



# Head and Spine Injuries

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# Objectives

- Discuss types of TBI
- Review Anatomy of head and brain
- Discuss types of head bleeds and traumatic injuries
- Emphasize the importance of minimizing secondary brain injuries
- Review the physiology and pathophysiology of ICP and CPP
- Discuss key features of assessment and their meaning.
- Have fun, while learning!

# Traumatic Brain Injury

- Defined as: an impairment of brain function caused by an external force that may involve physical, intellectual, emotional, social or cognitive changes.

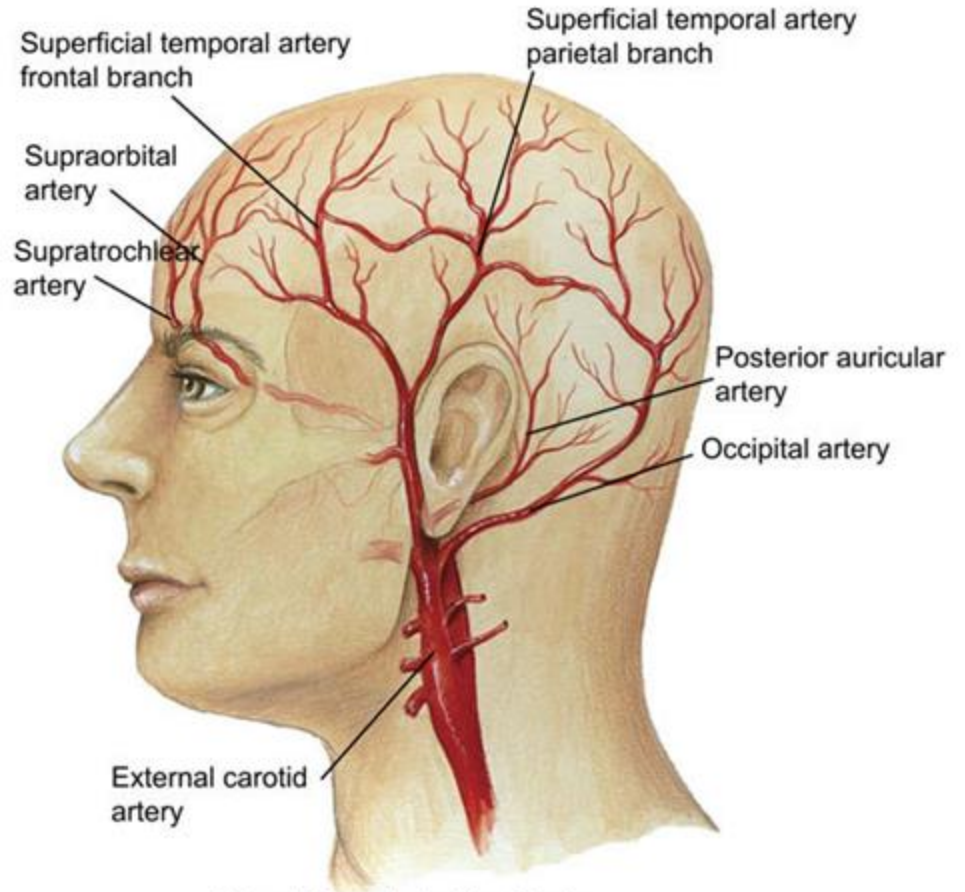
## Primary (Injury) → Secondary (Injury)

- Initial traumatic injury
  - Blunt
  - Penetrating

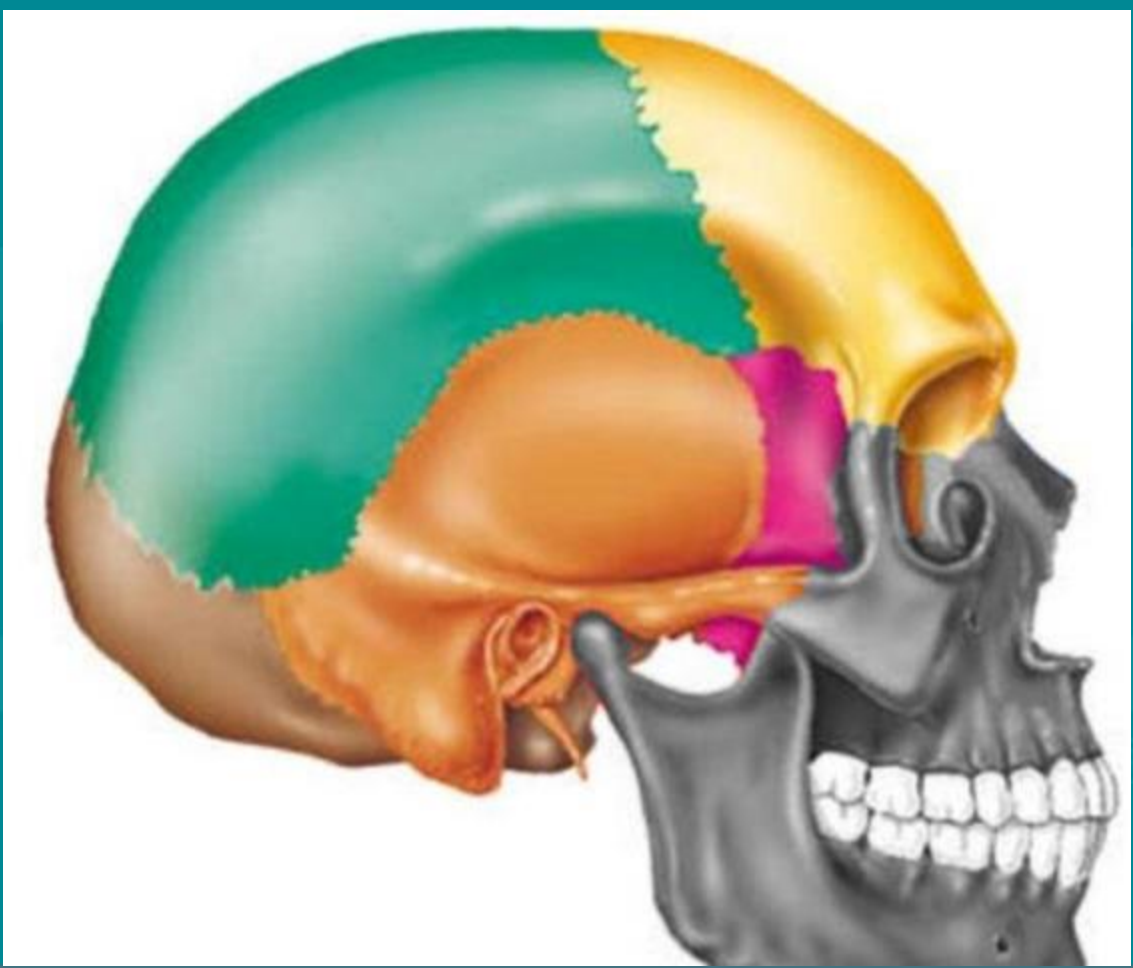
- Increased ICP
  - Results in decreased Blood flow
- Hypoxia
- Hypotension

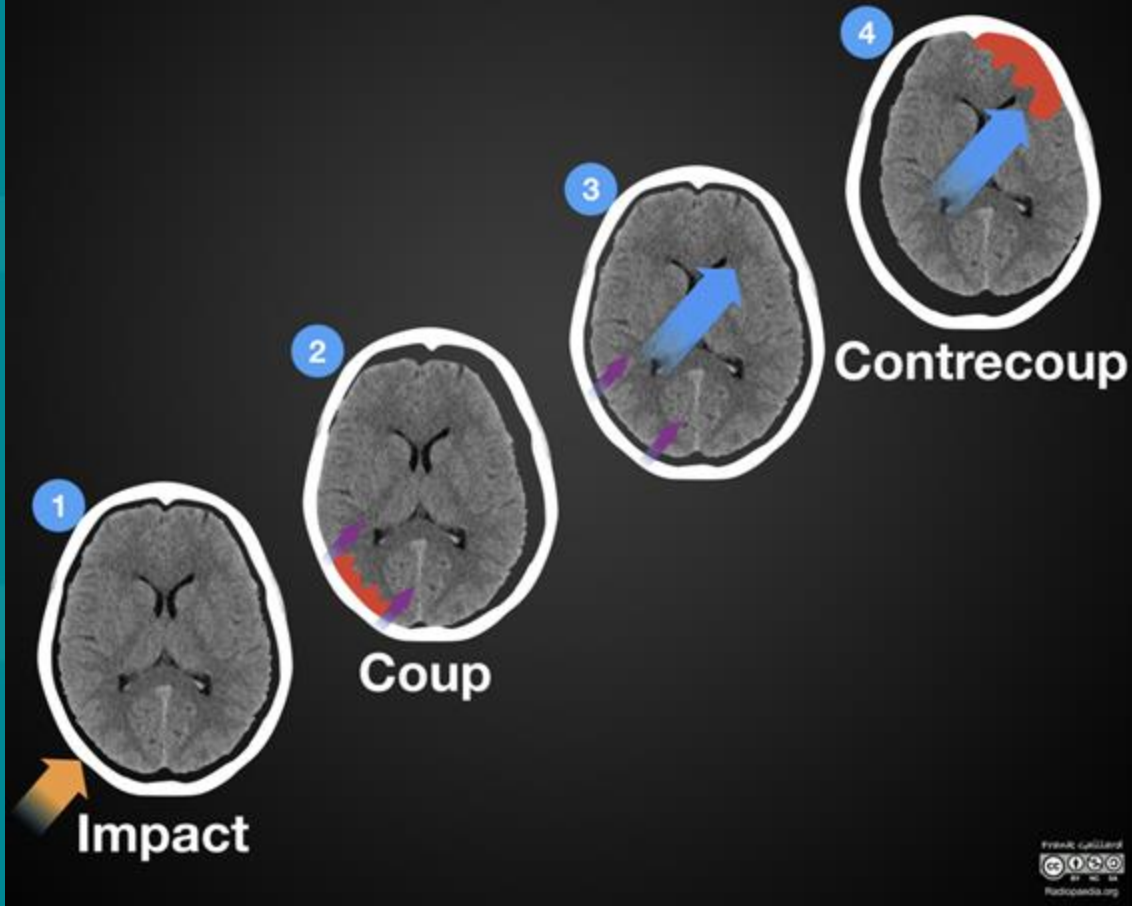
# Scalp

- Hypervascular
- Significant fascia and connective tissue can minimize vasospasm
  - This results in a lot of blood loss from lacerations.



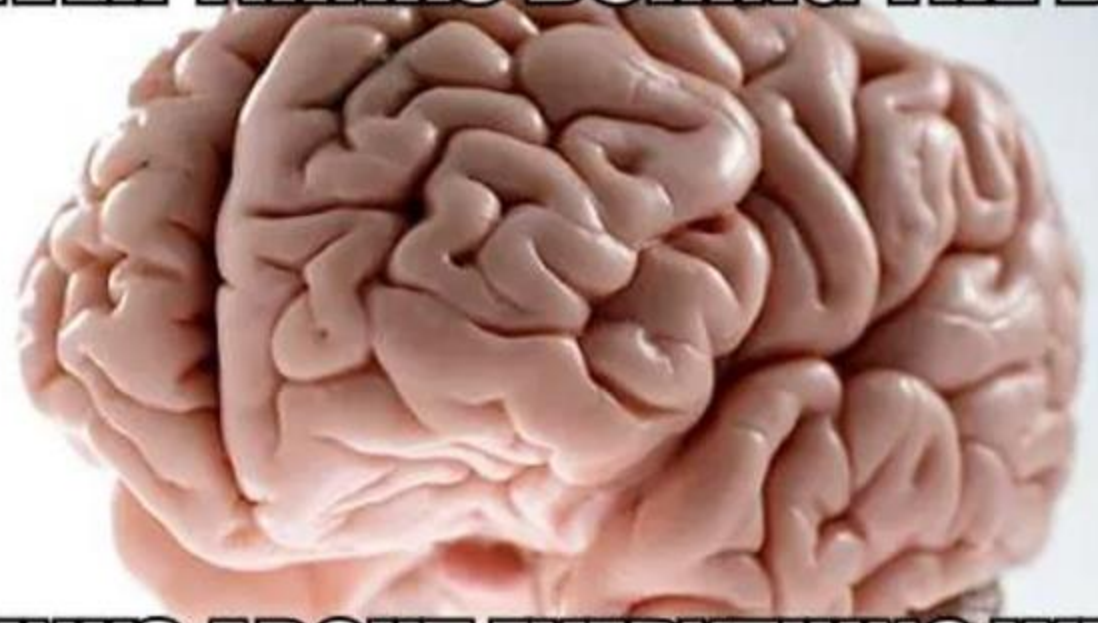
Blood Supply to the Scalp





# Brains

**NEVER THINKS DURING THE DAY**



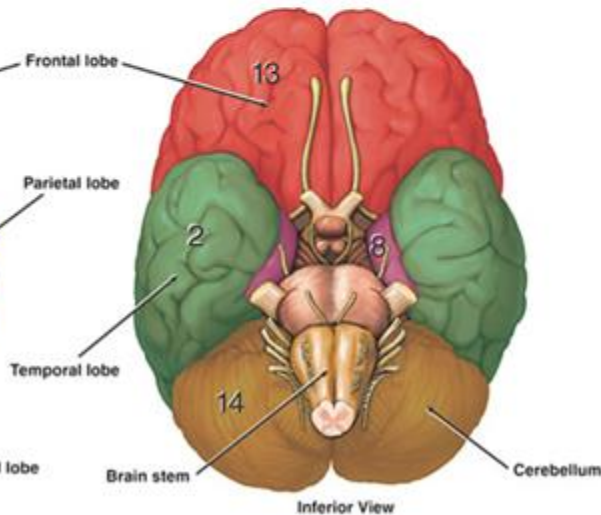
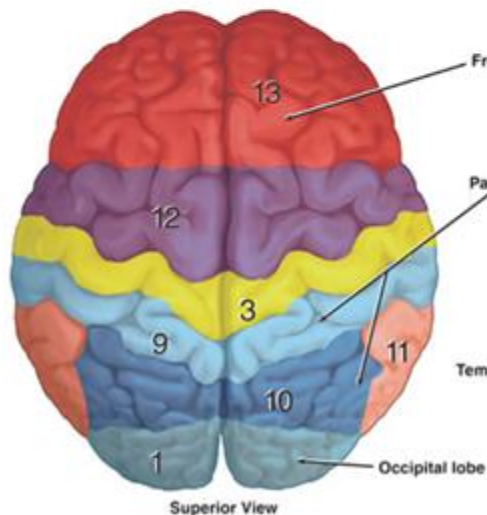
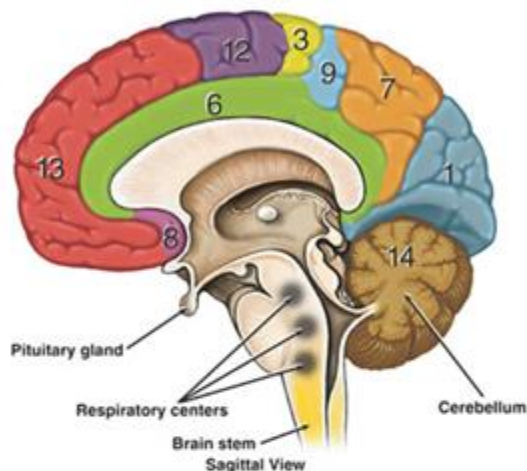
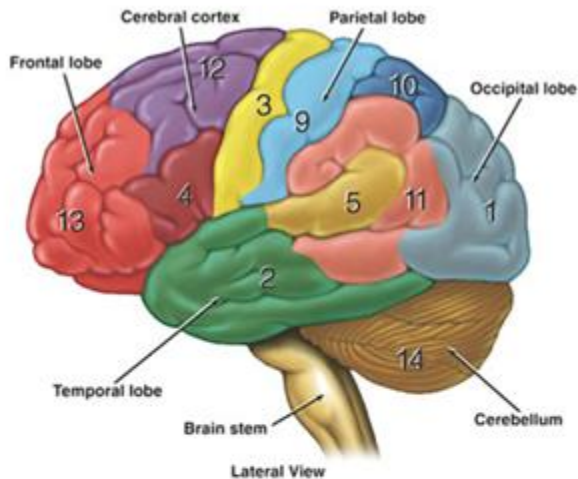
**THINKS ABOUT EVERYTHING WHEN  
TRYING TO SLEEP**

## Functional Areas of the Cerebral Cortex

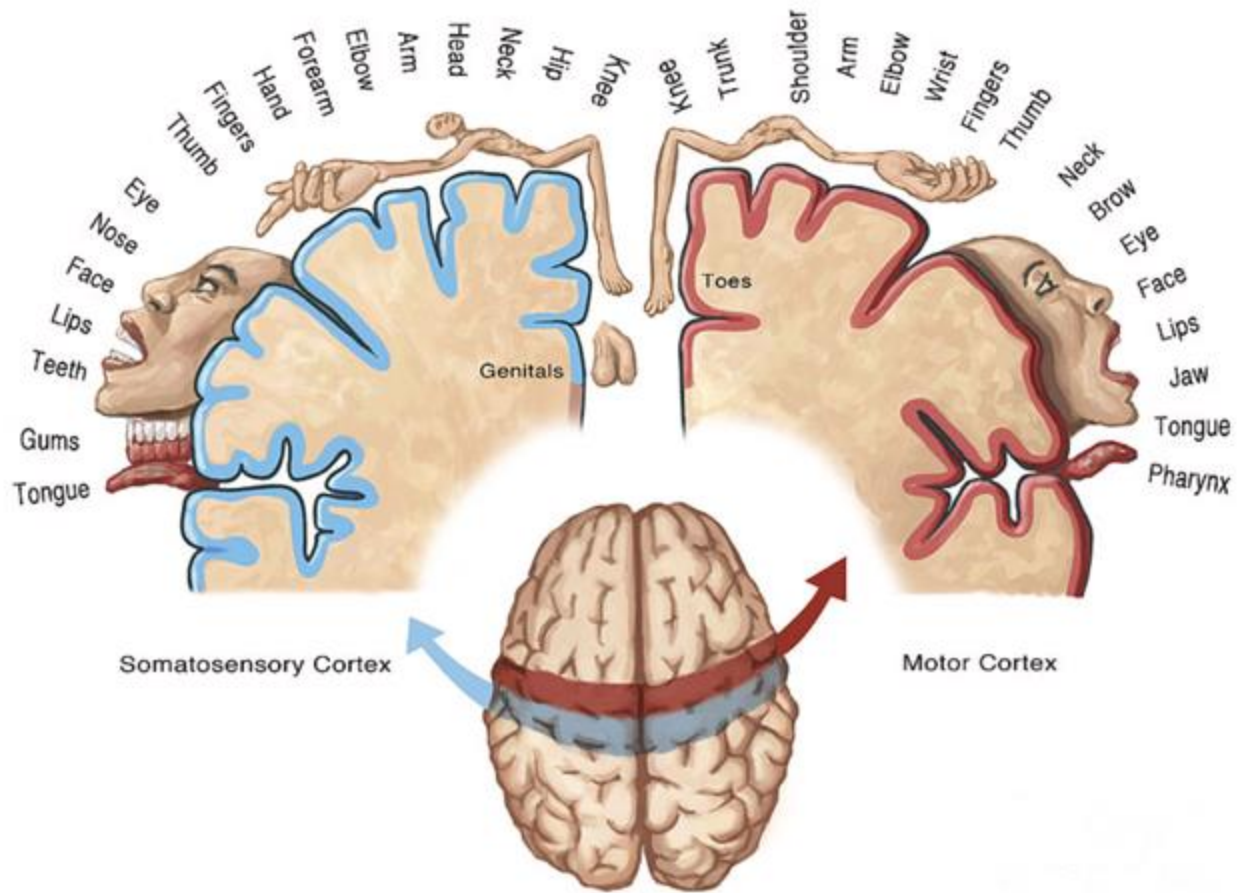
- 1 **Visual Area:**  
Sight  
Image recognition  
Image perception
- 2 **Association Area**  
Short-term memory  
Equilibrium  
Emotion
- 3 **Motor Function Area**  
Initiation of voluntary muscles
- 4 **Broca's Area**  
Muscles of speech
- 5 **Auditory Area**  
Hearing
- 6 **Emotional Area**  
Pain  
Hunger  
"Fight or flight" response
- 7 **Sensory Association Area**
- 8 **Olfactory Area**  
Smelling
- 9 **Sensory Area**  
Sensation from muscles and skin
- 10 **Somatosensory Association Area**  
Evaluation of weight, texture,  
temperature, etc. for object recognition
- 11 **Wernicke's Area**  
Written and spoken language comprehension
- 12 **Motor Function Area**  
Eye movement and orientation
- 13 **Higher Mental Functions**  
Concentration  
Planning  
Judgment  
Emotional expression  
Creativity  
Inhibition

## Functional Areas of the Cerebellum

- 14 **Motor Functions**  
Coordination of movement  
Balance and equilibrium  
Posture



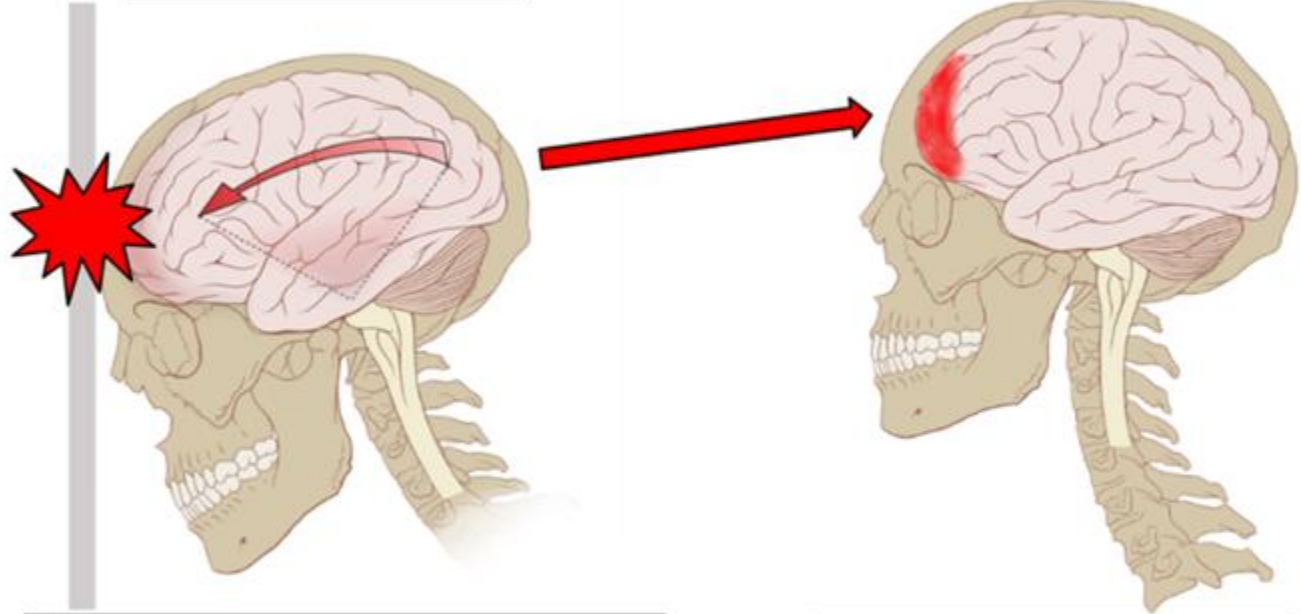




# Concussion

Concussion: A traumatic brain injury that changes the way your brain functions.

This can lead to bruising and swelling of the brain, tearing of blood vessels and injury to nerves, causing the concussion.

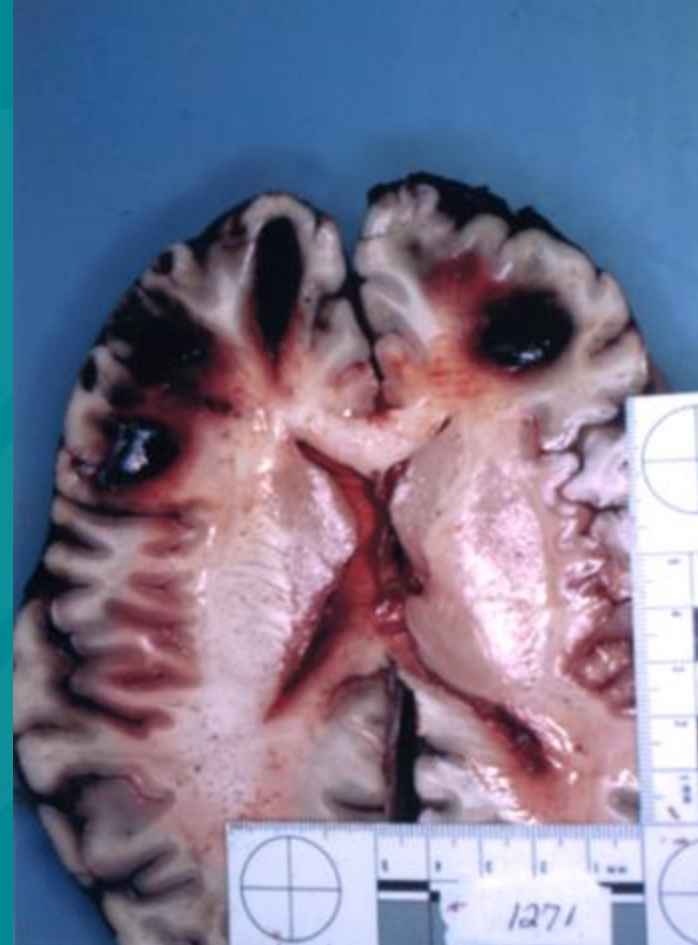


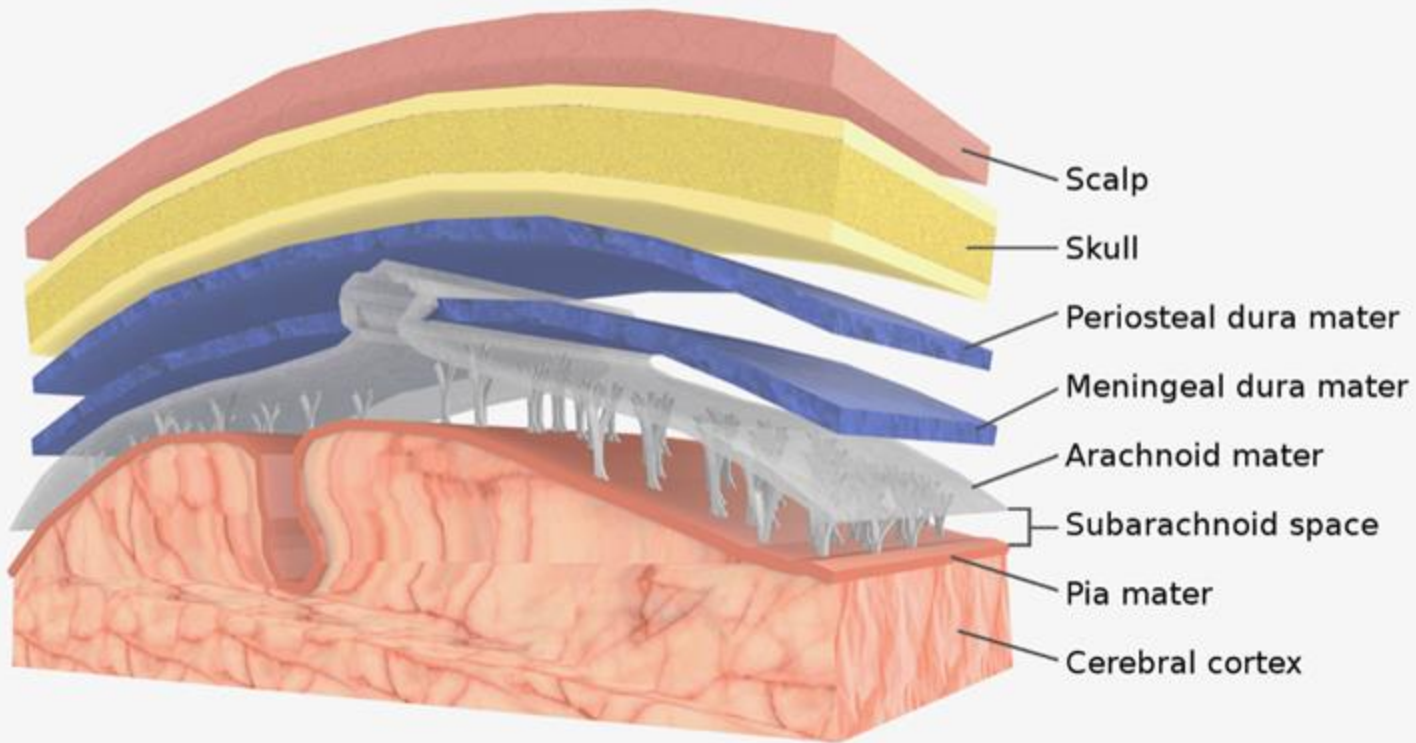
The brain is made up of soft tissue and is protected by blood and spinal fluid. When the skull is jolted too fast or is impacted by something, the brain shifts and hits against the skull.

Most concussions are mild and can be treated with appropriate care. But left untreated, it can be deadly.

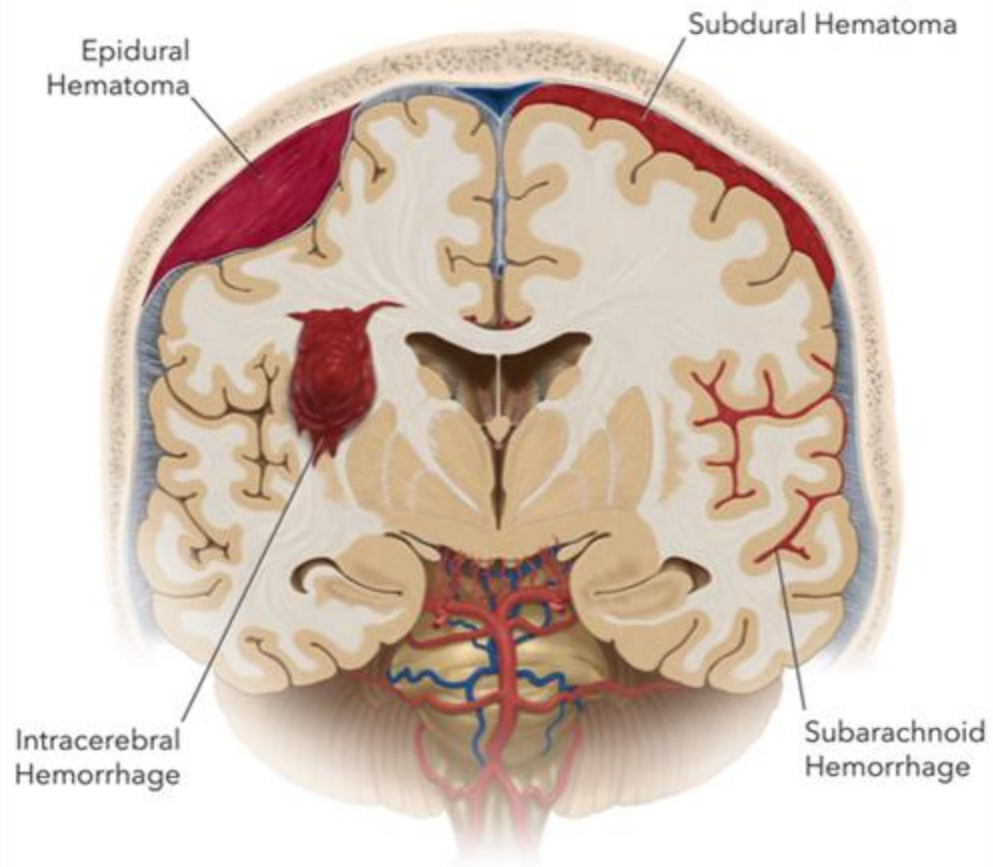
# Contusion

- More severe than a concussion
- Long lasting effects
- Can result in irreversible damage

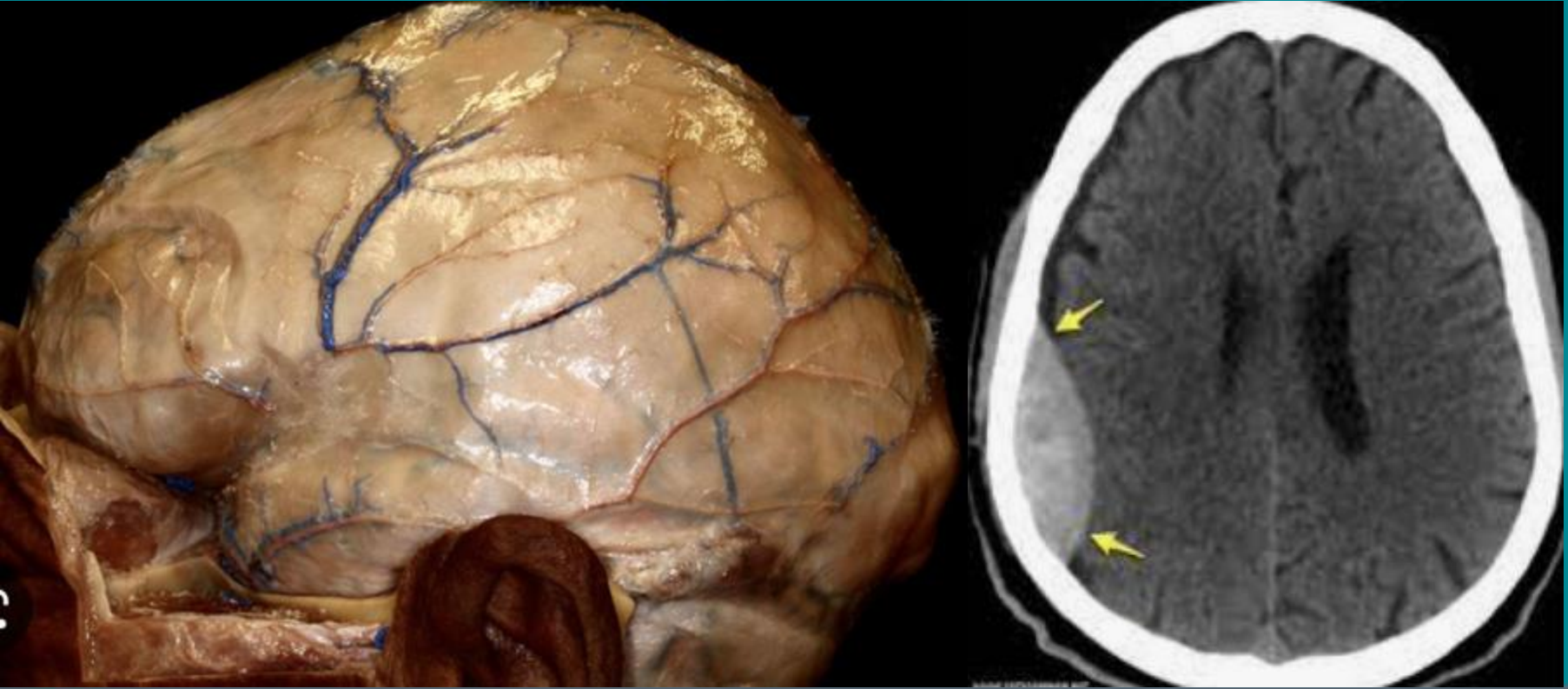




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# Epidural Hematoma



# Subdural Hematomas

- Common populations:
  - EtOH abuse
  - Geriatric
- Presenting symptoms:
  - Usually headache
  - Sometimes Focal/unilateral weakness

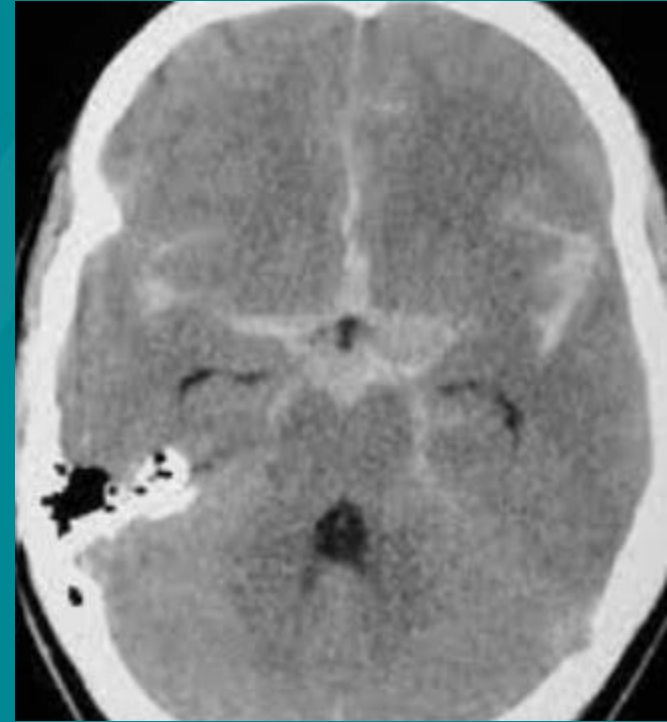
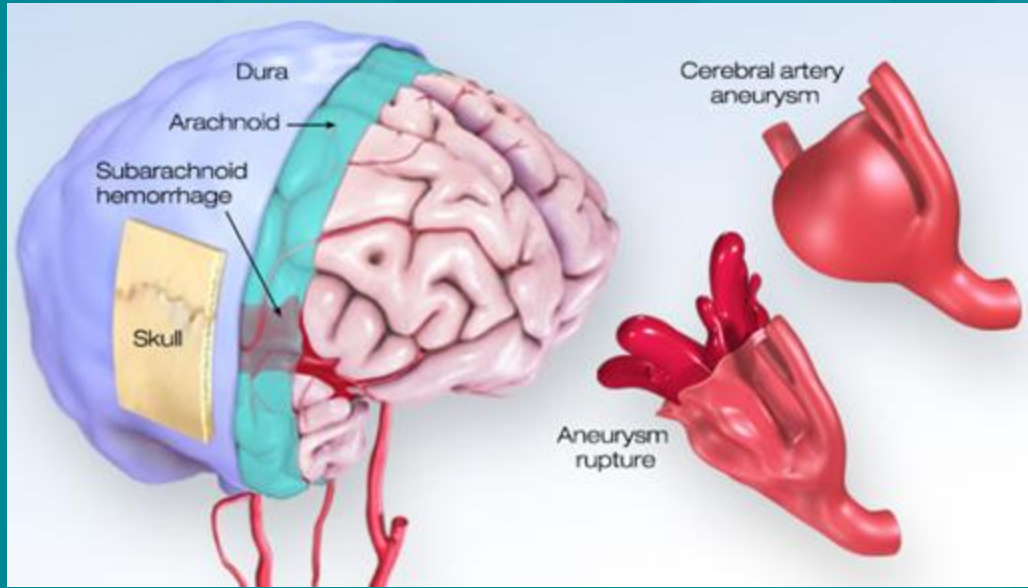


# Subdural Hematoma

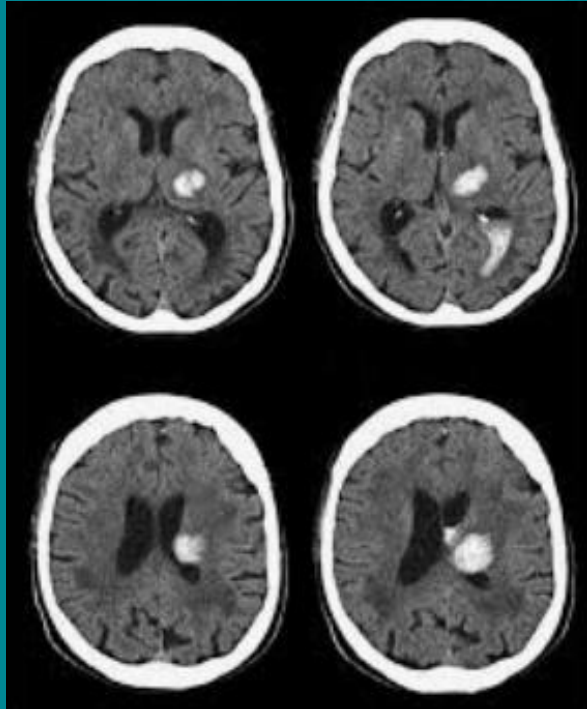




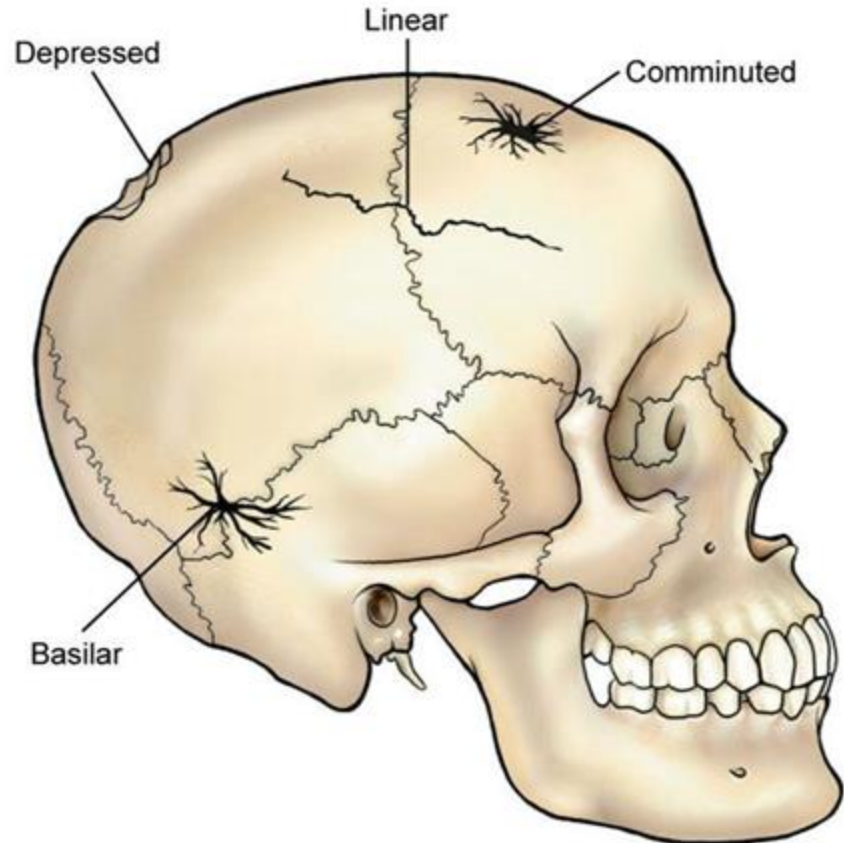
# Subarachnoid Hemorrhage



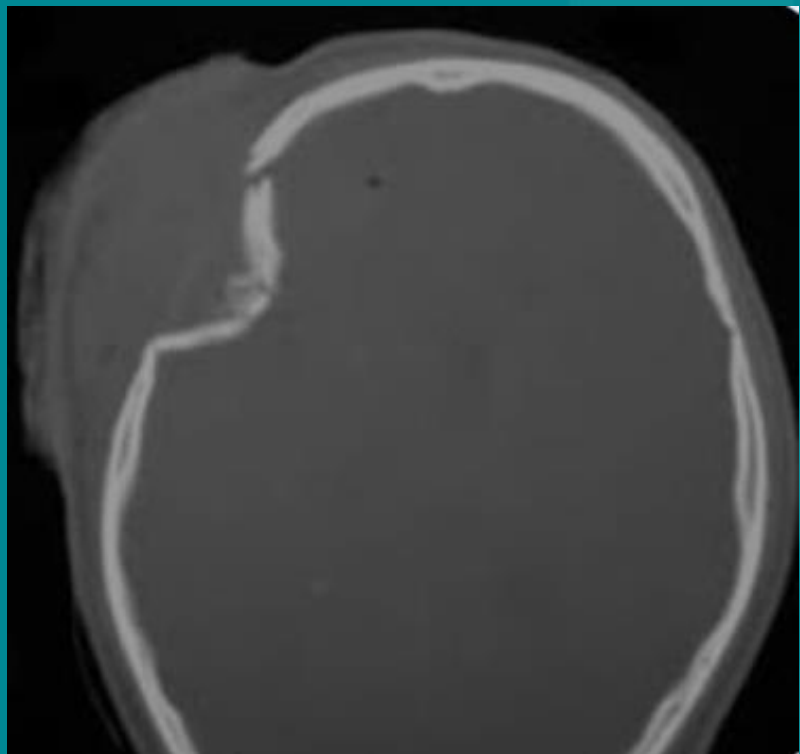
# Intraparenchymal w/ intraventricular extension



## Types of skull fractures



(From Monahan, F., & Neighbors, M. [1998]. *Medical-surgical nursing: Foundations for clinical practice* [2nd ed.]. Philadelphia: Saunders.)  
Fig. 56-26. Skull fractures.



## Base of skull fracture signs



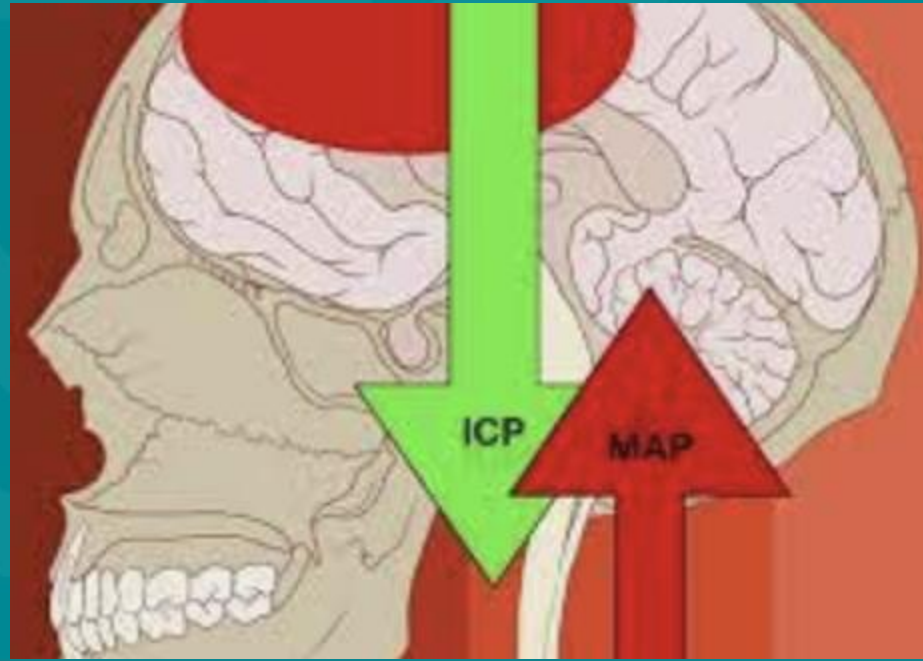
- a: raccoon eyes
- b: CSF rhinorrhea
- c: CSF otorrhea
- d: battle sign
- e: haemotympanum
- f: bump

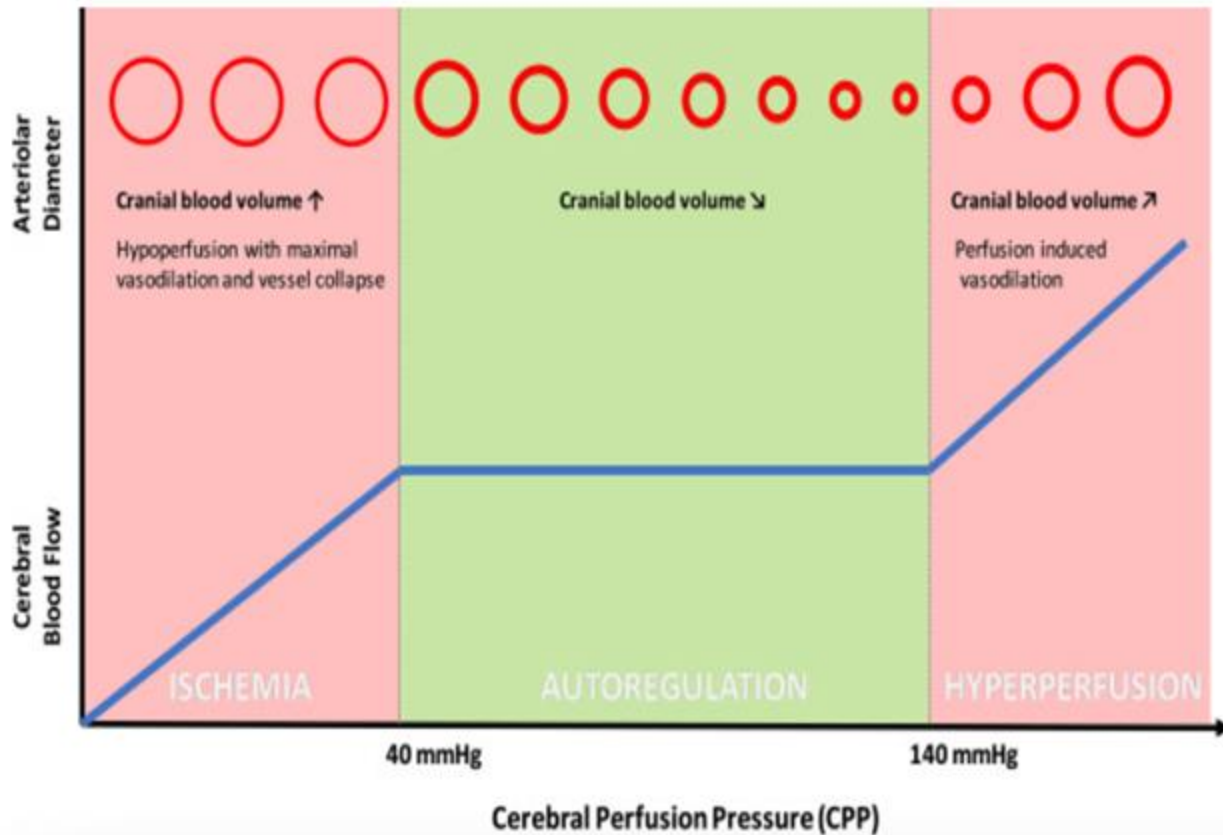
# ICP?



# CLOSED HEAD Injuries

- $(\frac{1}{3} \text{ SBP} - \text{DBP}) + \text{DBP} = \text{MAP}$
- $\text{MAP} - \text{ICP} = \text{CPP}$







# Traumatic Brain Injury

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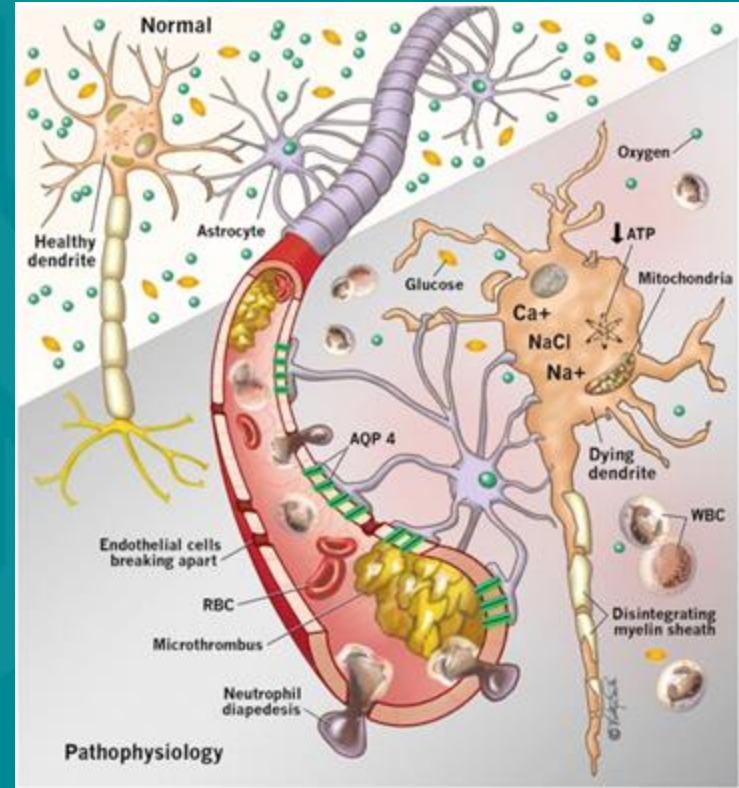
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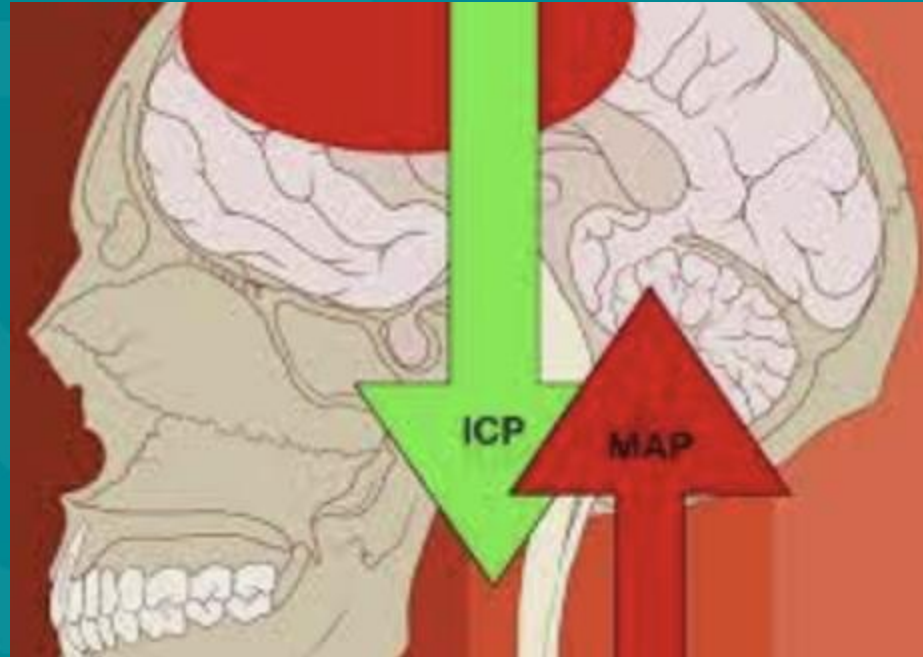
# Hypoxia: Secondary Brain injury

- $<90\% \text{ O}_2$
- Be aggressive in preventing hypoxia.
- Patients who have episode of hypoxia have nearly double the rates of morbidity and mortality.



# Hypotension: Secondary Brain Injury

- A single episode of hypotension can double to quadruple mortality rates.
- Systolic BP: <90 mmhg
- $(\frac{1}{3} \text{ SBP} - \text{DBP}) + \text{DBP} = \text{MAP}$
- $\text{MAP} - \text{ICP} = \text{CPP}$



# Assessment



# Glasgow Coma Scale

EYE OPENING	VERBAL RESPONSE	MOTOR RESPONSE
		
<i>Spontaneous</i> 4	<i>Oriented</i> 5	<i>Obeys commands</i> 6
<i>To sound</i> 3	<i>Confused</i> 4	<i>Localising</i> 5
<i>To pressure</i> 2	<i>Words</i> 3	<i>Withdrawal</i> 4
<i>None</i> 1	<i>Sounds</i> 2	<i>Abnormal flexion</i> 3
	<i>None</i> 1	<i>Extension</i> 2
		<i>None</i> 1

## Glasgow coma scale scoring

**Mild**  
13-15

**Moderate**  
9-12

**Severe**  
3-8

# Manifestations of Brain Injury

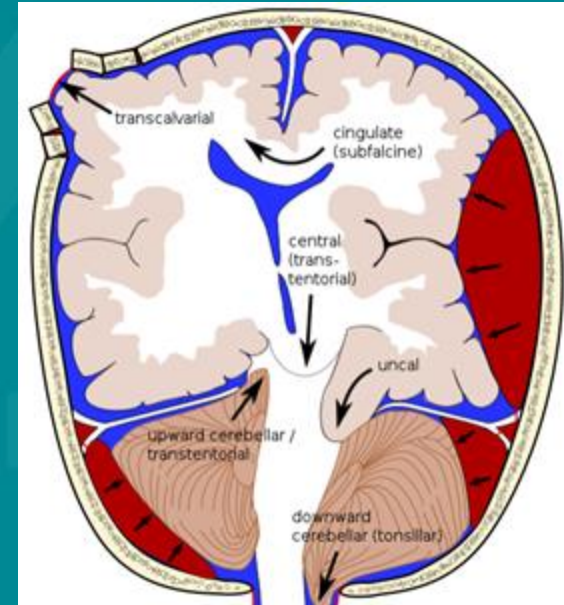
## Decorticate posturing



## Decerebrate posturing



# Pupils









# Case example

- Hit in the head with a bottle
- Large scalp laceration
- Bleeding “controlled” per EMS
- Initial scene vitals: 120/90, 110, 24  
95% RA
- Initial vitals in the ED: 80/40, 120, 22  
95% RA
- What happened here?

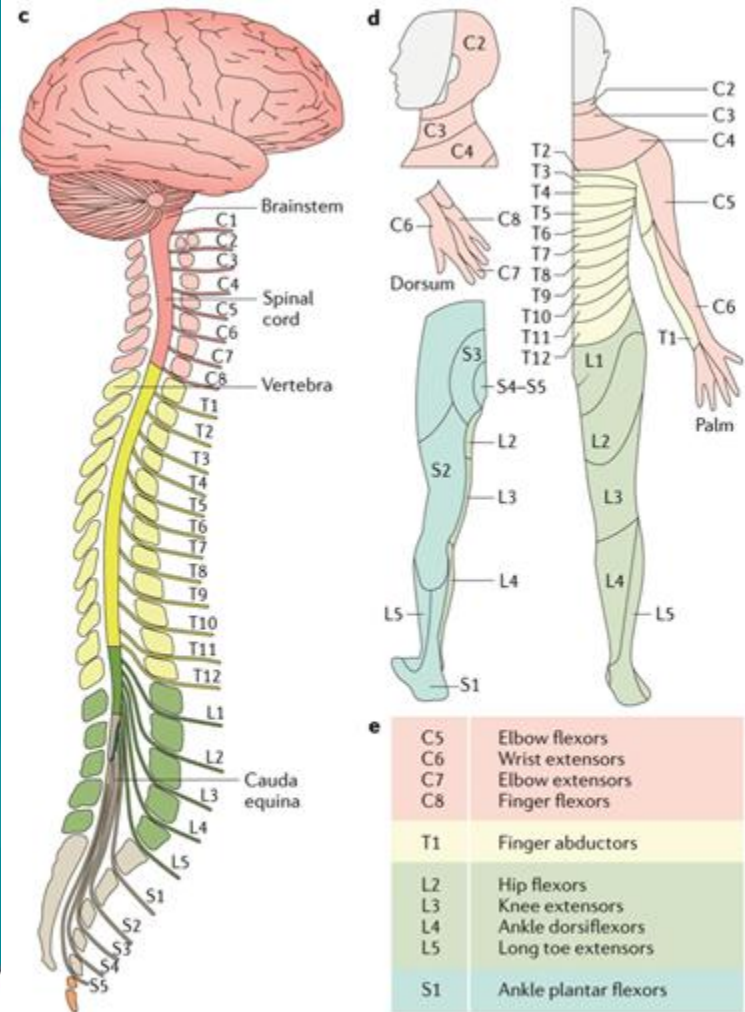


# Spine Trauma

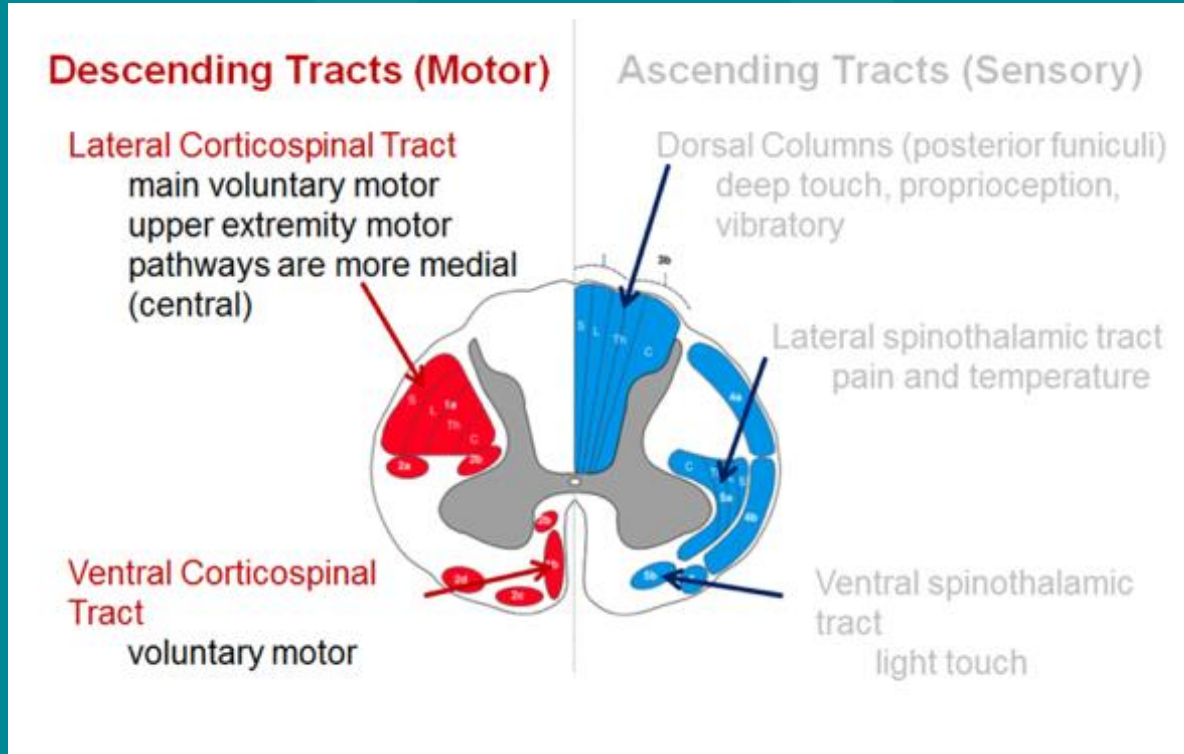
# Objectives

- Review the Anatomy of the spine and spinal cord
- Discuss common mechanisms of injury and types of injuries that result from them.
- Discuss treatment and stabilizations
- Review Distributive shock and management

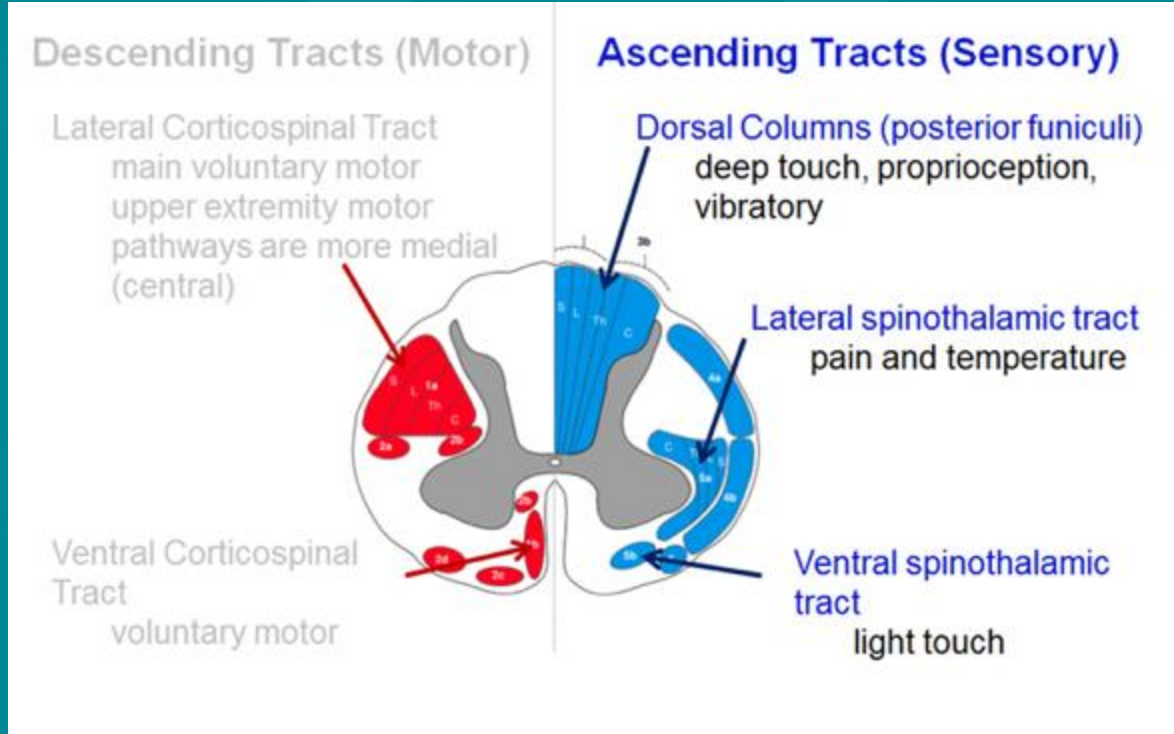
# Vertebral Anatomy



# Spinal Cord Anatomy

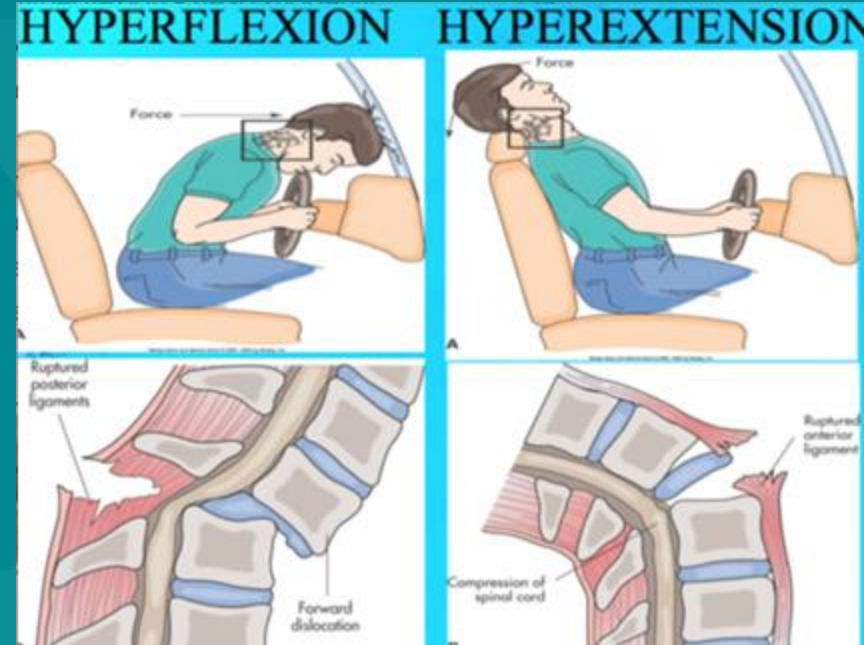


# Spinal Cord Anatomy



# Vertebral injuries

- Hyperflexion
- Hyperextension
- Penetrating
- Vertical compression
- Torsional/rotational
- Distraction





# Hyperflexion



# Hyperextension

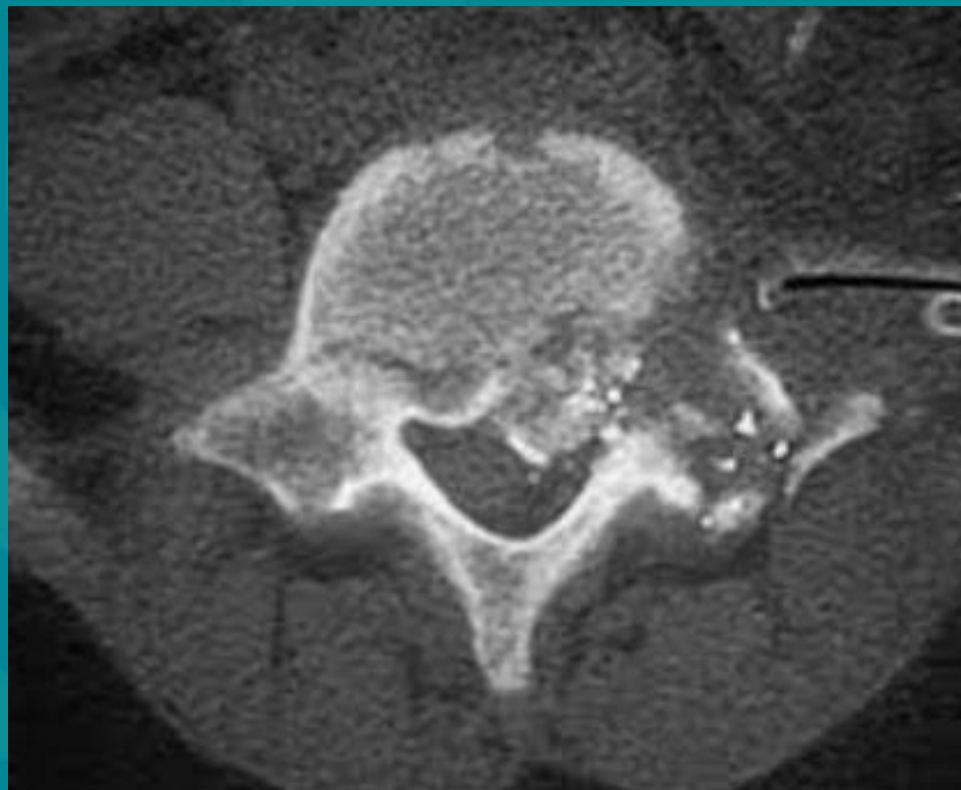
- Avulsion or tearing of anterior longitudinal spinal ligament.



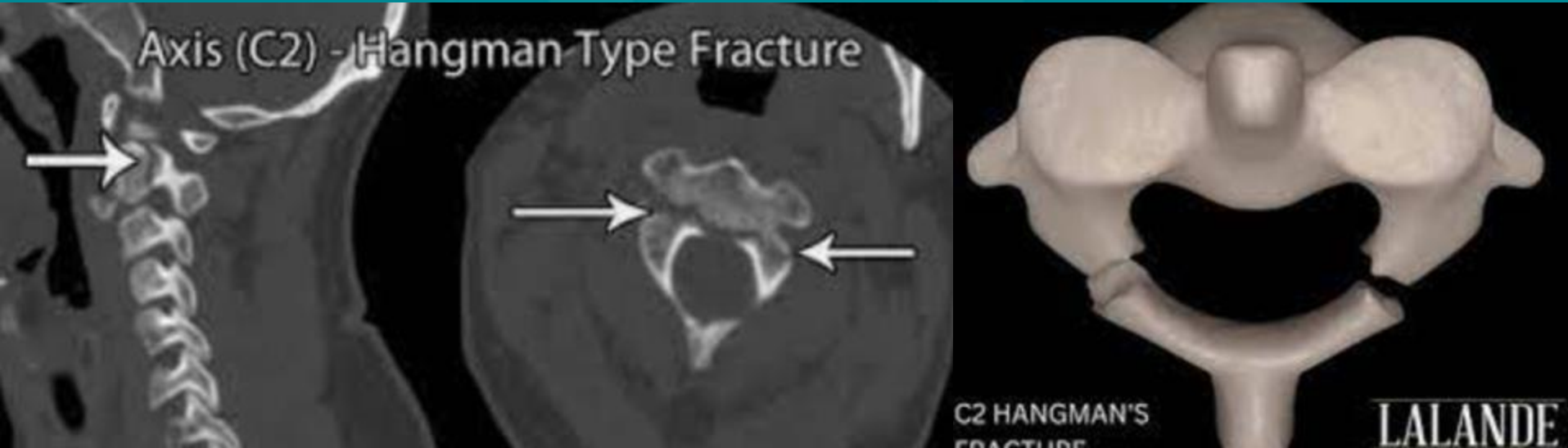
# Vertical



# Penetrating



# Distraction



# SCI (Spinal Cord Injury)

Primary



Secondary

Direct and final  
damage

Damage 2/2  
hypoperfusion,  
inflammation  
resulting in ischemia

## Descending Tracts (Motor)

### Lateral Corticospinal Tract

main voluntary motor  
upper extremity motor  
pathways are more medial  
(central)

### Ventral Corticospinal Tract

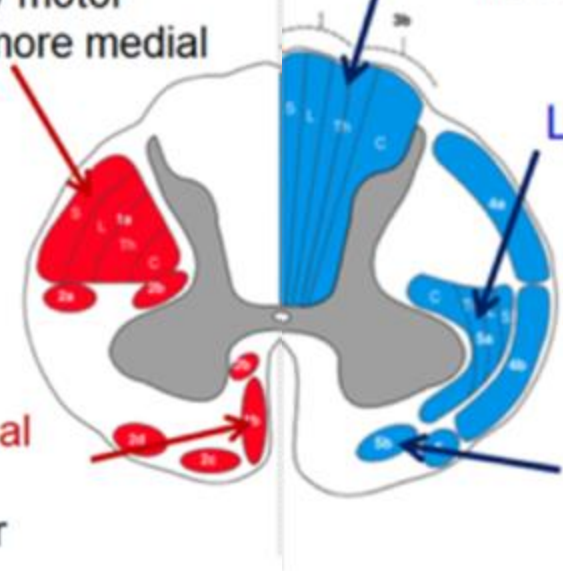
voluntary motor

## Ascending Tracts (Sensory)

Dorsal Columns (posterior funiculi)  
deep touch, proprioception,  
vibratory

Lateral spinothalamic tract  
pain and temperature

Ventral spinothalamic tract  
light touch



# Anterior Cord syndrome



Level of injury



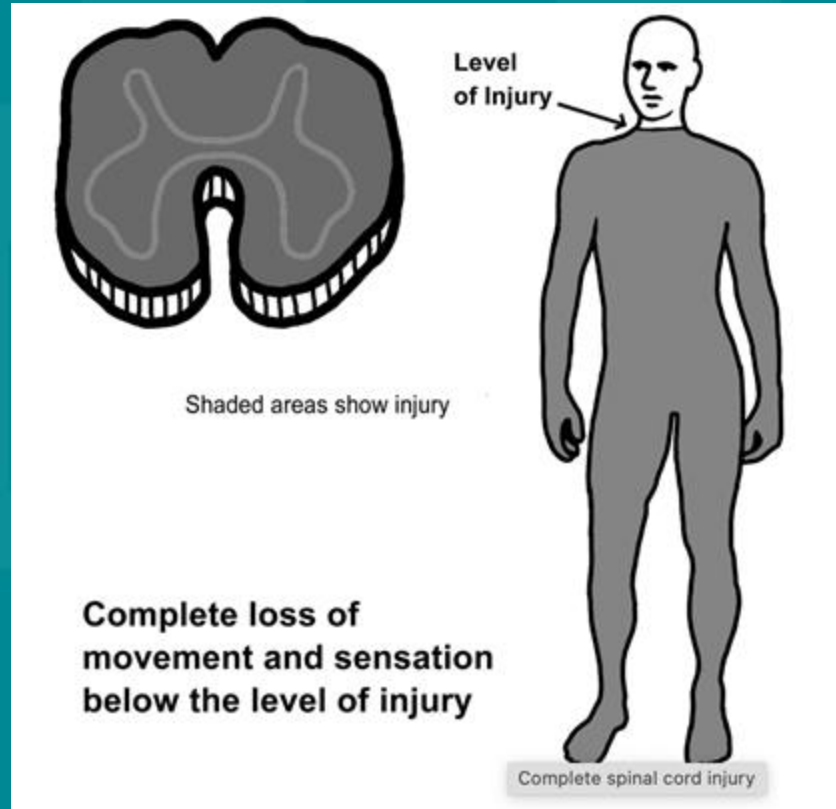
Shaded areas show injury

**Loss of movement, pain,  
and temperature**

**Still able to feel position,  
vibration, and touch**

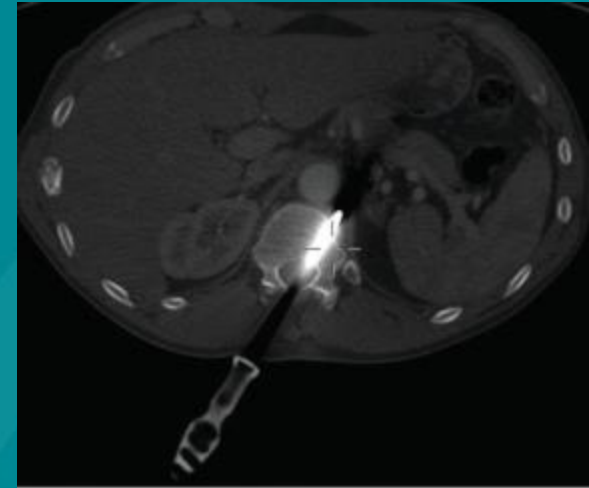
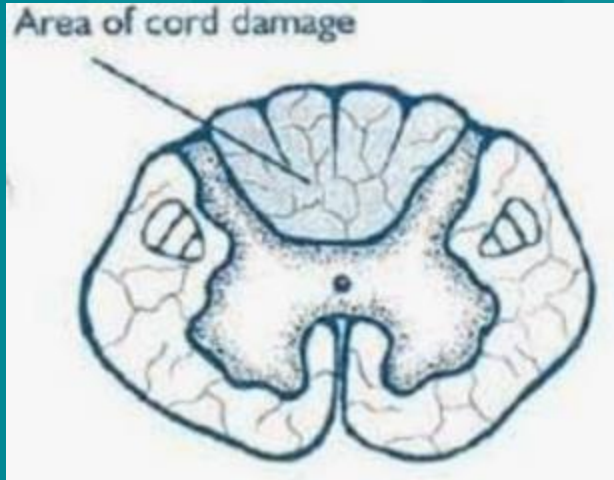


# Complete cord injury



# Posterior Cord syndrome

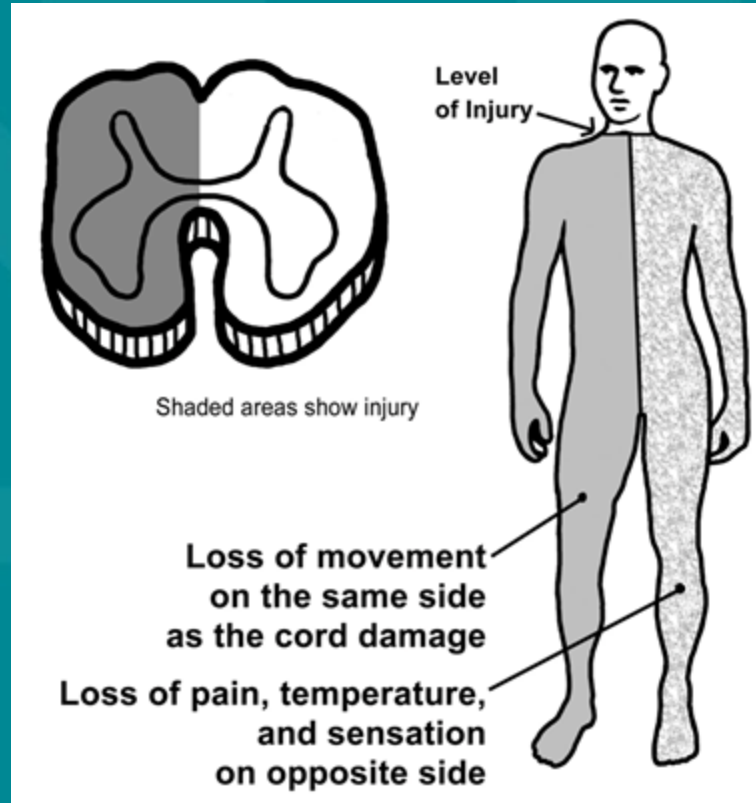
- Loss of pressure, light touch and proprioception.



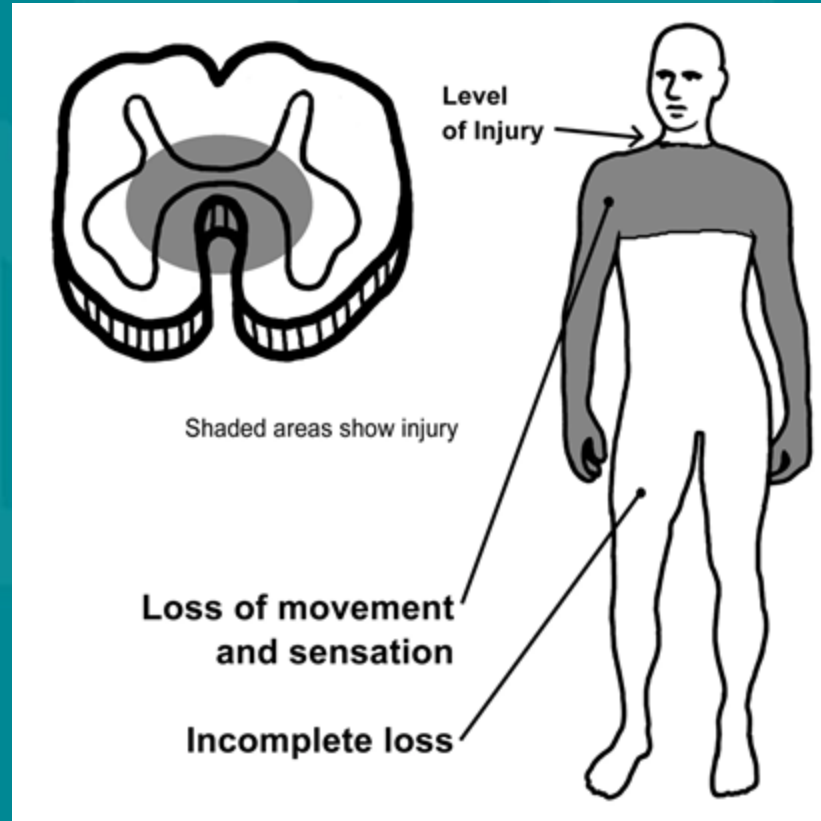
(a)



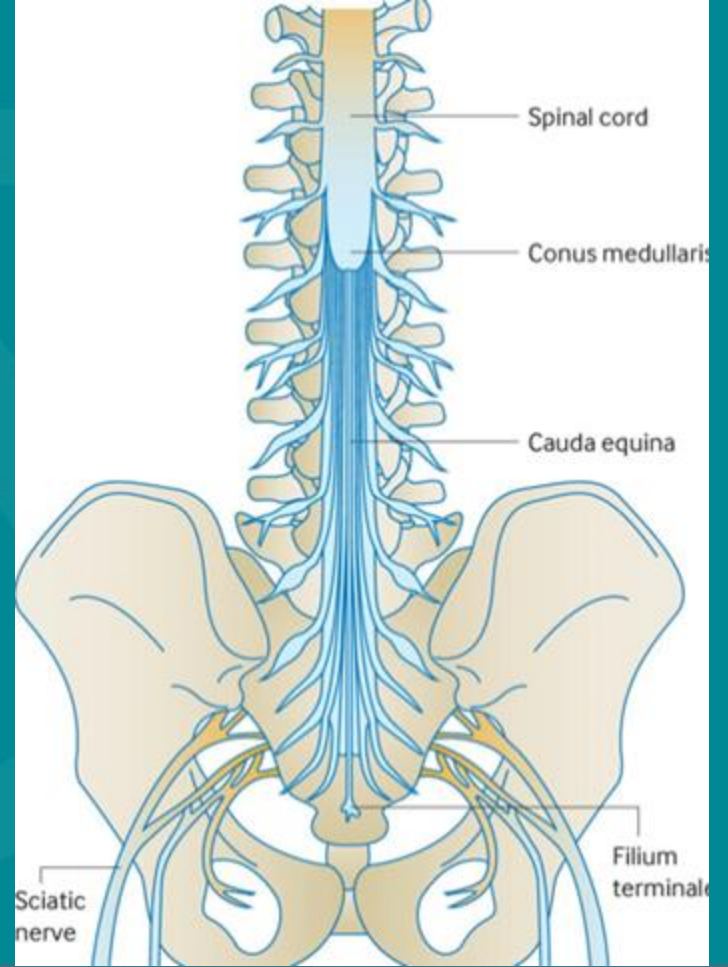
# Brown Sequard syndrome



# Central cord syndrome



# Cauda Equina



# Cauda Equina

- Urinary retention
- Fecal incontinence
- Saddle anesthesia
- Lower extremity weakness and numbness



# Assessment

Document the estimated level of injury

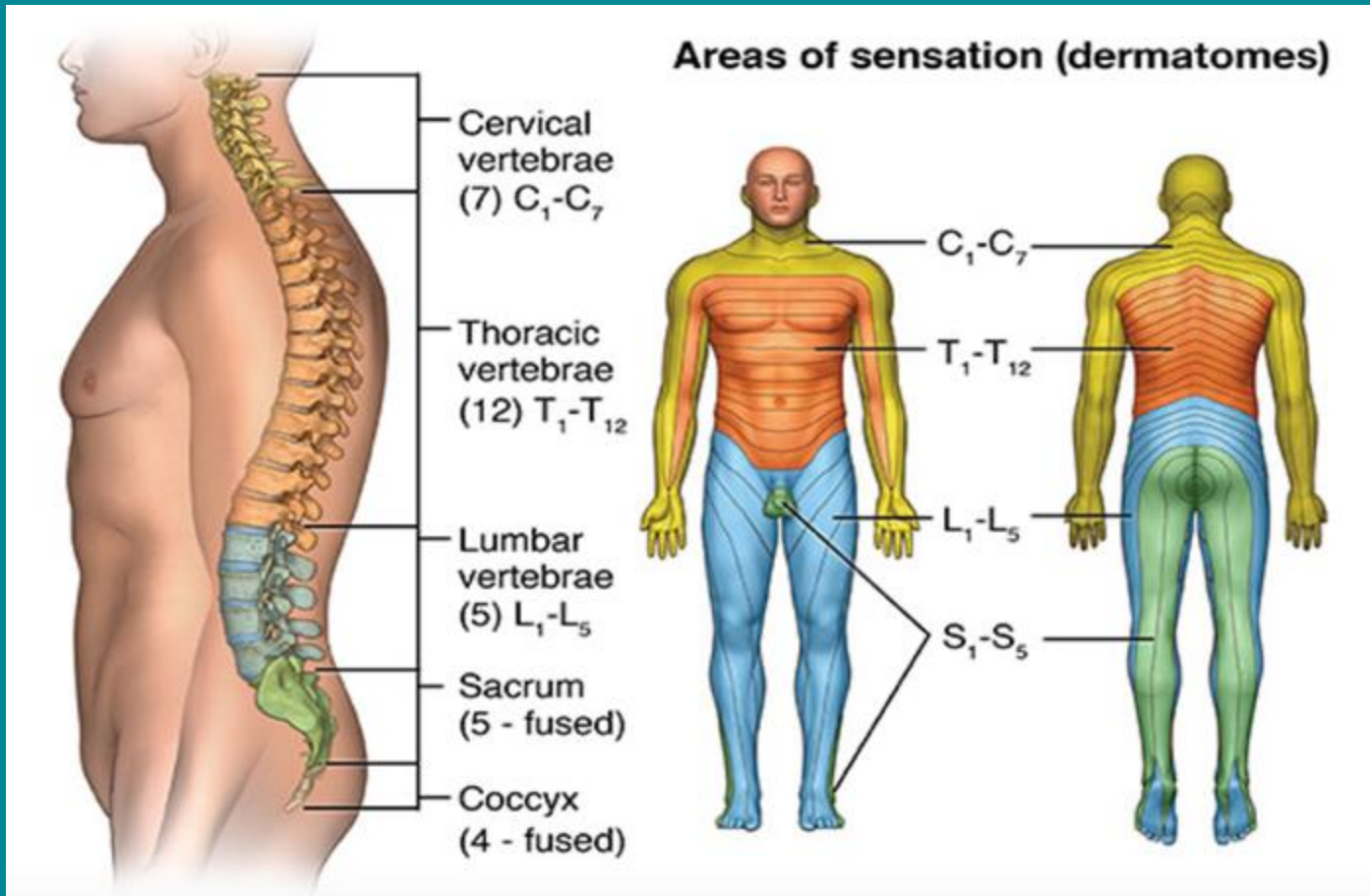
Document noted deficits and monitor for progression

Stabilize manually and apply cervical collar.

Rapid transport

Keep warm

Watch for spinal shock.





# Questions

1. What is the difference between primary and secondary brain injury?
2. What effect does hypotension and hypoxia have on mortality risk in TBI?
3. List the Goal(s) of treatment of severe TBI
4. How does Mannitol and hypertonic saline decrease brain swelling?
5. When administering hypertonic saline should you administer the medication quickly rapid IV push? Slow IV push or infusion? Why?