

- **Allow patient to become hypotensive**
- **Over-aggressively hyperventilate**
- **Use hypotonic IV fluids**
- **Use long-acting paralytics**
- **Paralyze before performing complete exam**
- **Depend on clinical exam alone**

*Thank
you*



