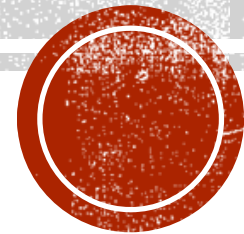


CNS LECTURE 3

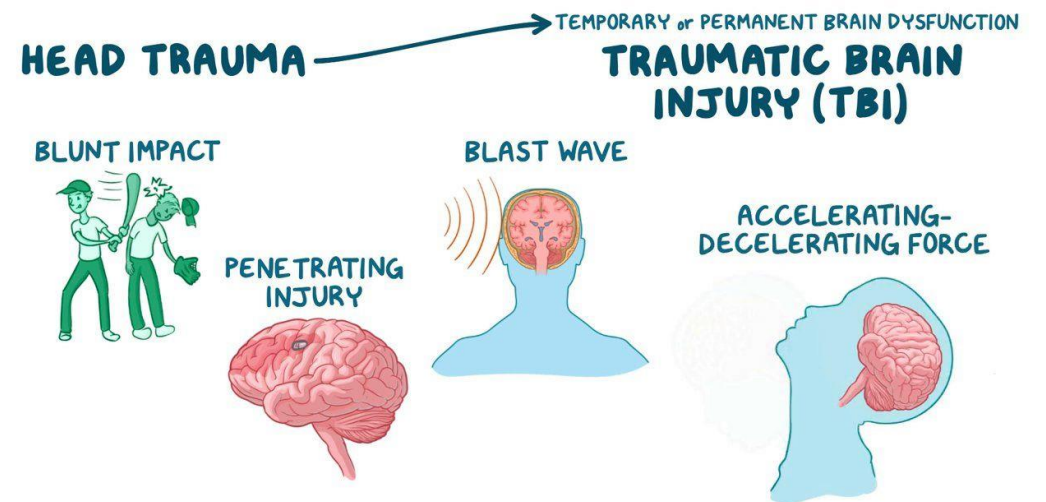
CENTRAL NERVOUS SYSTEM (CNS) TRAUMA

Dr. Dua Abuquteish



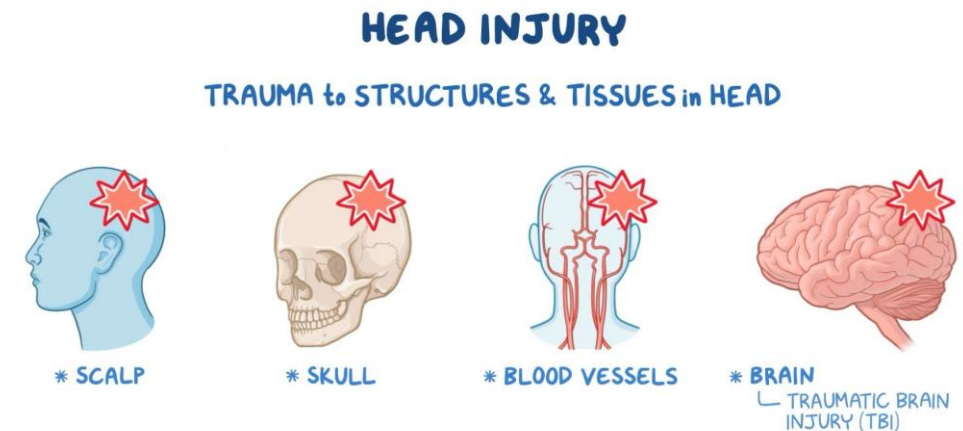
CENTRAL NERVOUS SYSTEM (CNS) TRAUMA

- The severity and site of injury affect the outcome: may be clinically silent (if in the frontal lobe), severely disabling (affecting the spinal cord), or fatal (involving the brain stem).
- Penetrating or blunt injury, shape of the object causing the trauma, the force of impact, and whether the head is in motion at the time of injury.



CENTRAL NERVOUS SYSTEM (CNS) TRAUMA

- Severe brain damage can occur in the absence of external signs of head injury, and conversely, severe lacerations and even skull fractures do not necessarily indicate damage to the underlying brain.
- Injuries may involve the **parenchyma**, the **vasculature**, or both



TRAUMATIC PARENCHYMAL INJURIES

CONCUSSION

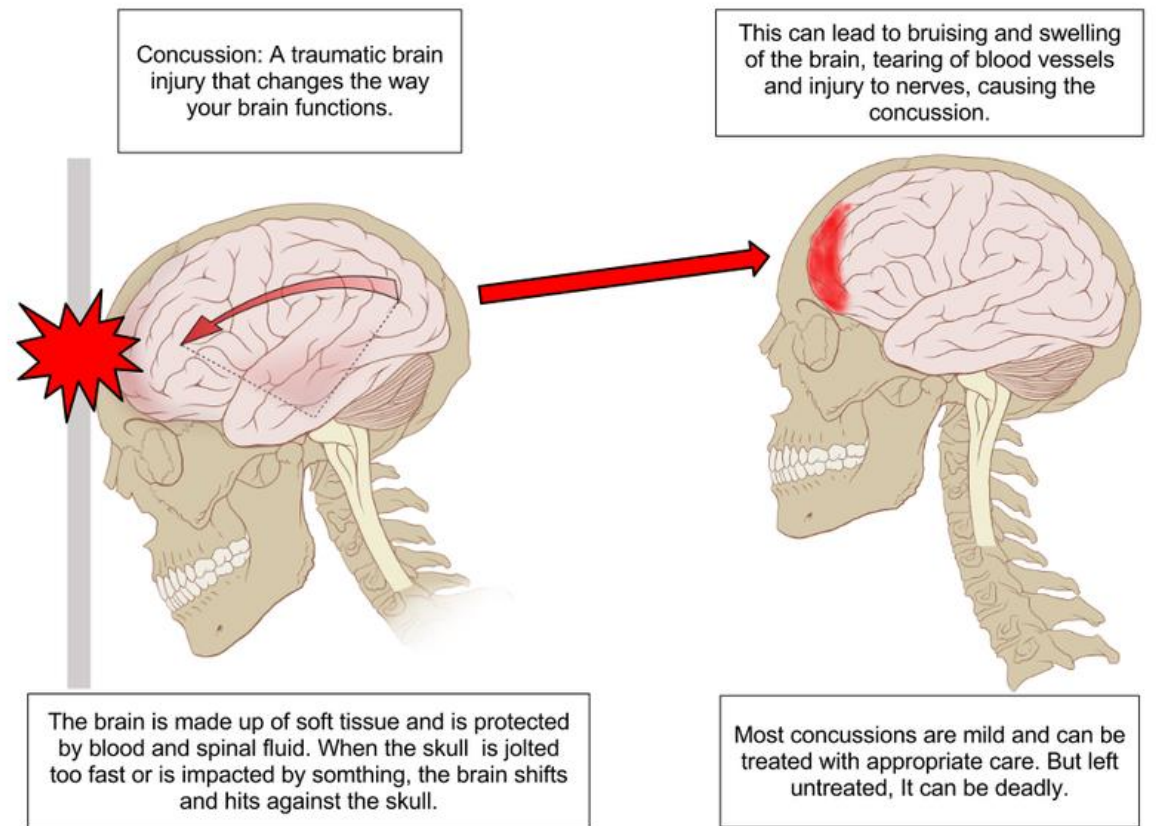
Concussion describes reversible altered brain function, with or without loss of consciousness, from head injury.

Two types of injury:

1. Coup-Contrecoup

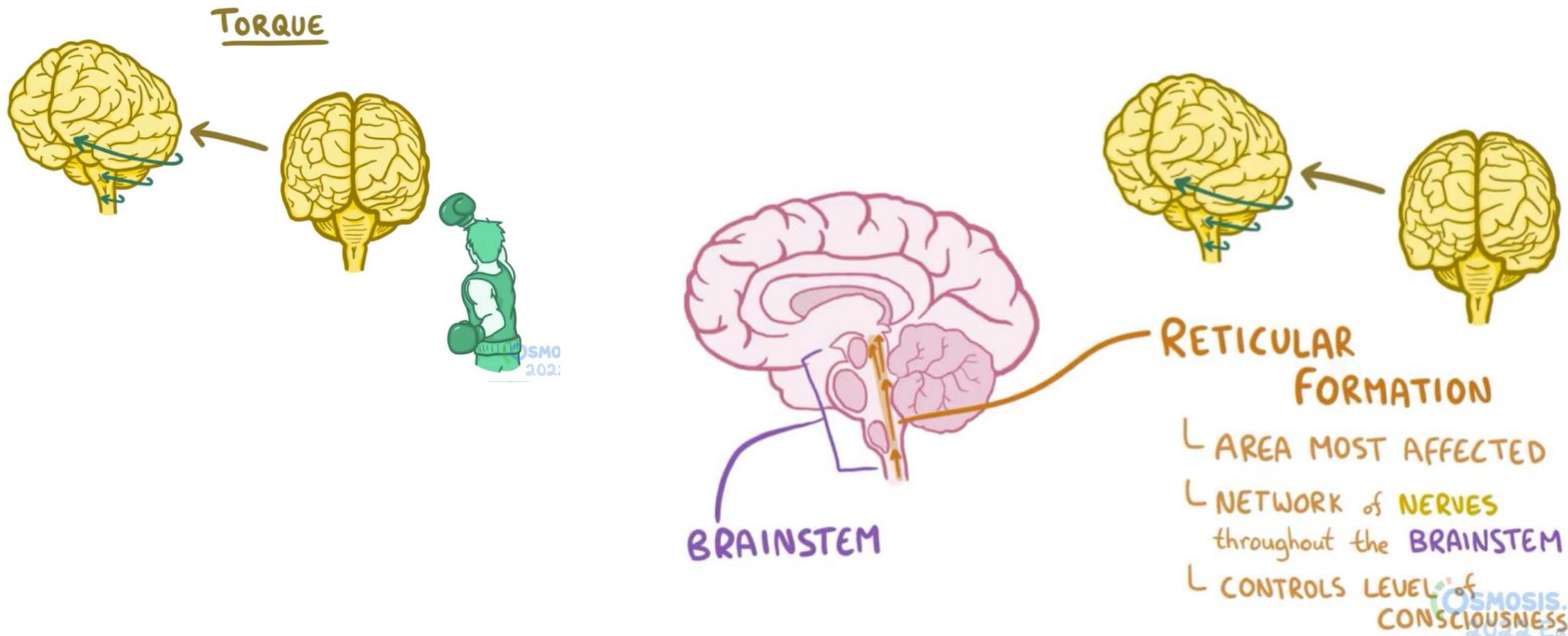
2. Torque

(more severe with loss of consciousness)

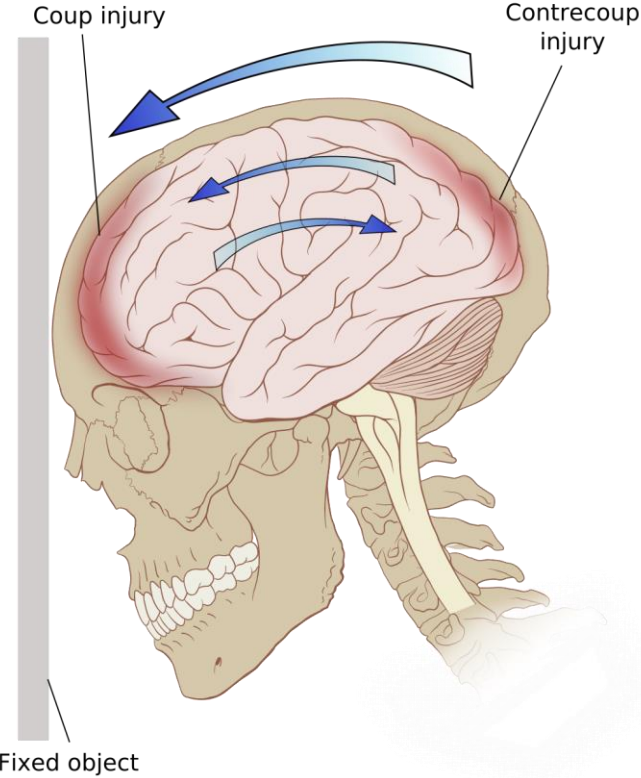
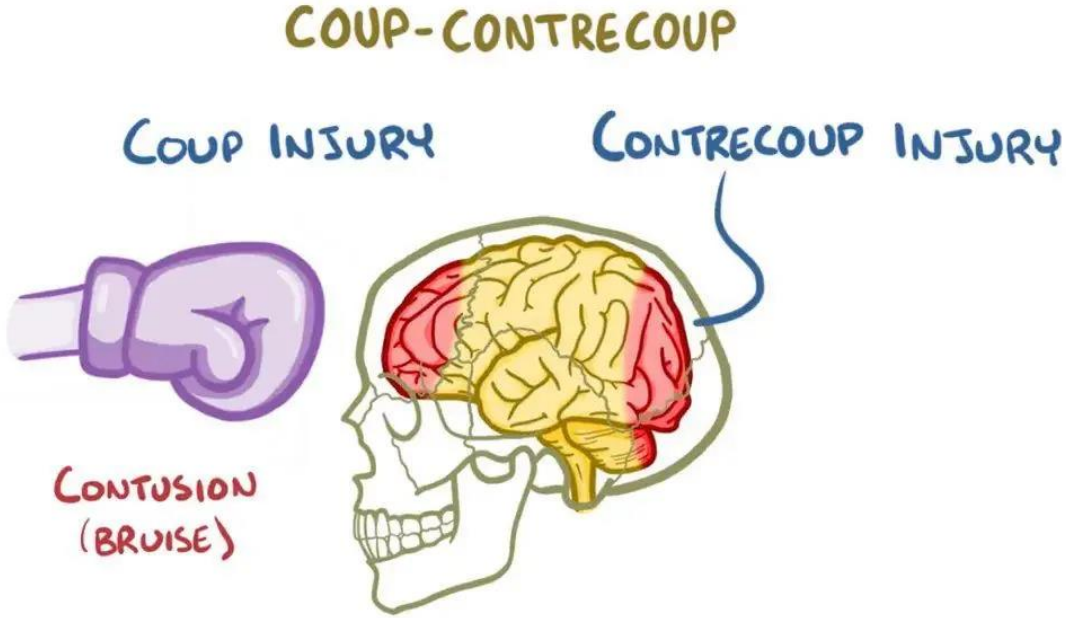


TRAUMATIC PARENCHYMAL INJURIES

CONCUSSION - TORQUE



TRAUMATIC PARENCHYMAL INJURIES



TRAUMATIC PARENCHYMAL INJURIES

CONCUSSION

- Usually a hit to the head causing diffuse brain injury
- No obvious brain trauma on imaging (normal CT scan)
- Damage is usually microscopic - at the level of the neurons
- **Most likely injuries:** motor vehicle accidents, falling down stairs, recreational activities, and violence
- **Symptoms** include confusion, memory loss, and loss of consciousness. Followed by headache, nausea/vomiting, and dizziness.
- **Treatment:** rest and ensure complete recovery



TRAUMATIC PARENCHYMAL INJURIES

COUP-CONTRECOUP

- When an object impacts the head, brain injury may occur at the site of impact—a **coup injury**
- Or opposite the site of impact on the other side of the brain—a **contrecoup injury**.
- Both coup and contrecoup lesions are contusions
- A contusion is caused by rapid tissue displacement, disruption of vascular channels, and subsequent hemorrhage, tissue injury, and edema.
- Contusions are common in the orbitofrontal regions and the temporal lobe tips





The characteristic location of the **dark red-black hemorrhage over the anterior inferior surface of this brain** is consistent with a **fall backwards resulting in a contracoup injury** to the inferior frontal and temporal lobes.

This has resulted in extensive contusions and subarachnoid hemorrhage.





A coronal section through the frontal lobes reveals extensive contusions involving the inferior gyri.

This was a contracoup injury from a fall in the bathtub by an elderly person.

Where is an external contusion (bruise) most likely to be seen in this case?

- A Vertex
- B Forehead
- C Right side
- D Left side
- E Occiput



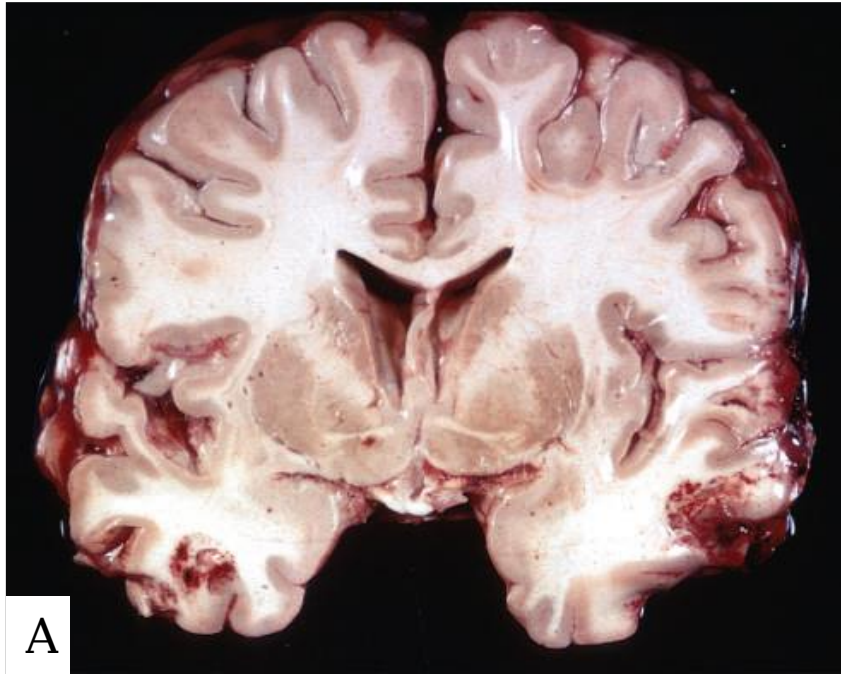
TRAUMATIC PARENCHYMAL INJURIES

CONTUSIONS

- **Contusions** are wedge-shaped, with the widest aspect closest to the point of impact
- First few hours of injury , blood extravasates throughout the involved tissue, across the cerebral cortex, the white matter and subarachnoid spaces.
- Morphological evidence of neuronal injury (nuclear pyknosis, and cytoplasmic eosinophilia) takes about 24 hours to appear.
- The inflammatory response occurs, with neutrophils, then macrophages.
- Old traumatic lesions are depressed, yellowish-brown patches, and show gliosis and residual hemosiderin-laden macrophages.



TRAUMATIC PARENCHYMAL INJURIES



Cerebral trauma. (A) Acute contusions are present in both temporal lobes, with areas of hemorrhage and tissue disruption.

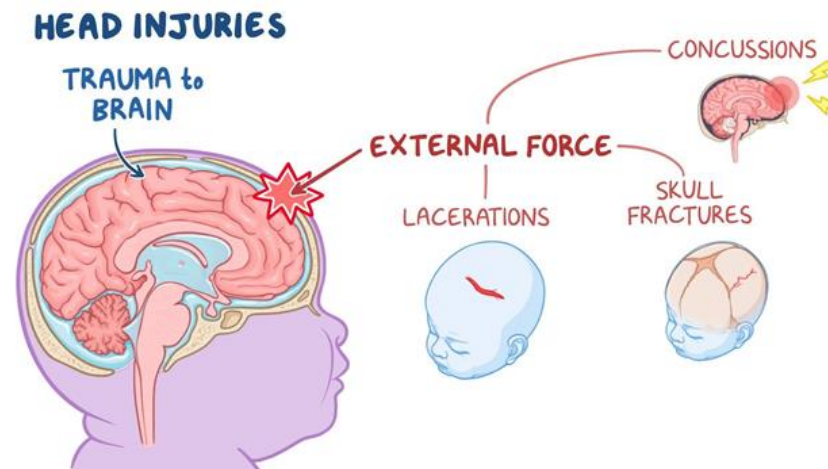


(B) Remote contusions, seen as discolored yellow areas, are present on the inferior frontal surface of this brain.



TRAUMATIC PARENCHYMAL INJURIES

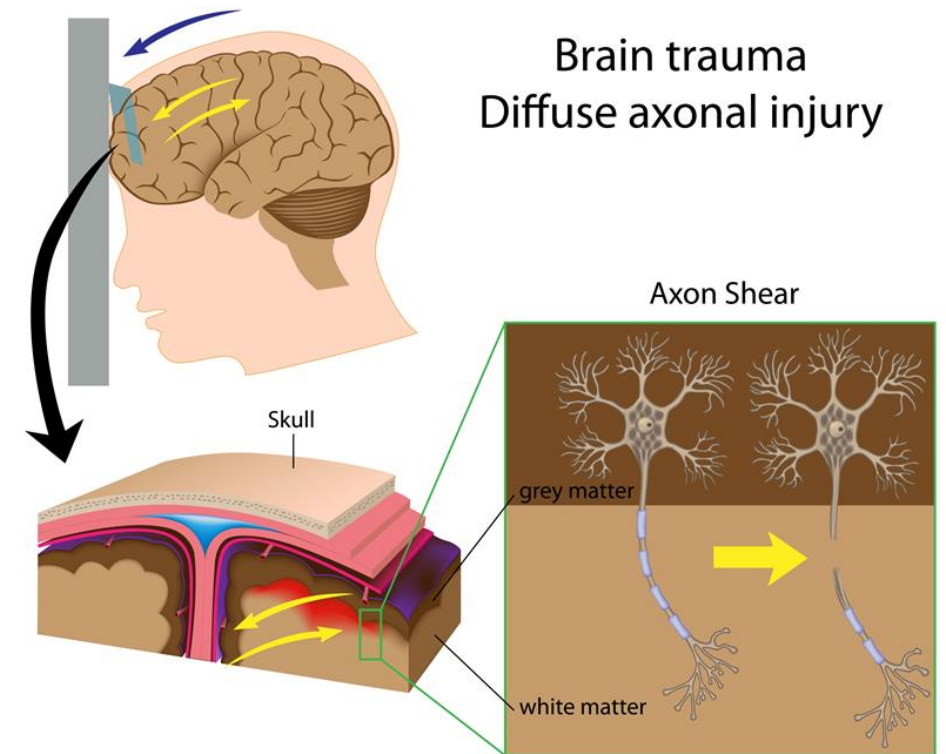
- Penetration of the brain by a projectile such as a bullet or a skull fragment from a fracture causes a laceration, with tissue tearing, vascular disruption, and hemorrhage.



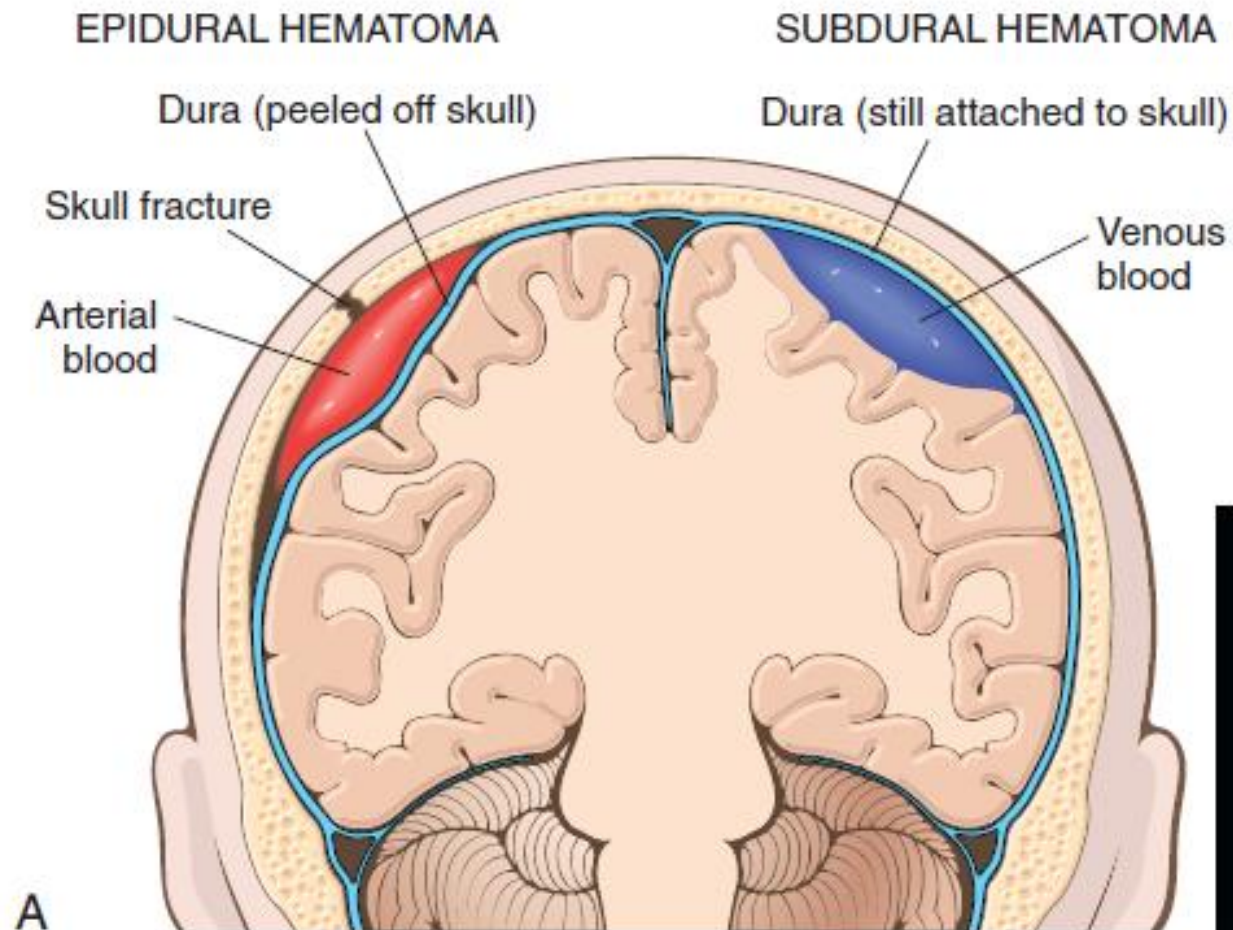
TRAUMATIC PARENCHYMAL INJURIES

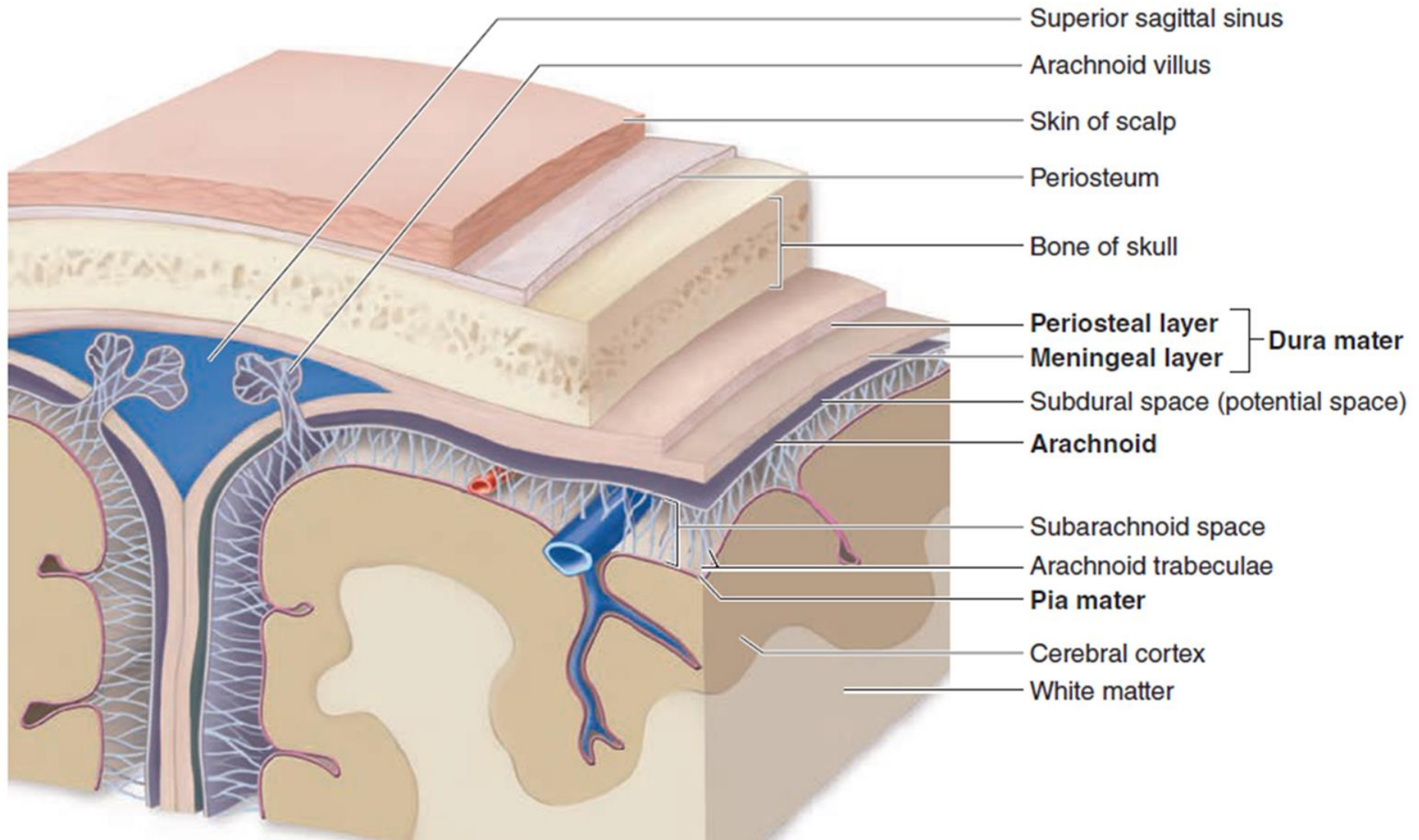
DIFFUSE AXONAL INJURY

- Rapid displacement of the head and brain can tear axons
- Severe, irreversible neurologic deficits.
- As many as **50% of patients who develop coma** shortly after trauma are believed to have white matter damage and diffuse axonal injury.
- Affect deep white matter
- Microscopy: axonal swelling



TRAUMATIC VASCULAR INJURY





EPIDURAL HEMATOMA

- Usually acute & accompanied by skull fracture
- Rupture of **middle meningeal artery**
- Once a vessel tears, blood accumulates under arterial pressure and dissects the tightly applied dura away from the inner skull surface producing a hematoma that compresses the brain surface

Clinically :

- When blood accumulates slowly: Patient has a short LUCID interval followed by rapid loss of consciousness
- May expand rapidly leading to a Neurologic emergency



CAUSE

* HEAD TRAUMA

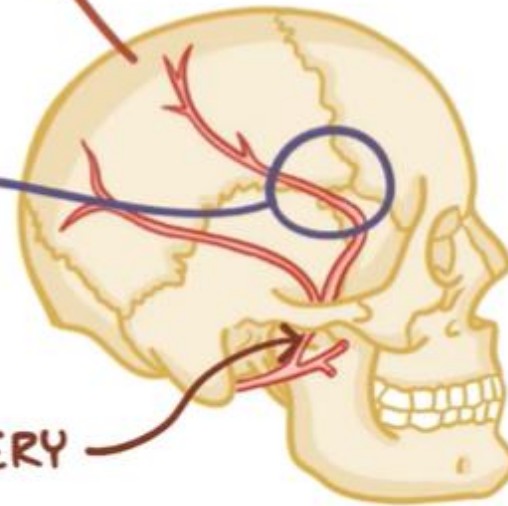


* **MENINGEAL ARTERIES**

- ↳ PROTECTED by the SKULL
- ↳ DAMAGED by SERIOUS HEAD TRAUMA

↳ USUALLY at the **PTERION**

- ~ THIN
- ~ ABOVE MIDDLE MENINGEAL ARTERY



FRONTAL
PARIETAL
TEMPORAL
SPHENOID

bones
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2023 Edition



EPIDURAL HEMORRHAGE

ABOVE

DURA MATER

BLEEDING

* CAUSED BY HEAD TRAUMA

↳ COMMONLY at the PTERION

↳ ABOVE MENINGEAL ARTERY



* SLOW FORMING

↳ LUCID INTERVAL

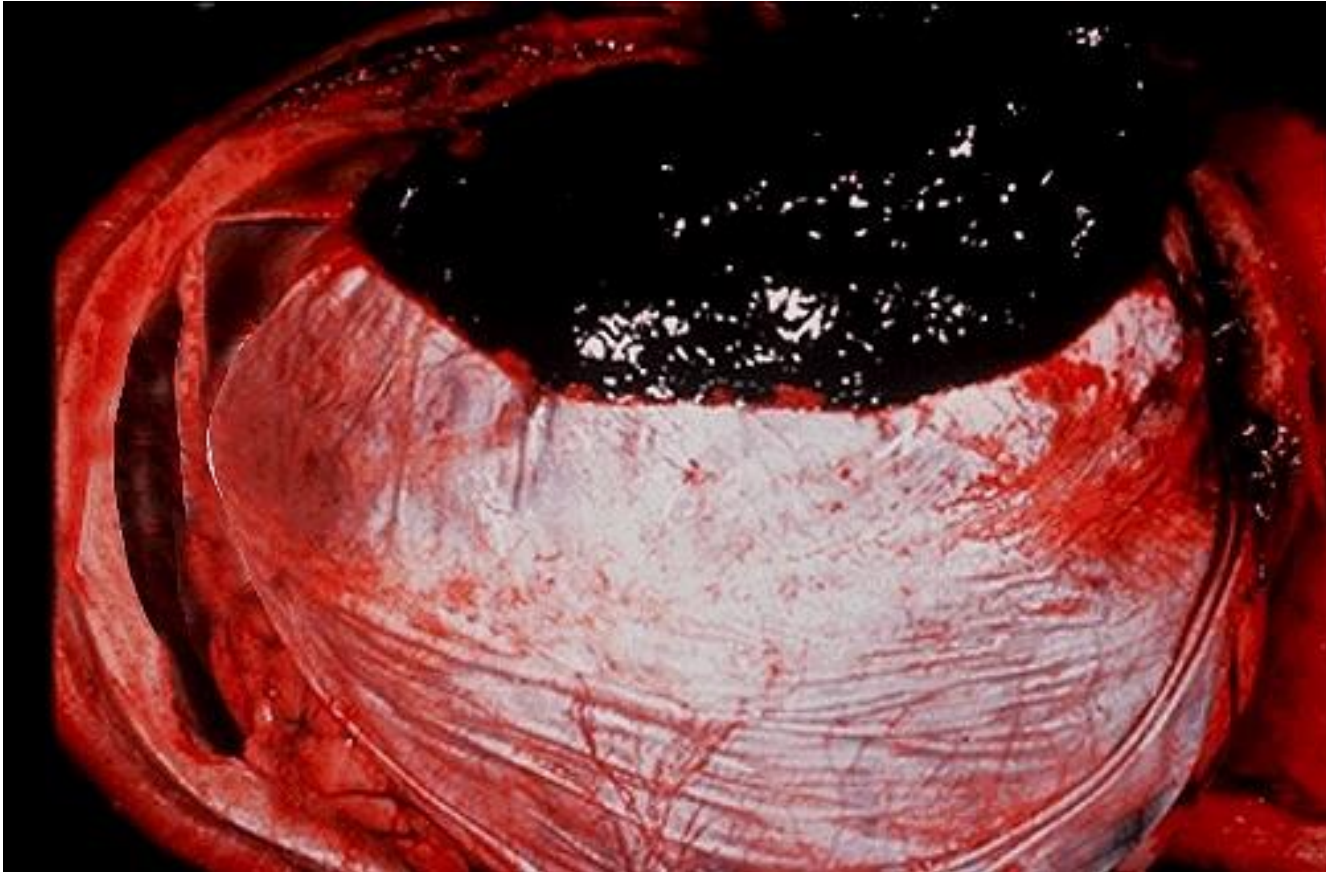
* CT SCAN

↳ DON'T CROSS SUTURES

↳ BICONVEX



EPIDURAL HEMATOMA



A blood clot is seen over the external surface of the dura within the cranial cavity after removing the top of the skull at autopsy.

Is always the result of trauma.

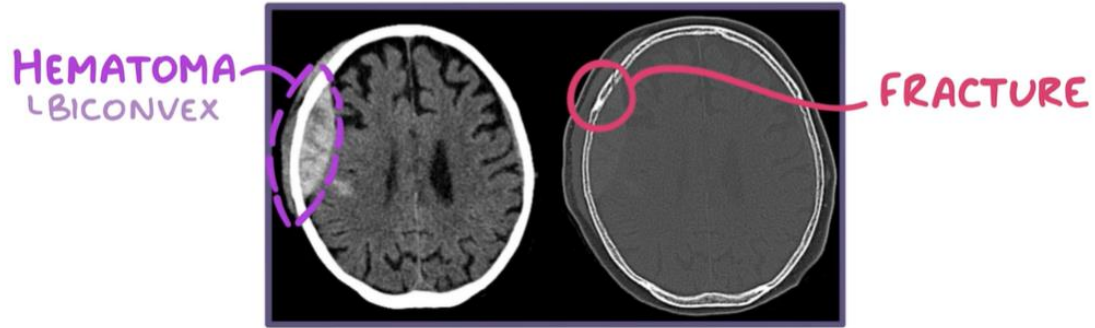
A tear in the **middle meningeal artery**, is the most likely source.

The arterial source means that the bleeding is brisk and blood collects quickly, leading to neurologic signs and symptoms within minutes to hours.

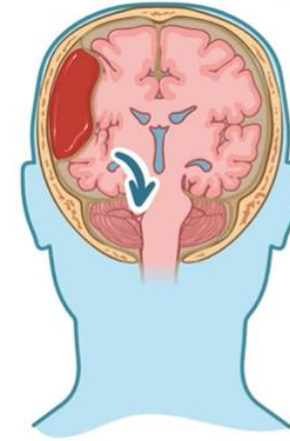


DIAGNOSIS

- * CT SCAN
 - ↳ HYPERDENSE MASS



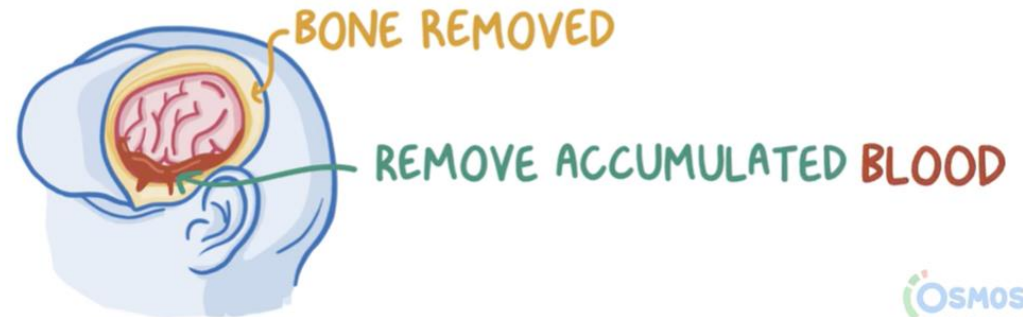
EPIDURAL HEMATOMAS



- * BRAIN HERNIATION
 - ↳ LOSS of CONSCIOUSNESS
 - ↳ COMA
 - ↳ DEATH

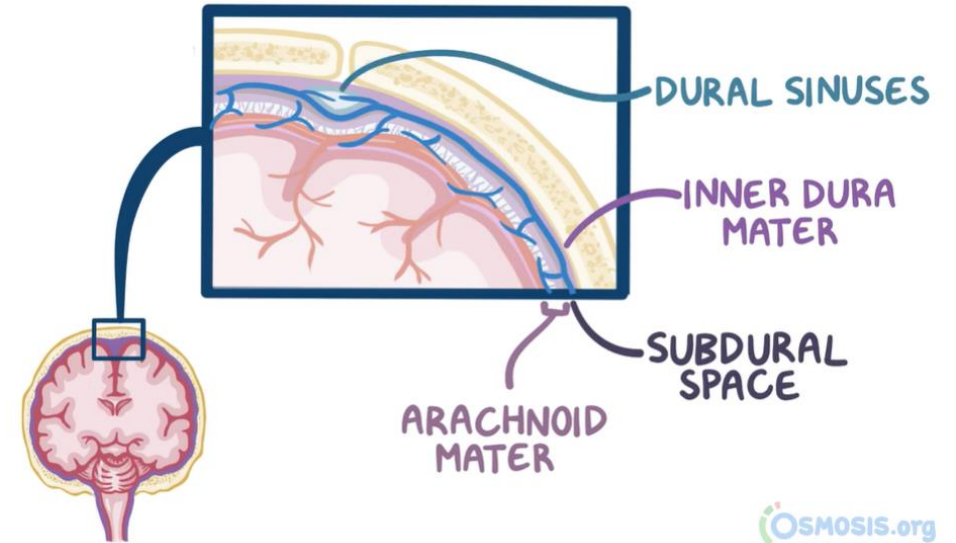
TREATMENT

- * CRANIOTOMY



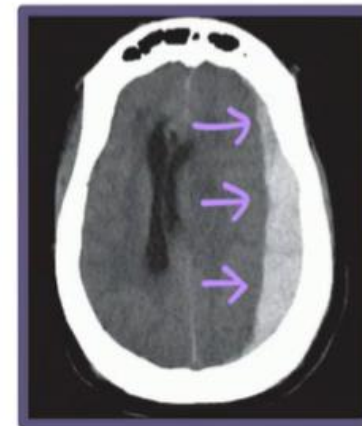
SUBDURAL HEMATOMA

- **Source:** Tearing of Bridging Veins
- **Gross:** Collection of fresh blood (slow bleeding)
- Mass effect causes brain compression, midline shift, and herniation
- **Clinically:** headache and confusion and slow progressive neurologic deterioration
- **CT scan:** crescent shape hyperdense mass
- **Treatment:** remove blood and associated organizing tissue.



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* HYPERDENSE MASS



SUBDURAL

BELOW

OUTERMOST
PROTECTIVE
LAYER

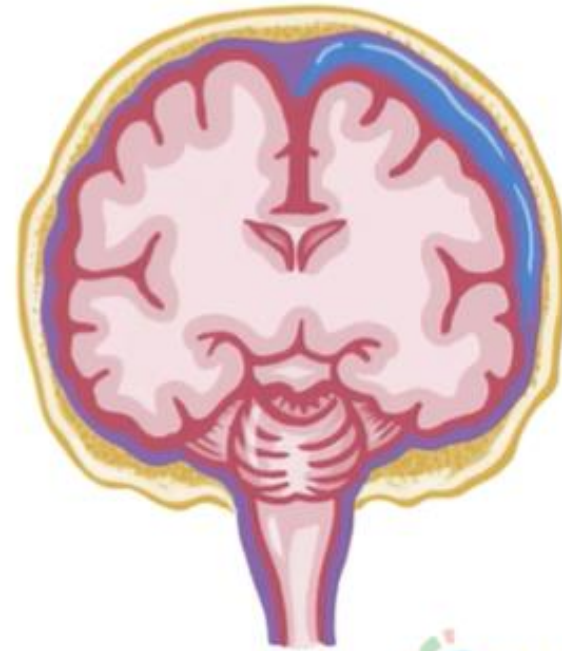


DURA
MATER

* BLEEDING BELOW the
DURA MATER

HEMORRHAGE

BLEEDING



CAUSE

* BRAIN ATROPHY

- ↳ BRAIN SHRINKS
- ↳ BRIDGING VEINS UNSUPPORTED



* HEAD TRAUMAS

- ↳ WHACKING YOUR HEAD
- ↳ SHAKEN BABY SYNDROME



* ALCOHOL ABUSE

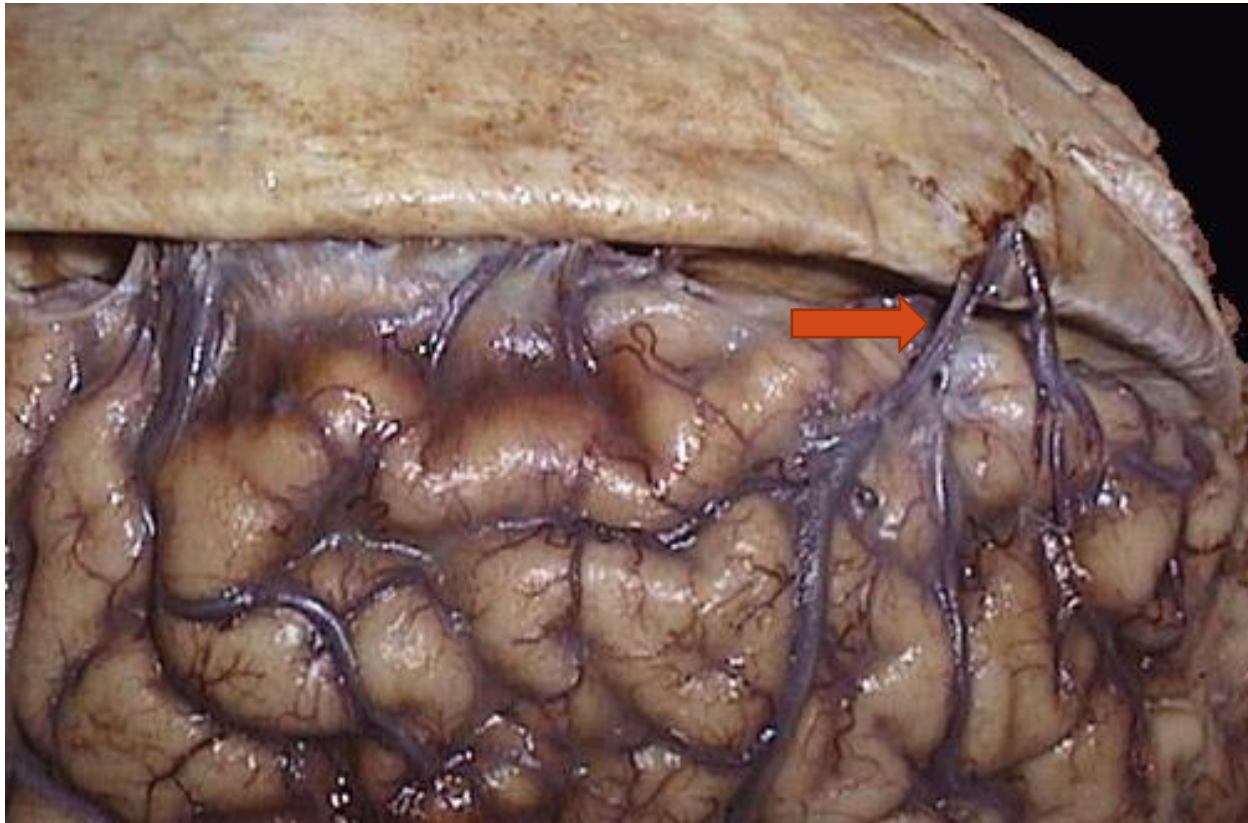
- ↳ VEINS ARE THIN WALLED
- ↳ LIKELY TO BREAK



* ACCELERATION - DECELERATION INJURY



SUBDURAL HEMATOMA

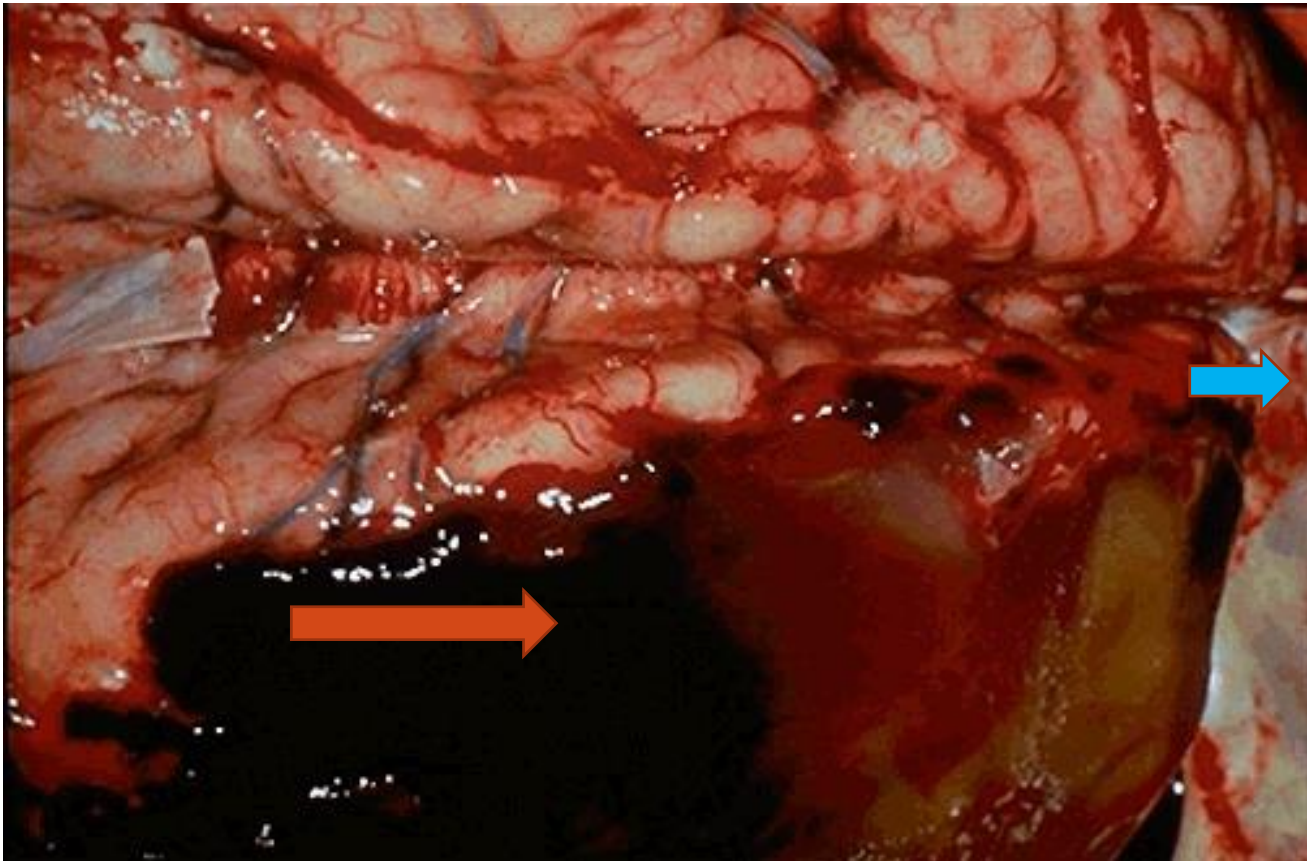


The dura has been reflected above to reveal the **bridging veins that extend across to the superior aspect of the cerebral hemispheres.**

These cerebral veins can be torn with trauma, particularly if there is significant cerebral atrophy (as with aging) that exposes these veins even more.



ACUTE SUBDURAL HEMATOMA



The dura has been reflected back (**blue arrow**) to reveal a subdural hematoma (**orange arrow**).

Usually the result of trauma with **tearing of the cerebral bridging veins** at the vertex.

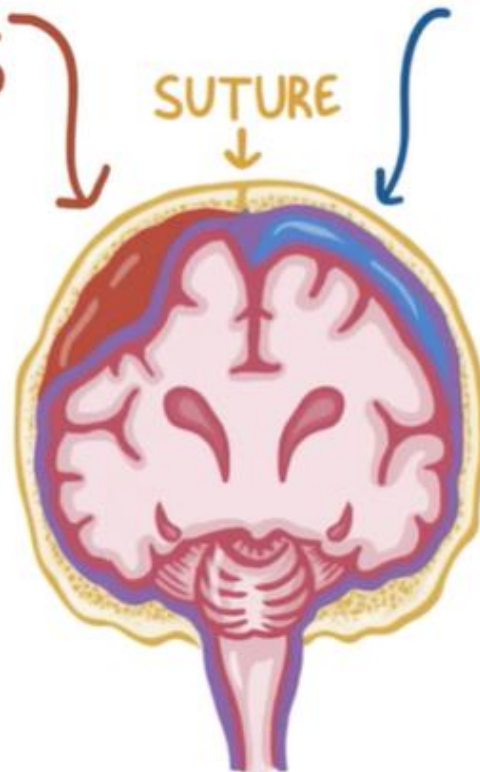
The venous source means that the bleeding may be slow and blood collects over a variable length of time, leading to neurologic signs and symptoms within hours to days or even weeks.



DIAGNOSIS

* EPIDURAL HEMORRHAGES

- ~ BETWEEN the OUTER LAYER of the DURA MATER and the SKULL
- ~ DO NOT CROSS SUTURE LINES
- ~ BICONVEX SHAPE



* SUBDURAL HEMORRHAGES

- ~ BETWEEN the ARACHNOID and the INNER LAYER of the DURA MATER
- ~ CRESCENT SHAPE
- ~ CROSS SUTURE LINES



Table 23.1 Patterns of Vascular Injury in the Central Nervous System

Location	Etiology	Additional Features
Epidural space	Trauma	Usually associated with a skull fracture (in adults); rapidly evolving neurologic symptoms requiring intervention
Subdural space	Trauma	Level of trauma may be mild; slowly evolving neurologic symptoms, often with a delay from the time of injury
Subarachnoid space	Vascular abnormalities (arteriovenous malformation or aneurysm) Trauma	Sudden onset of severe headache, often with rapid neurologic deterioration; secondary injury may emerge due to vasospasm Typically associated with underlying contusions
Intraparenchymal	Trauma (contusions) Hemorrhagic conversion of an ischemic infarction Cerebral amyloid angiopathy Hypertension Tumors (primary or metastatic)	Selective involvement of the crests of gyri where the brain contacts the skull (frontal and temporal tips, orbitofrontal surface) Petechial hemorrhages in an area of previously ischemic brain, usually following the cortical ribbon “Lobar” hemorrhage, involving cerebral cortex, often with extension into the subarachnoid space Centered in the deep white matter, thalamus, basal ganglia, or brain stem; may extend into the ventricular system Associated with high-grade gliomas or certain metastases (melanoma, choriocarcinoma, renal cell carcinoma)



SUBARACHNOID HEMORRHAGE

Causes:

- ❑ Rupture saccular (berry) aneurysm
- ❑ Vascular malformations
- ❑ Trauma
- ❑ Coagulopathies
- ❑ Tumors



SACCULAR (BERRY) ANEURYSM

- Commonest cause of spontaneous subarachnoid hemorrhage
- 2% of population, Rupture in fifth decade, F > M
- Not present at birth, but develop over time because of underlying defect in media of the vessel
- Rate of bleeding: 1.3% / year.



CONDITIONS ASSOCIATED WITH SACULAR ANEURYSMS

Genetic:

- Polycystic kidney disease (autosomal dominant)
- Defects in extracellular matrix proteins
- e.g. Marfan's syndrome, Others

Non-genetic:

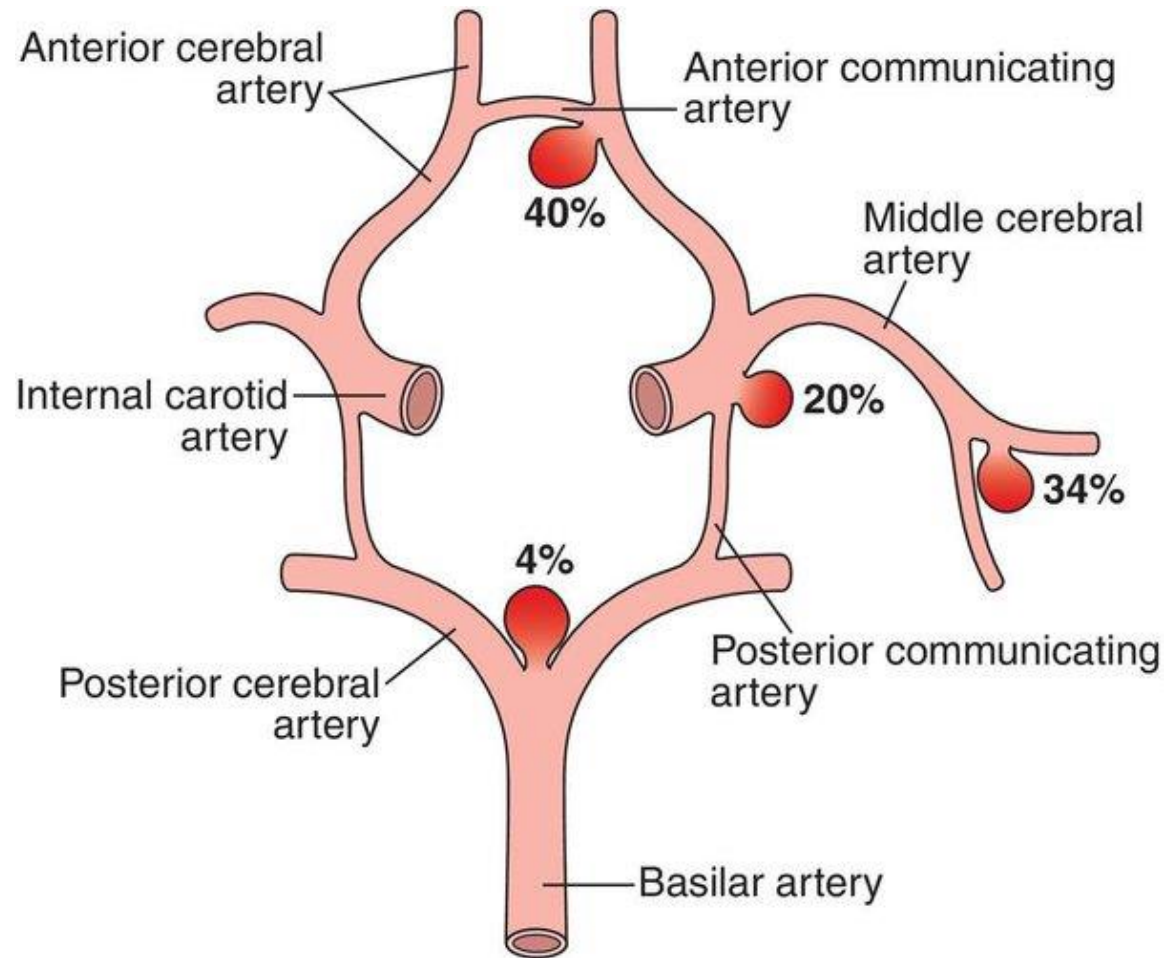
- Coarctation of aorta

Predisposing conditions:

- Hypertension
- Cigarette smoking



SACULAR (BERRY) ANEURYSM



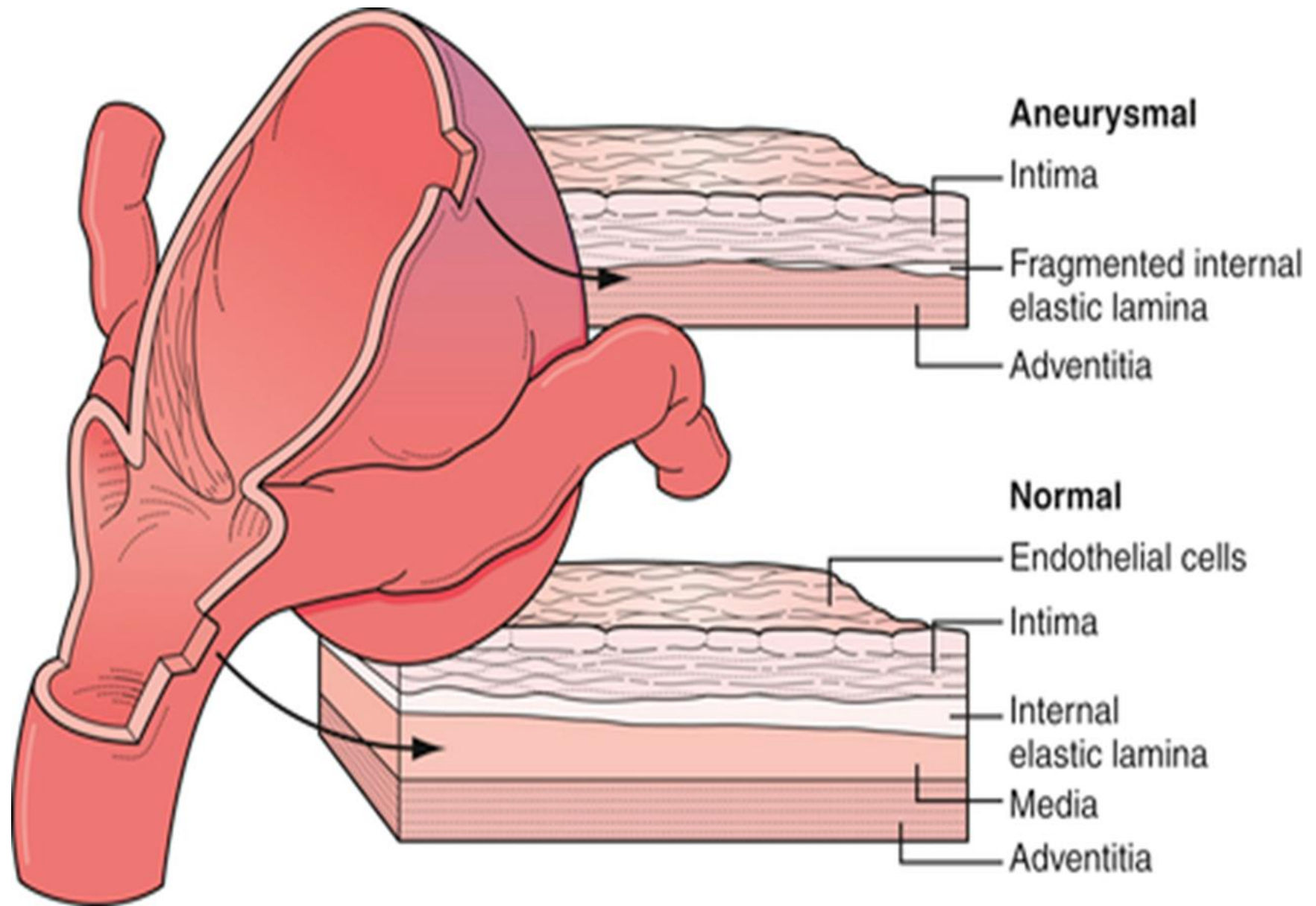
- About 90% near major arterial branch points in anterior circulation
- 20-30% multiple



SACULAR (BERRY) ANEURYSM MORPHOLOGY

- Size: from few mm to 2-3 cm.
- Muscular wall and internal elastic lamina are absent beyond the neck of the aneurysm.
- Aneurysm sac is lined only by thickened hyalinized intima. The adventitia covering the sac is continuous with that of the parent artery.
- Rupture usually occurs at the apex of the sac, releasing blood into the subarachnoid space or the substance of the brain, or both.

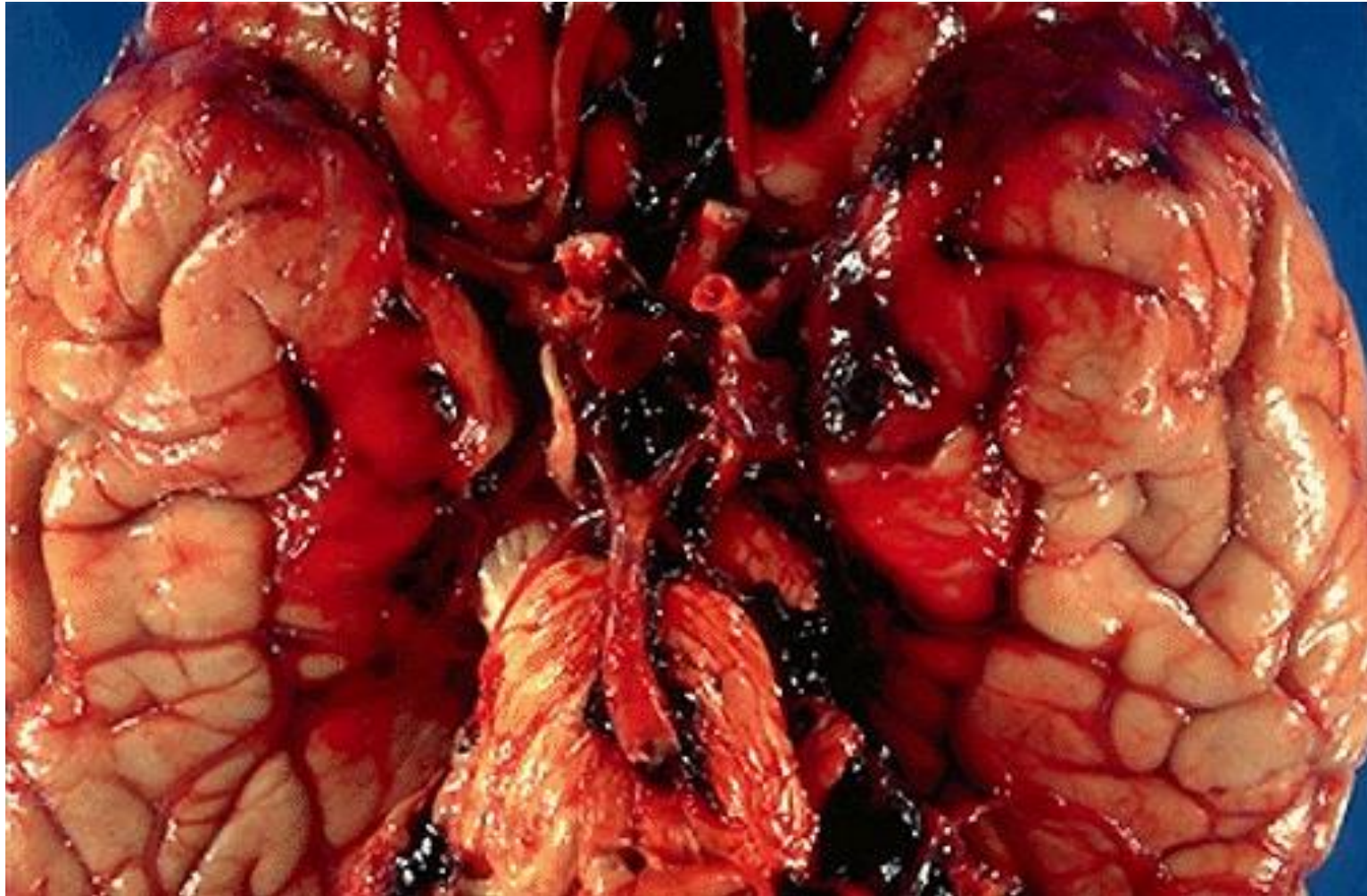






Apex/ Site of rupture





The subarachnoid hemorrhage from a ruptured aneurysm shown here at the base of the brain is more of an irritant producing vasospasm than a mass lesion



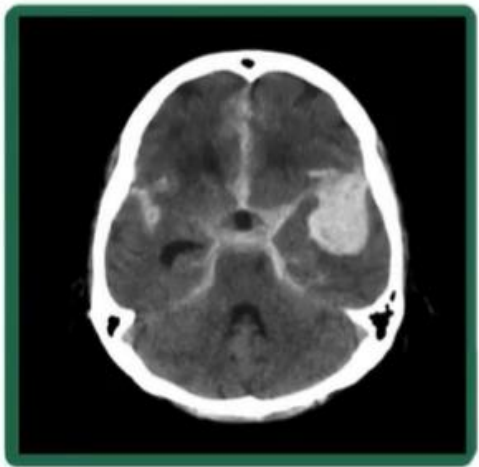
SACCULAR (BERRY) ANEURYSM

- Clinical: **Worst headache of my entire life**, sudden, excruciating with loss of consciousness. Nuchal rigidity.
- 25-50% die at time of first rupture
- **Acute:** in the first few days: vasospasm of other vessels >> Increased risk of additional ischemic injury
- **Repeat bleeding** is associated with increased mortality
- **Chronic (healing phase):** Meningeal fibrosis and scarring leading to obstruction of CSF flow or disruption of CSF resorption leading to hydrocephalus.

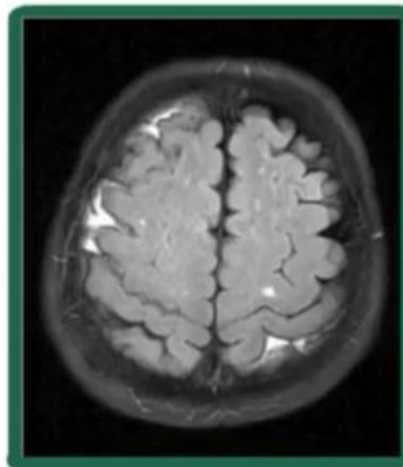


SACCULAR (BERRY) ANEURYSM

DIAGNOSIS



CT



MRI

LUMBAR PUNCTURE



RED BLOOD (FRESH)
or
YELLOWISH BLOOD (OLD)
(XANTHOCHROMIA)

