Introduction to head trauma (part 1)

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Objectives

- Basic anatomy
- Classification of injury
- Skull base fractures
- Autoregulation of ICP
- ICP formula
- Cushing's Triad
- Head Trauma Assessment
- Increased ICP Management
- Notes

Basic Anatomy

Basic Anatomy

- Scalp: highly vascular, bleeds freely.
- Skull
- Meninges
  - Dura Mater
  - Arachnoid
  - Pia Mater
- Brain Tissue
- CSF and Blood

Vascular
- EDH
- SDH
- ICH
- IV
- Contusion

Skull fractures
- fissures
- depressed

Brain

Head Injury

Others :
- Pneumocedphalus
- Cranial n. injury
- Carotid dissection
- Facial fractures

Classification of Head Injury

- Mode of trauma
- Morphology
- Severity
- Timing

Classification of Head Injury

By Mode of trauma

- **Blunt**
- **Penetrating**

Classifications of Head Injury

By Morphology: Brain

Focal

- **Epidural (extradural)**
- **Subdural / Subarachnoid**
- **Intracerebral/contusion**
- **Intraventricular**

Diffuse

- **Concussion**
- **Multiple Contusion**
- **Diffused axonal injury**

Classification of Head Injury

By Morphology: Skull Fractures

Vault

- **Depressed:** either open (compound) or closed (simple)
- **Fissure fracture:** either open (compound) or closed (simple)

Basilar

- **Anterior cranial fossa**
- **Middle cranial fossa**
- **Posterior cranial fossa**

Depressed Skull Fracture: Segment pushed inward

Concussion is defined as:
Nerve dysfunction without anatomical damage.

Most common outcome of blunt trauma to the head.

Symptoms of concussion:

Early
- Headache
- Dizziness
- Confusion
- Tinnitus
- Nausea
- Vomiting
- Loss of balance

Late
- Memory Disturbances
- Poor Concentration
- Irritability
- Sleep disturbances
- Fatigue
- Personality changes

Diffuse axonal injury (DAI)

- Type of brain injury characterized by shearing, stretching or tearing of nerve cells axons
- Axons are the communication pathways of nerve cells
- due to acceleration/deceleration forces usually with rotation
- Injuries can range from mild to severe and life threatening

Classification of Head Injury

By Severity

- **Glasgow Coma Score**
  - **Mild : GCS 13-15**
  - **Moderate : GCS 9-12**
  - **Severe : GCS <9**

Glasgow Coma Scale score

1. **Eye opening**
   - Spontaneous 4
   - To voice 3
   - To pain 2
   - None 1

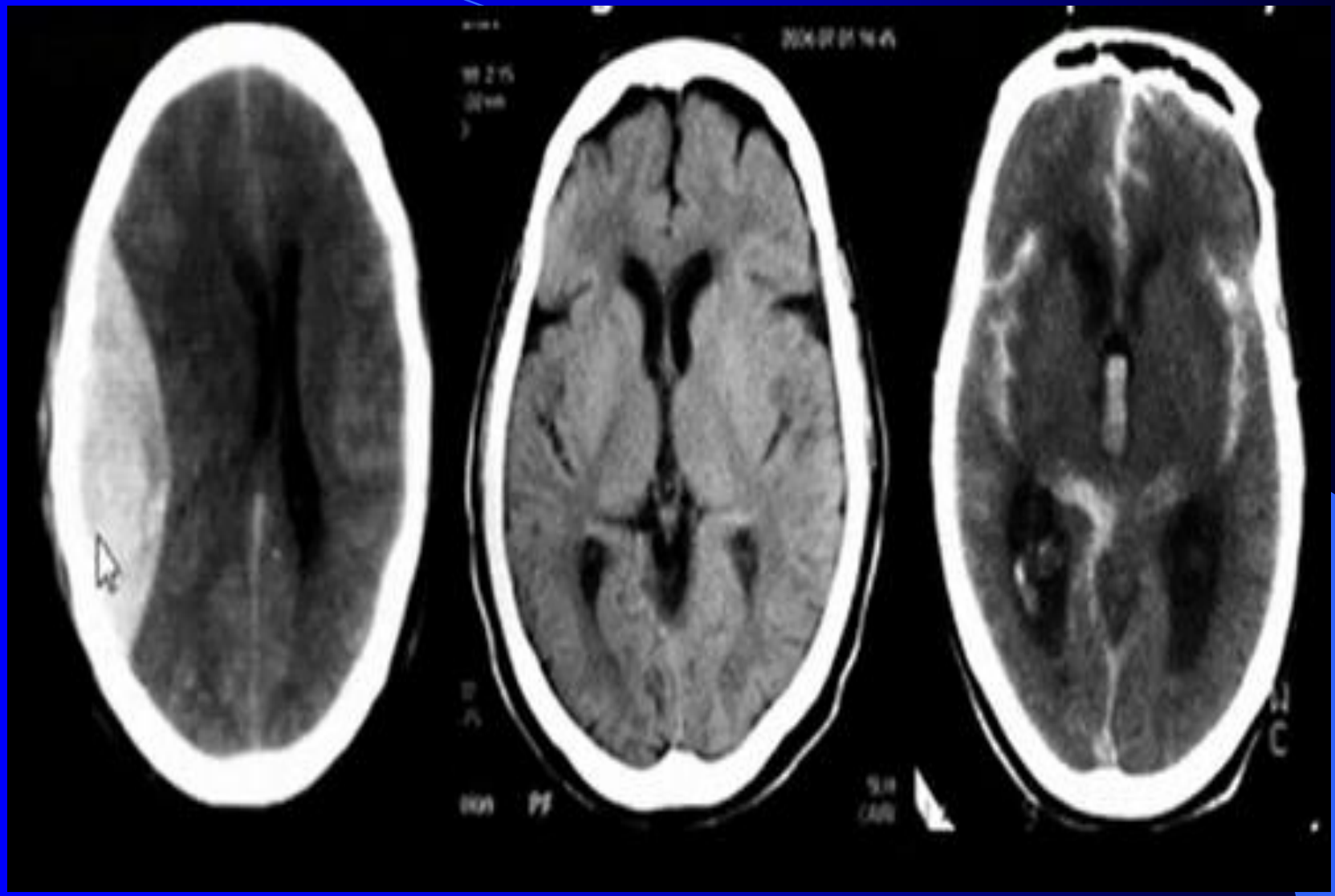
2. **Verbal response**
   - Oriented 5
   - Confused 4
   - Words 3
   - Sounds 2
   - None 1

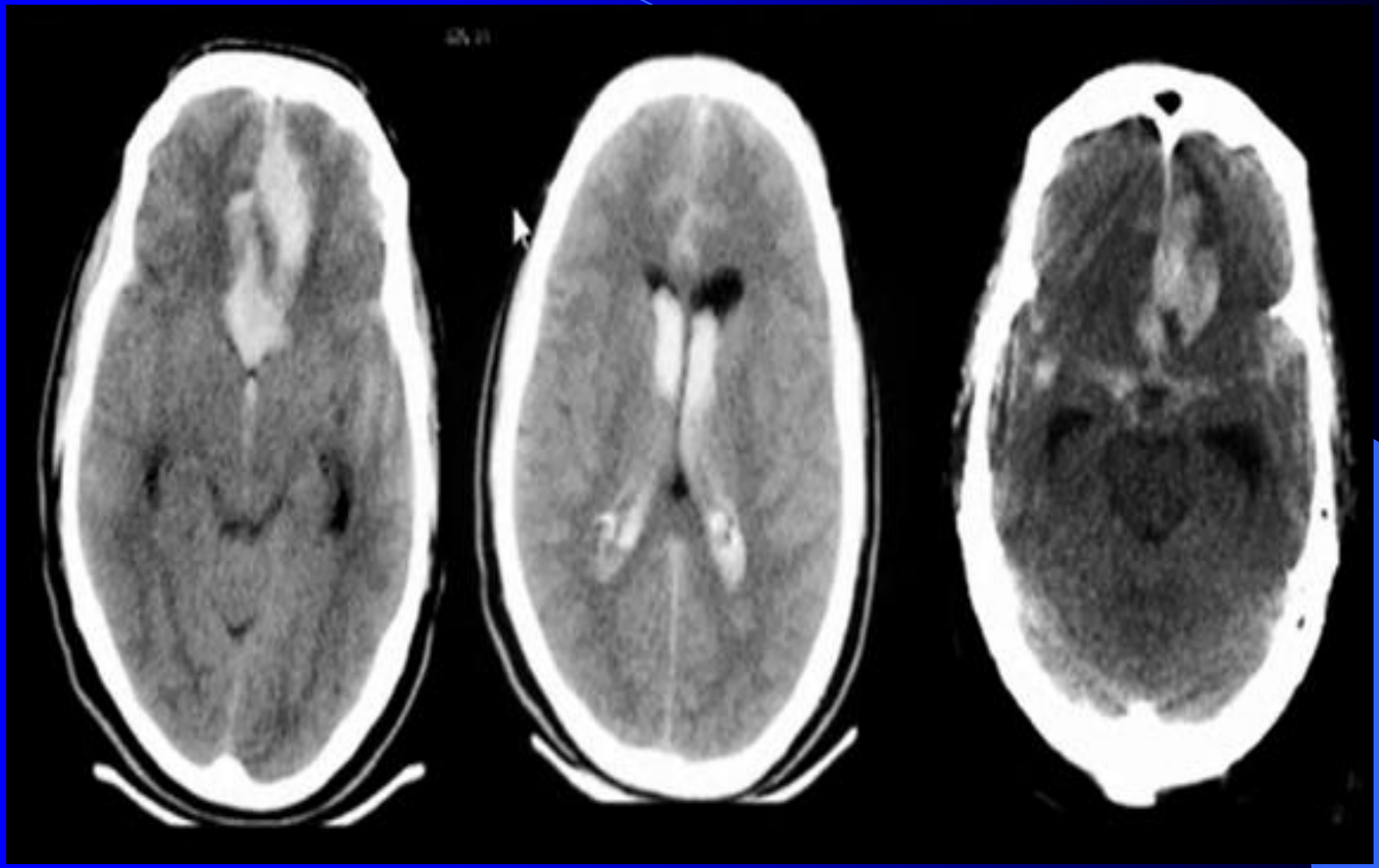
3. **Best motor response**
   - Obeys command 6
   - Localizes pain 5
   - Flexion withdrawal 4
   - Abnormal flexion 3
   - Extension (pain) 2
   - None 1

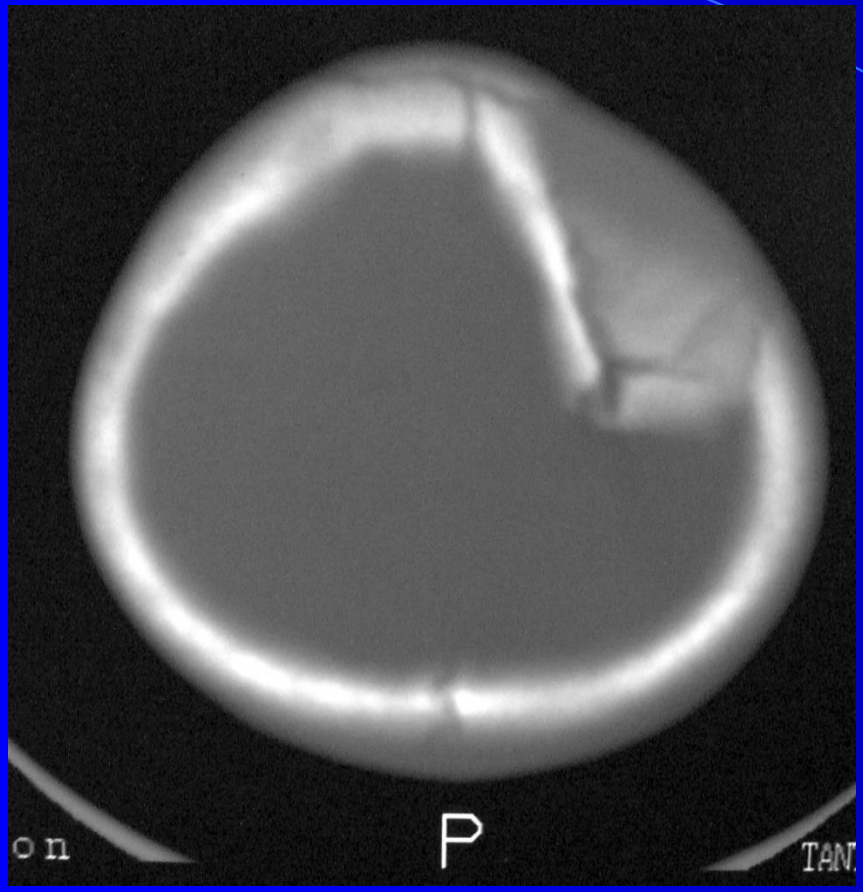
Classification of Head Injury

By timing

- Primary: direct impact (Mechanical disruption of cells)
- Secondary: indirect causes
  - edema, infection, inadequate perfusion, tissue hypoxia.



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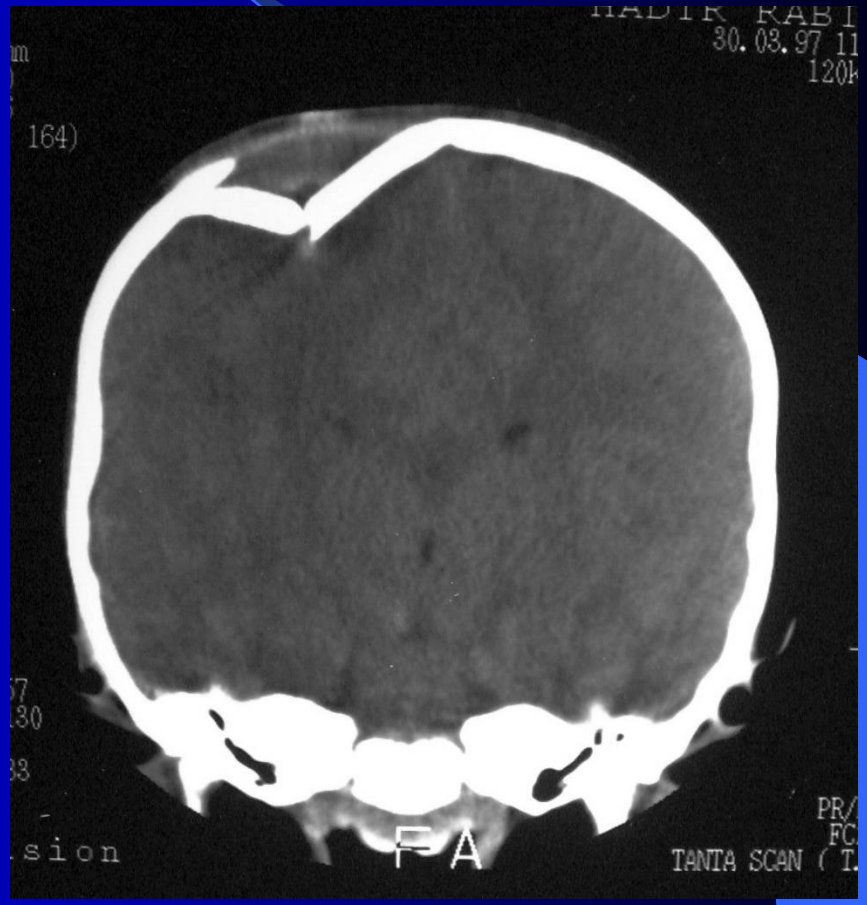
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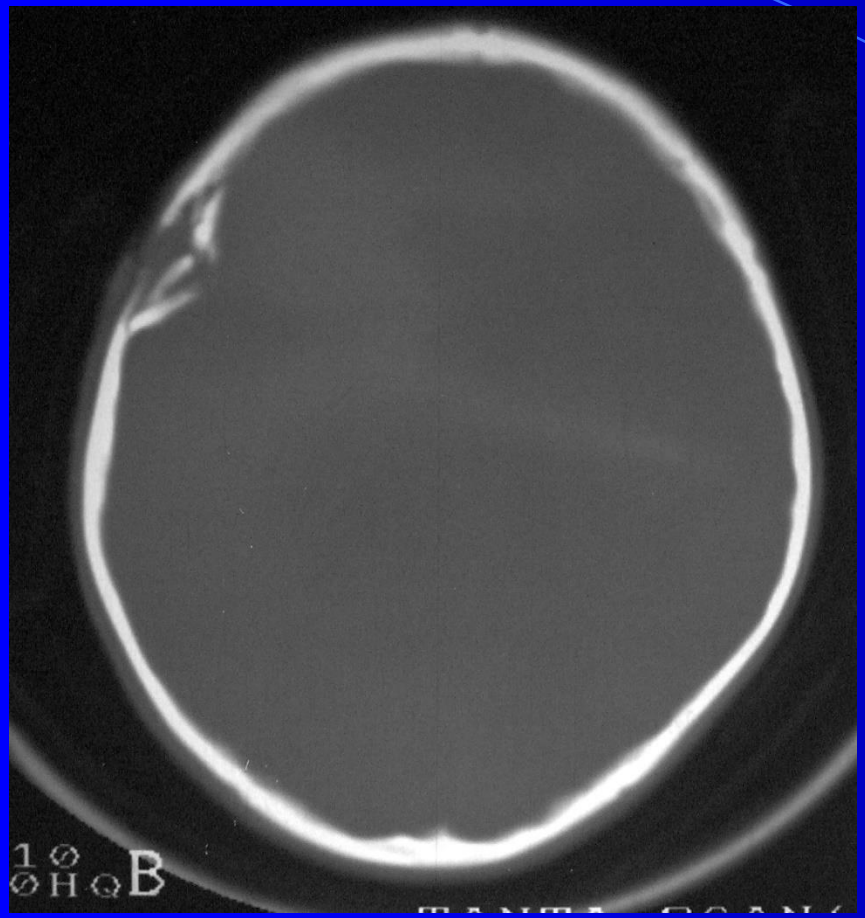


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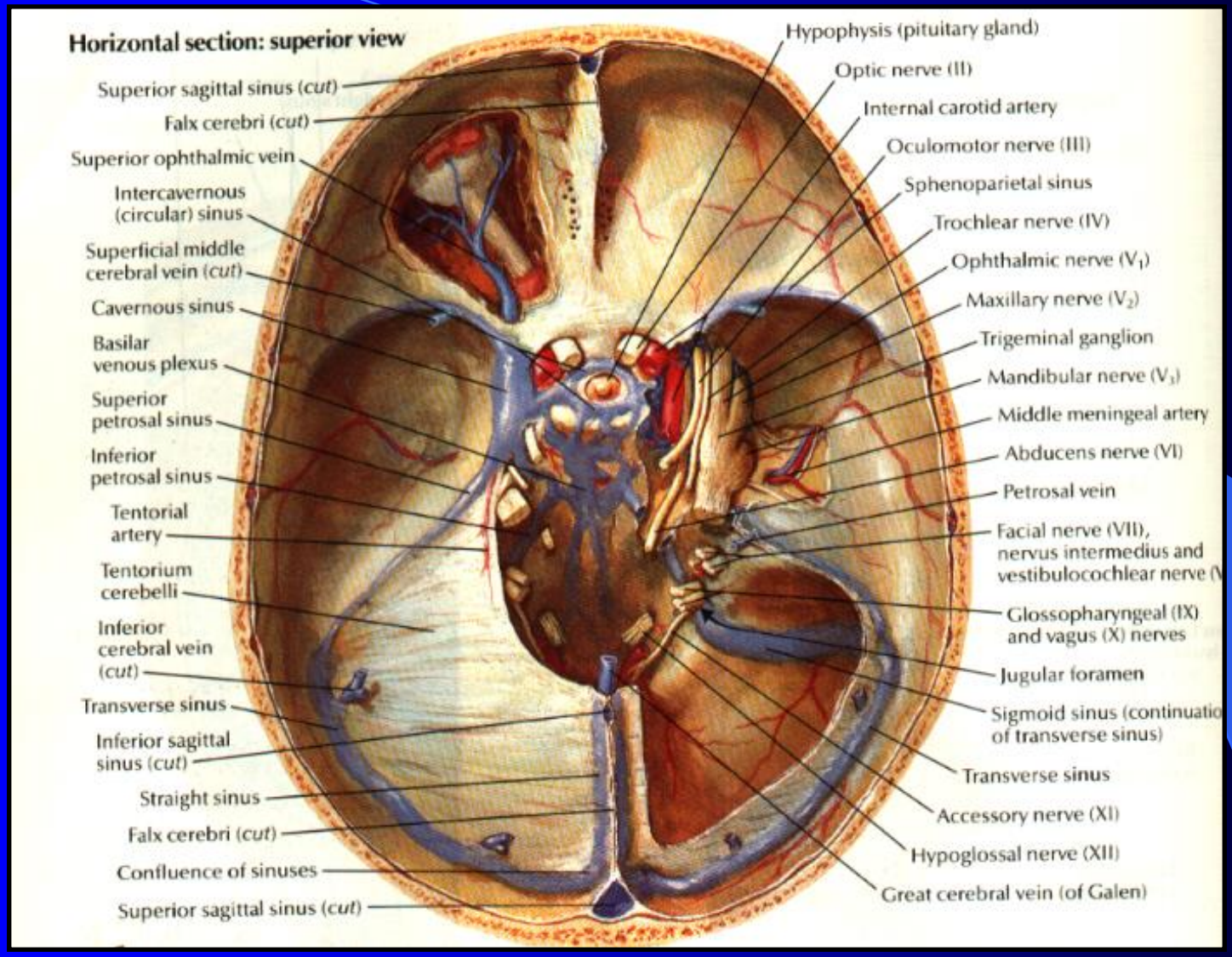
Skull base fractures

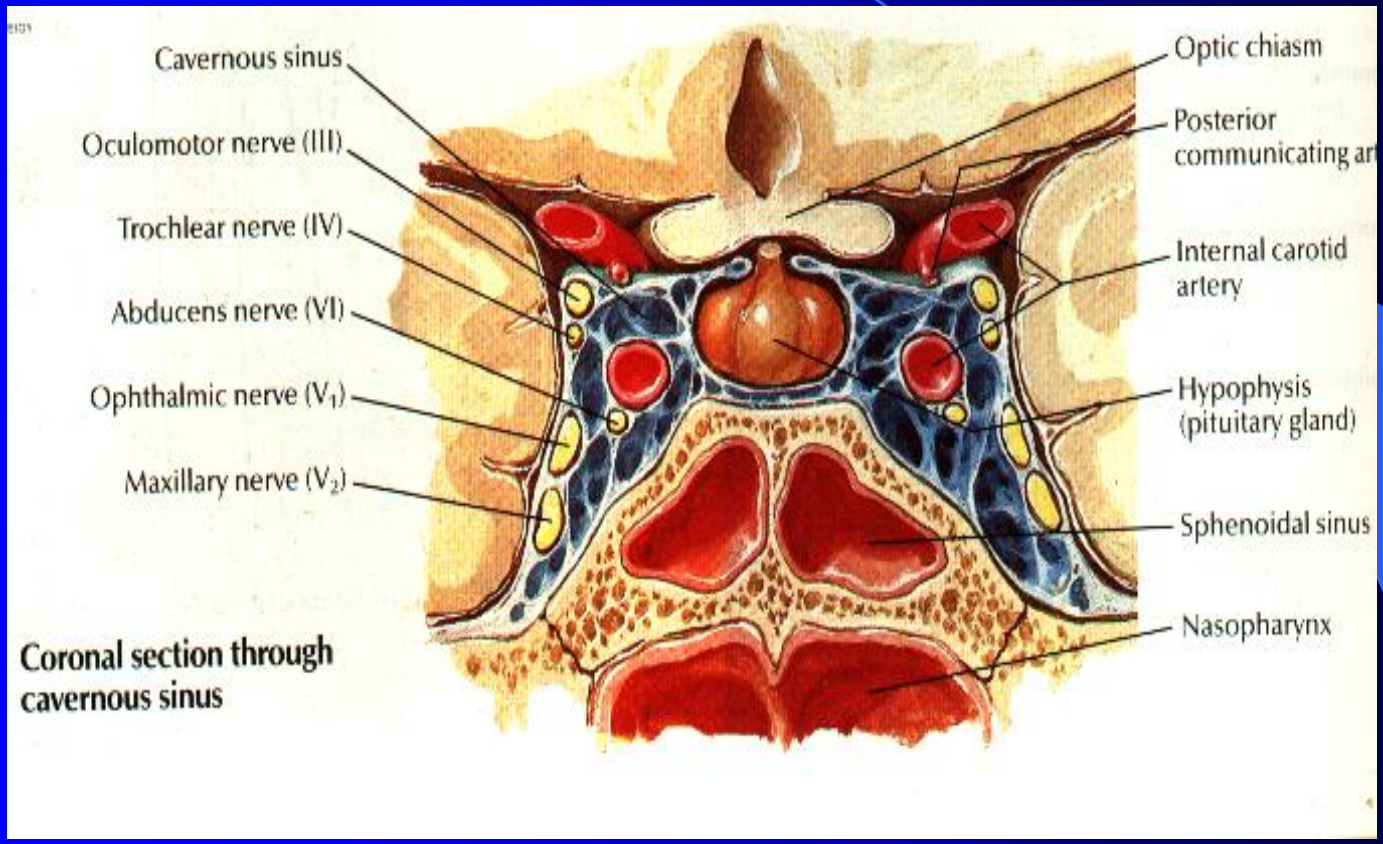
Skull base fractures

- Skull base fractures are clinically important
  - May penetrate dura causing CSF fistulas
  - Predispose pt to meningitis
  - Damage critical structures in close proximity
    - Carotid artery
    - Cavernous sinus
    - Cranial nerves



Complexity of skull base anatomy

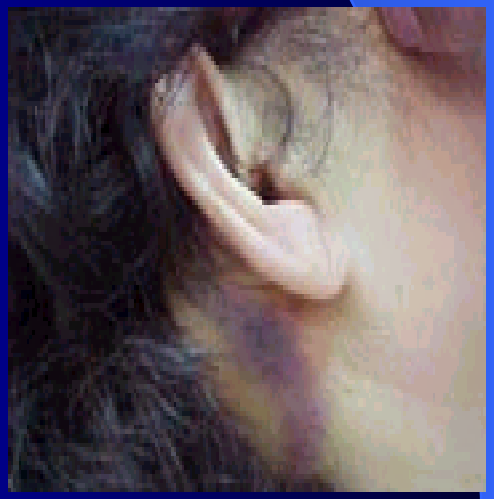
Skull base fractures



Cavernous sinus anatomy showing proximity of structures.

Skull base fractures

- Sign:
  - Bloody or CSF otorrhea/rhinorrhea
  - Raccoon's eyes
  - Battle's sign
  - Cranial nerve palsy (foramen)
  - Hemotympanum



Skull base fractures

Cranial Nerves Injury in skull base fracture

Nerve	Deficit
I. Olfactory	Anosmia
II. Optic	Blindness
III. Oculomotor	Diplopia
IV. Trochlear	Diplopia
V. Trigeminal	Asensate face

Nerve	Deficit
VI. Abducens	Lateral gaze diplopia
VII. Facial	Facial paralysis
VIII. Vestibulo-cochlear	Nystagmus, ataxia
IX. Glosso-pharyngeal	Absent gag reflex; Dysphagia
X. Vagus	Vocal cord paralysis

Nerve	Deficit
XI. Spinal accessory	SCM paralysis
XII. Hypoglossal	Tongue deviation and atrophy

Autoregulation of ICP

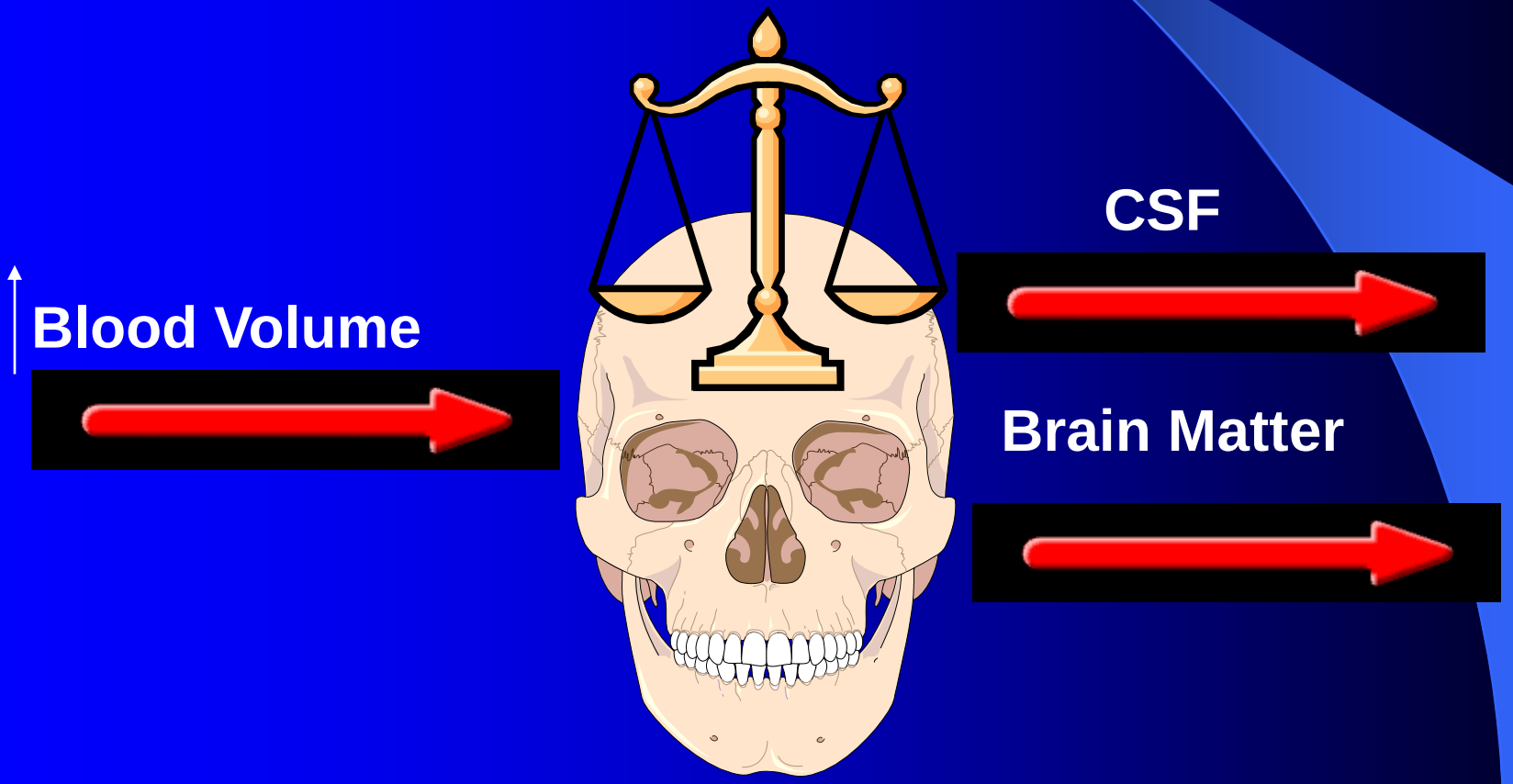
Autoregulation of ICP

Intracranial volume:

- **80% Brain Matter**
- **10% Blood**
- **10% CSF**

* **Volume is Fixed at 100%**
* **If more of one thing is added, then something else must go.**
* **This is called autoregulation**

Autoregulation of ICP



Autoregulation of ICP

- Two main factors that increase intracranial volume after head trauma:

- Vasodilation (immediately)
- Cerebral edema (24-48 hrs)

Autoregulation of ICP

Vasodilatation:

Why vasodilatation occurs?

- CO_2 is produced by hypoxic cells
- CO_2 is a very potent vasodilator

What happens when vasodilation occurs?

To compensate, the brain releases CSF into the spinal column to make room for the increase in blood volume

To critical limit after which catastrophic event may occure

Intracranial Pressure formula

Intracranial Pressure formula

- cerebral perfusion pressure = mean arterial pressure- intracranial pressure

- MAP (Mean Arterial Pressure) can be determined by a simple formula:

$$MAP = \frac{\text{systolic} + 2\text{x diastolic}}{3}$$

Cushing's Triad

Cushing's Triad

Cushing's Triad

- hypertension
- bradycardia
- altered respirations

Why hypertension?

As ICP rises, autoregulation increases the MAP to maintain an adequate cerebral perfusion pressure

If the patient has Cushing's Triad and then suddenly dropped Bpr, This is NOT GOOD! As herniation is mostly occured

Head Trauma Assessment

Head Trauma Assessment

- Vital Signs
  - Isolated head injury will NOT cause hypotension in adult
  - Look for another life threatening injury
    - **Chest**
    - **Abdomen**
    - **Pelvis**
    - **Multiple long bone fractures**

Head Trauma Assessment
First aid management of head injury

First aid management of head injury

To identify life threatening conditions and initiate their management by following **A B C**

A. Airway B. Breathing C. Circulation

- Positional issues
- Maximize oxygenation and ventilation
- Decrease intracranial pressure
- Decrease cerebral metabolic rate

Head Trauma Assessment

Positional Changes:

- Laying flat increases ICP, elevate backboard at head 15-30 degrees.
- Head and neck in neutral position to avoid kinking of the jugular vein that impaire venous drainge of the head.

Head Trauma Assessment

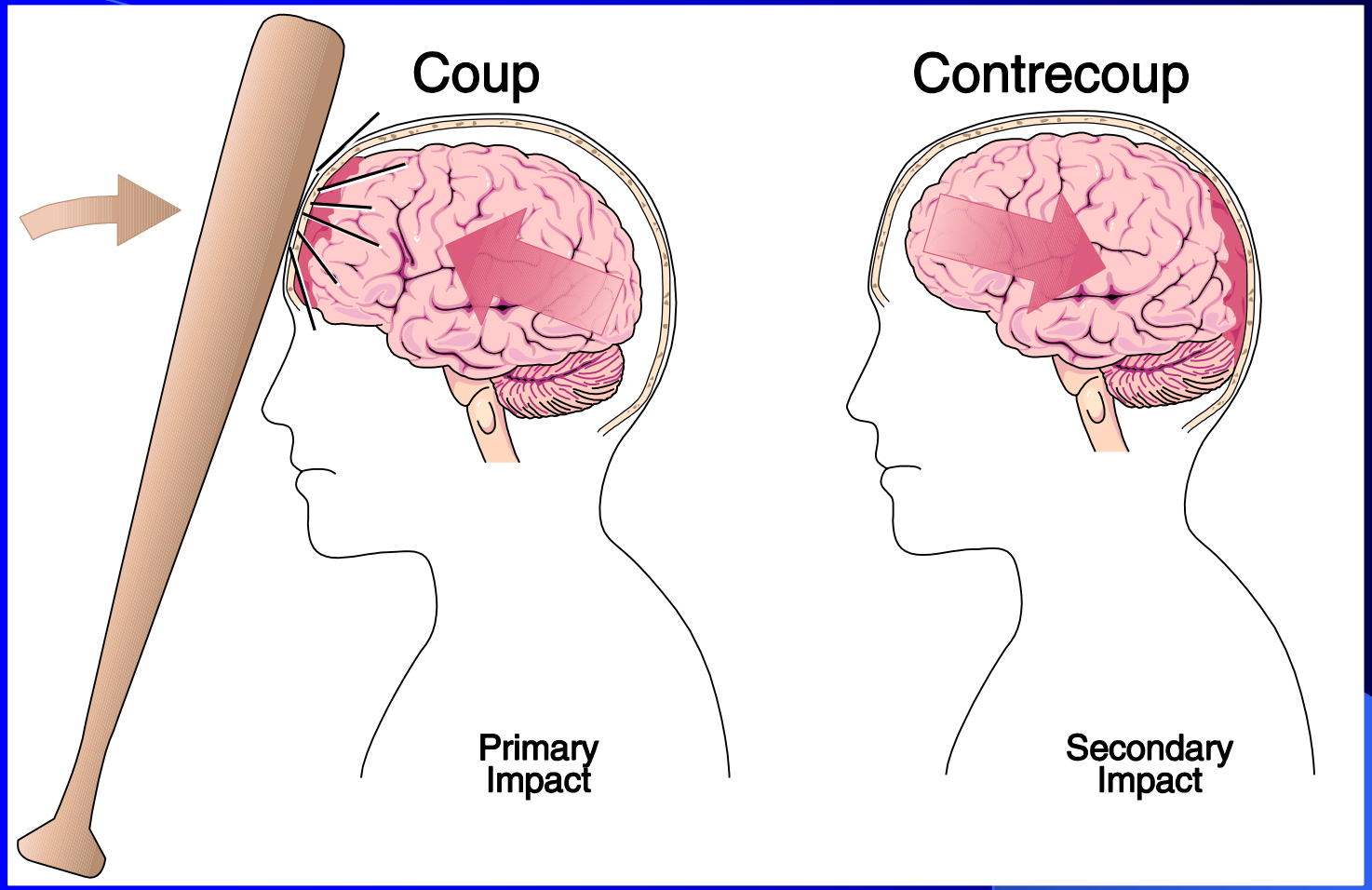
- Decrease intracranial pressure
  - Evacuate mass occupying hemorrhages
  - Consider draining CSF with ventriculostomy when possible
  - Hyperosmolar therapy, +/- diuresis (cautious use to avoid hypovolemia and decreased BP)
  - Mid-line neck, elevated head of bead (some research supports elevation not > 30 degrees)
  - Treat pain and agitation - consider pre-medication for nursing activities, +/- neuromuscular blockade (only when needed)
  - Suction only as needed, limit passes, pre-oxygenate / +/- pre-hyperventilate (PaCo2 not < 30) / use lidocaine IV or IT when possible

Head Trauma Assessment

- Decrease Cerebral Metabolic Rate
  - Prevent seizures
  - Reserve pentobarbital for refractory conditions
  - Avoid hyperthermia, +/- hypothermia
  - Avoid hyperglycemia (early)

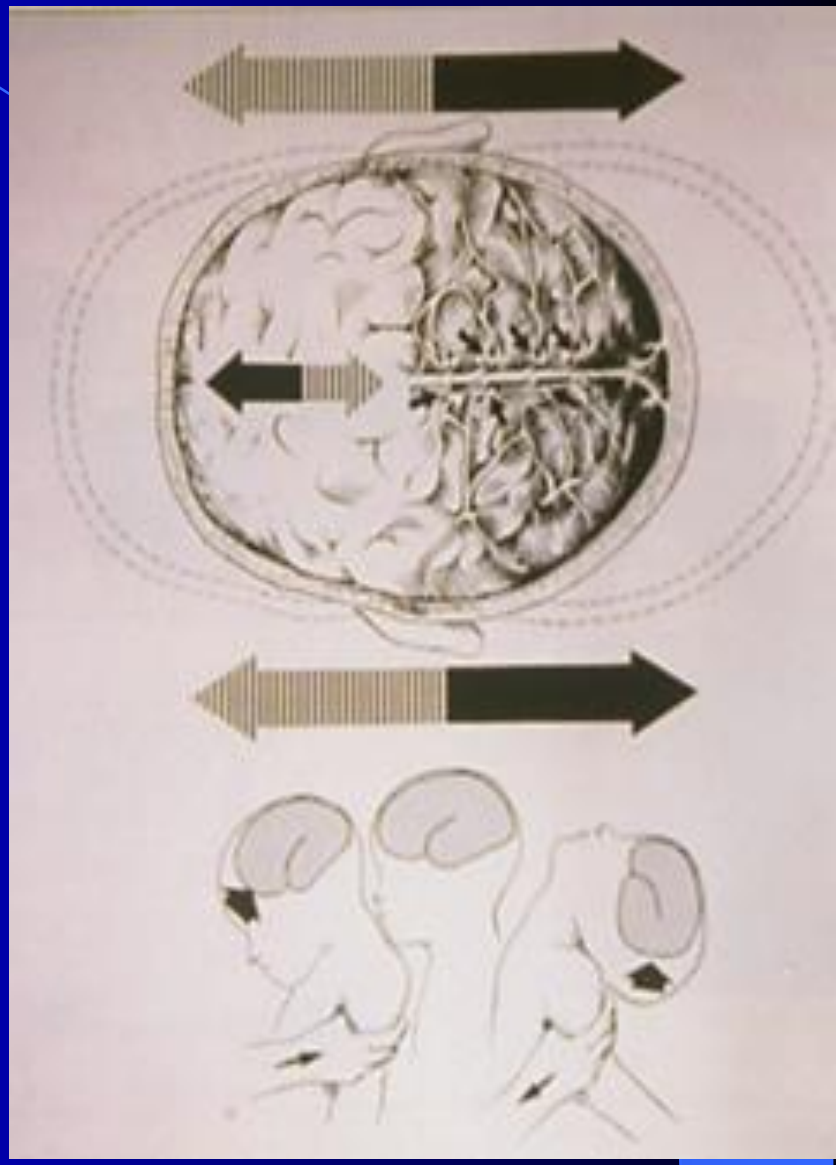
Notes

Notes



Notes

- Coup injuries
  - Directly below point of impact
  - More common when front of head struck
- Contrecoup injuries
  - Injury on the pole on opposite site of impact
  - More common when back of head struck



- **Thanks**