CNS pathology

Dr Heyam Awad

Lecture 2: traumatic and non traumatic brain hemorrhage

- This is an online lecture.

Youtube link:

- https://www.youtube.com/watch?v=feVqml3Gmms

Intracranial hemorrhage

" He can't stand the sight of blood. "

Causes of intracranial hemorrhage

Intracranial hemorrhage can be traumatic or non traumatic.

Causes of non traumatic hemorrhage:

- 1. Primary brain parenchymal hemorrhage , which is caused mainly by hypertension.
- 2. Cerebral amyloid angiopathy =الداء النشواني
- 3. Ruptured aneurysmsتمدد كيسي دموي =
- 4. Vascular malformation
- 5. Vasculitis

Other (rarer) causes of intra-cerebral hemorrhage

- Bleeding disorders
- Drug related: anti-coagulants
- Cocaine use
- Tumors.. Can encroach on a vessel and cause bleeding

1. Primary brain parenchymal haemorrhage

- Primary = spontaneous = non-traumatic.

-Peak 60 years of age.

-Mostly due to rupture of a small intra-parenchymal vessel.

-Hypertension is the leading cause.

- Most affected sites: basal ganglia, thalamus, pons and cerebellum.
- Outcome depends of the site and extent of haemorrhage

Why hypertension causes parenchymal hemorrhage ?

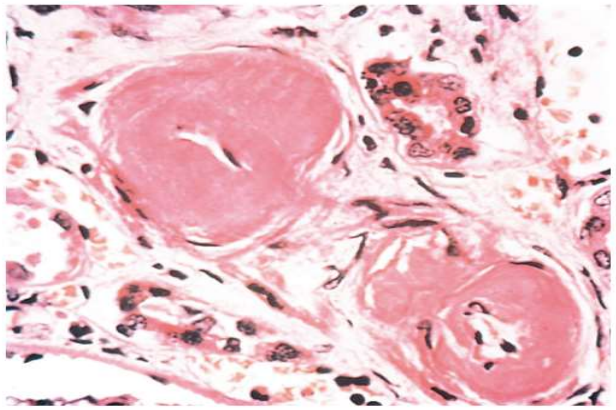
- Hypertension causes hyaline arteriolosclerosis.
- This results in weak arterioles, so the arterioles can rupture especially if there is sudden or sustained increase in blood pressure.

- Minute aneurysms can form (Charcot- Bouchard micro aneurysms) because of the weak vascular walls and these also can rupture.

Hyaline arteriolosclerosis

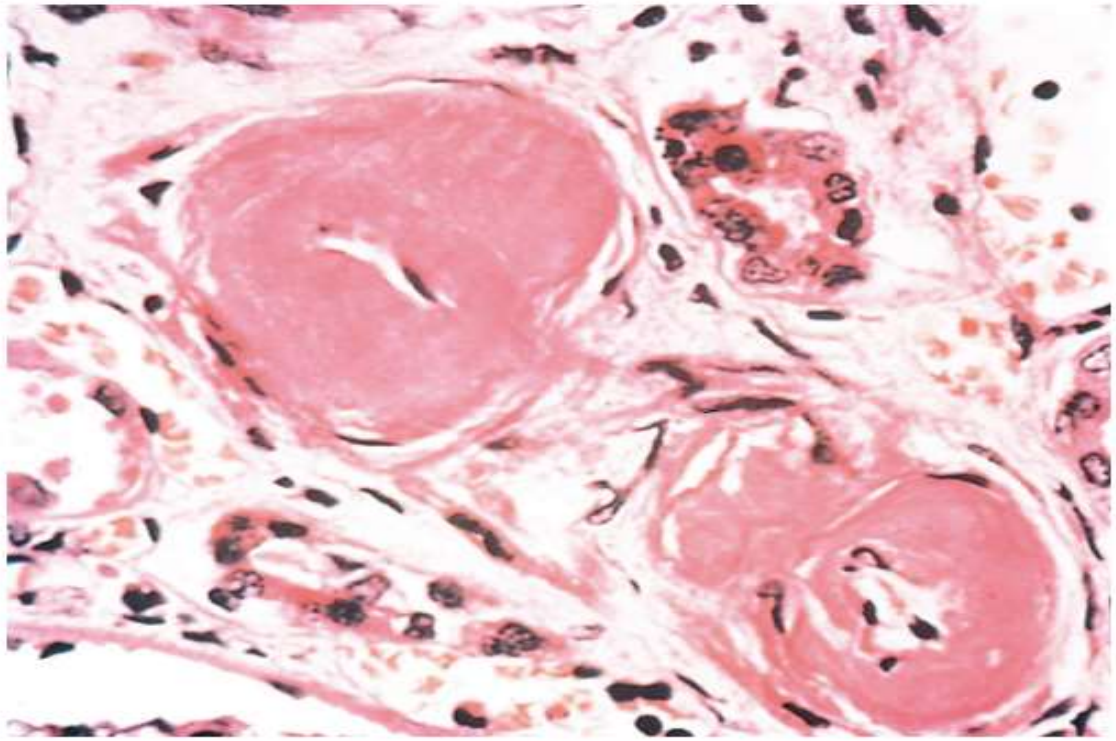
- Homogeneous pink hyaline thickening of the arteriolar walls with luminal narrowing and loss of underlying structural detail.
- Occurs due to leakage of plasma components across injured endothelial cells into vessel walls and increased extracellular matrix production by smooth muscle in response to chronic hemodynamic stress.

Hyaline arteriolosclerosis



Note the thick walls that contain hyaline, pink, material.

Hyaline arteriolosclerosis



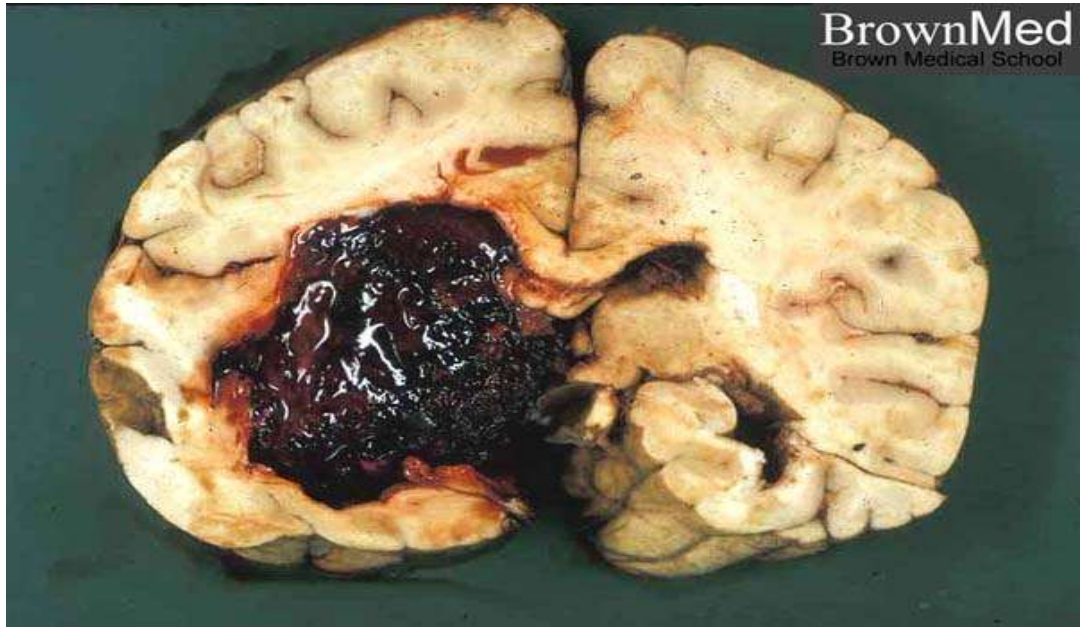
Symptoms of parenchymal brain haemorrhage

- 1. neurological symptoms related to the area affected
- 2. symptoms of increased intracranial pressure

morphology

- Extravagated blood.
- With time.. Resolution and cavity formation

Brain haemorrhage



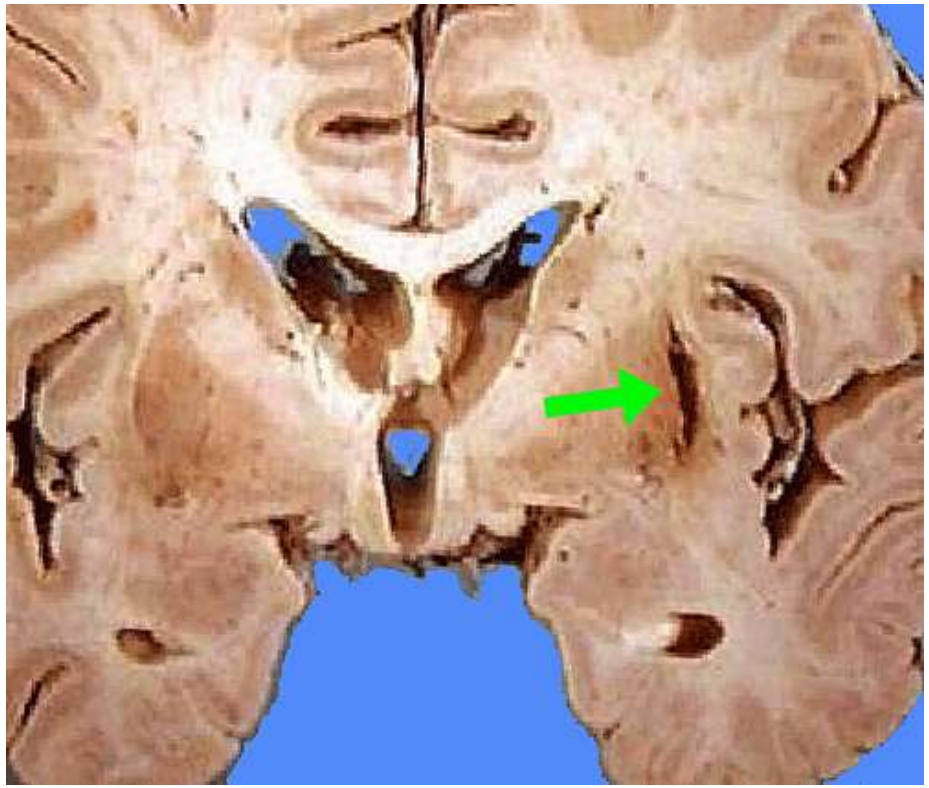
Cavity.. Old infarct or old hemorrhage; both will end up with a cavity!

Hypertension/ effects of hypertension on the brain:

- Massive intracranial haemorrhage.
- Lacunar infarcts.
- Rupture of small penetrating vessels
- Acute hypertensive encephalopathy= edema

Vessel rupture

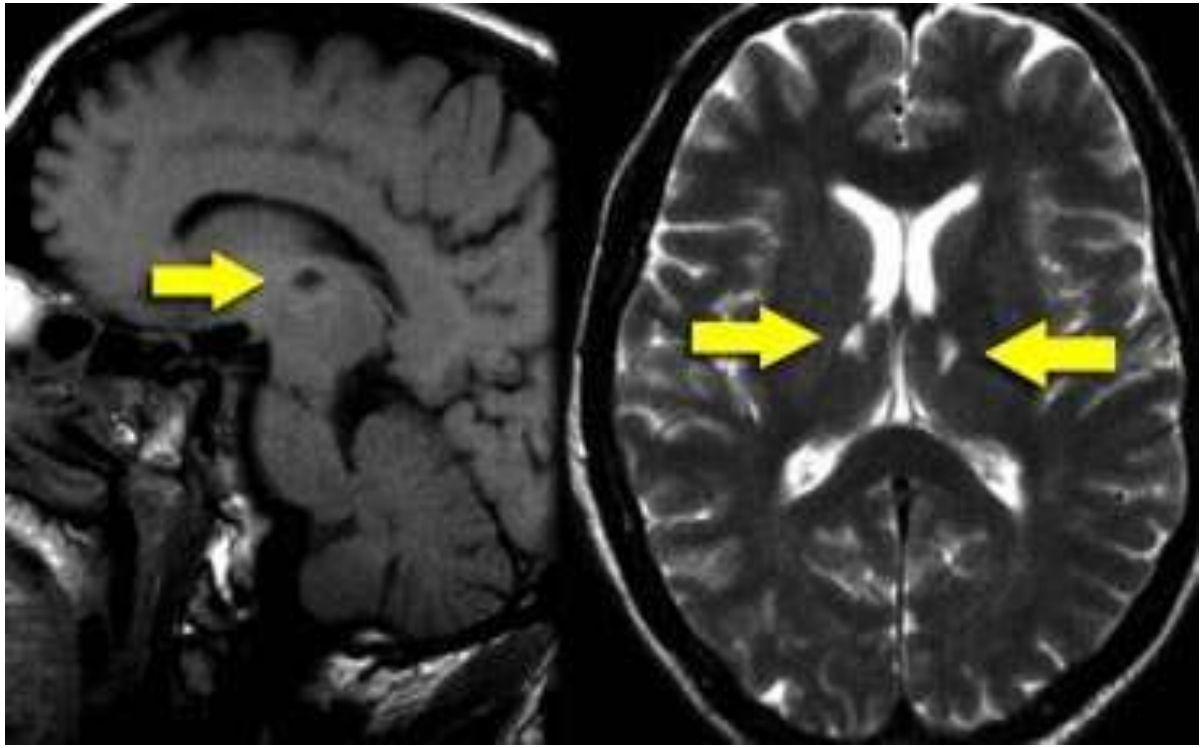
- Small penetrating vessels may rupture.
- Cause small haemorrhages = slit haemorrhages.



Lacunar infarcts

- Small infarcts, mostly in deep grey matter (basal ganglia and thalamus), internal capsule, deep white matter and pons.
- Caused by occlusion of penetrating branches of a large cerebral artery.
- Effect: depends on site

Lacunar infarct



2. vasculitis

- = inflammation of the blood vessel wall
- Inflammation weakens the vessel wall so it can rupture and cause hemorrhage.

Causes of vasculitis

Infectious arteritis:

- previously seen with syphilis and TB.
- Now in association with: CMV, herpes, aspergillosis….. immunosuppression

Polyarteritis nodosa.

Primary angiitis of CNS cause diffuse encephalopathy with cognitive dysfunction.

3. Cerebral amyloid angiopathy

- Amyloid deposition in the walls of arteries
- Causes weakness in vessel wall
- Bleeding , usually in the lobes of cerebral cortex (lobar hemorrhage)

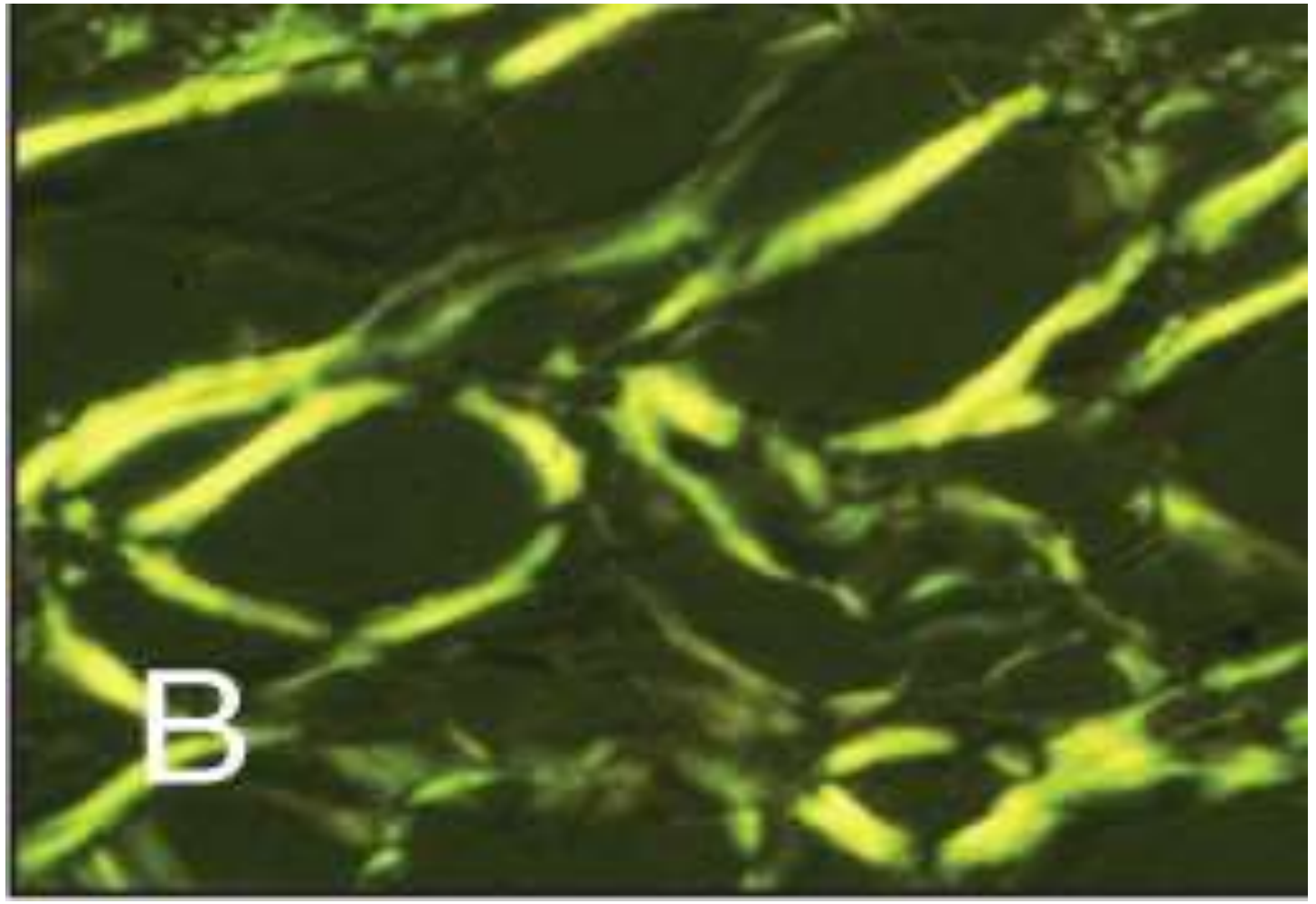
Amyloidosis

- Deposition of extracellular fibrillary proteins
- These abnormal fibrils are produced by the aggregation of misfolded proteins (which are soluble in their normal folded configuration).

- Amyloid is deposited in the extracellular space in various tissues and organs of the body

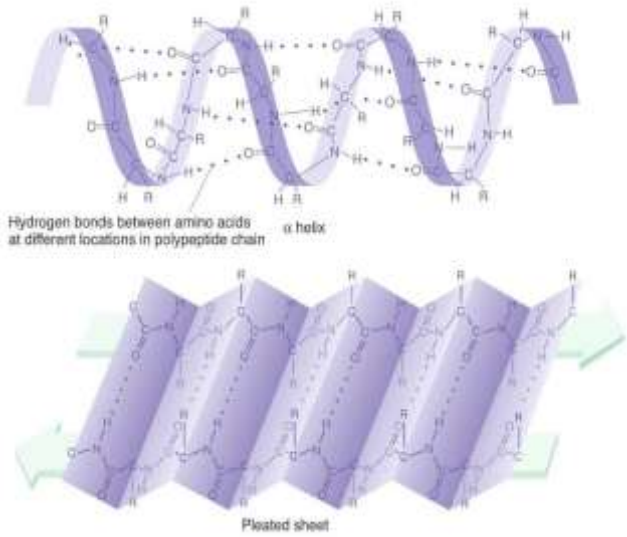
- These fibrillary proteins are responsible for tissue damage and functional compromise

Congo red stain



By electron microscope

- All types of amyloid consist of continuous, non-branching fibrils with a diameter of approximately 7.5 to 10 nm. With a cross-β-pleated sheet conformation



4. Ruptured berry aneurysm

- Rupture happens usually due to increased intracranial pressure.
- Sudden severe headache followed by loss of consciousness
- 25-50% die
- Survivors: risk of recurrent bleeding

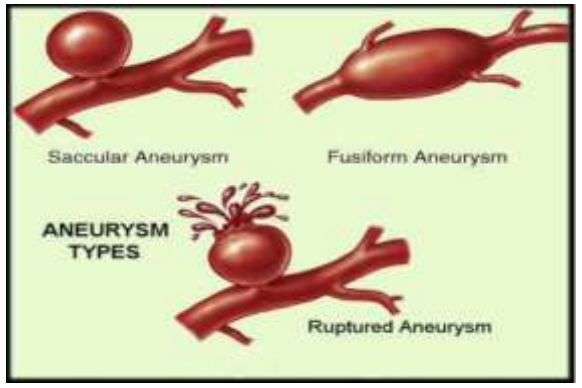
Ruptured aneurysm

- Mainly causes subarachnoid hemorrhage but also can cause hemorrhage within the brain paranchyma.

Subarachnoid haemorrhage

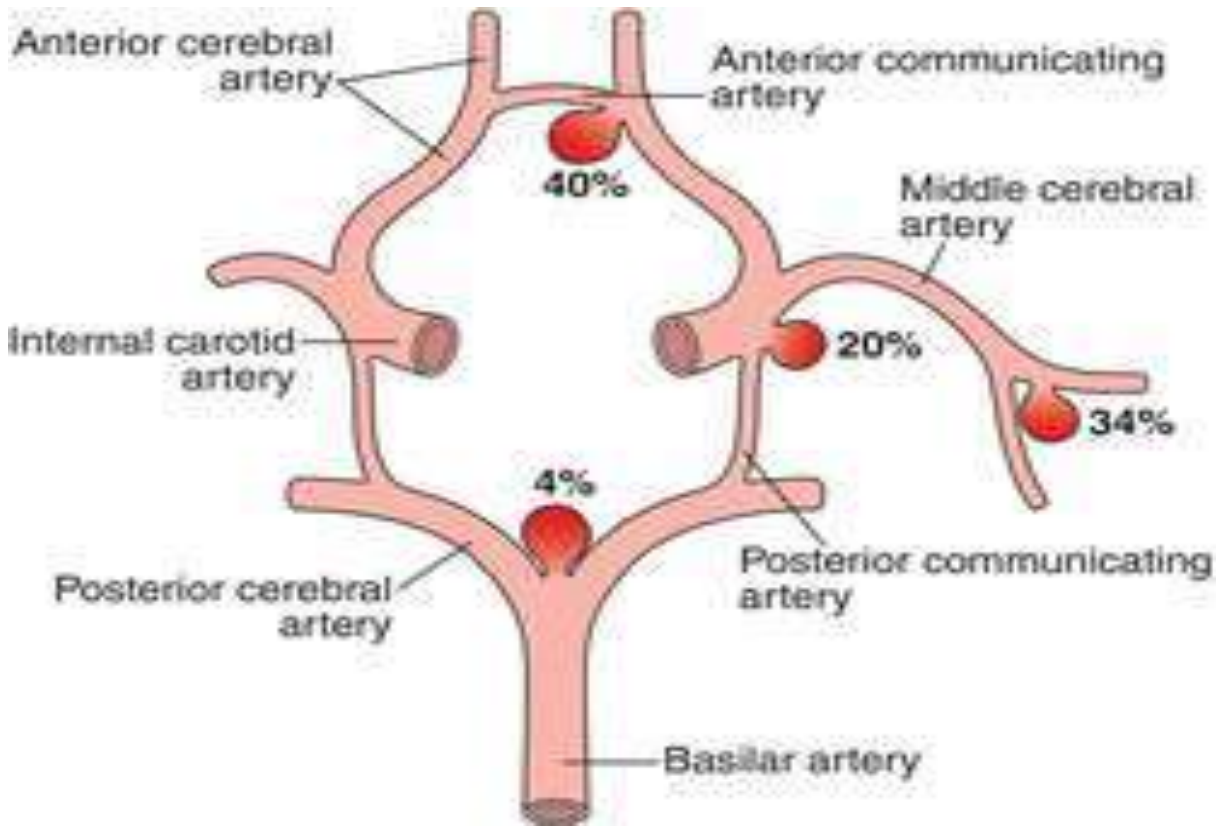
- Most common cause: ruptured berry aneurysm.
- Other causes: vascular malformations, trauma, tumours, haematological disturbances.

Subarachnoid haemorrhage
Ruptured berry (secular) aneurysm is the most common cause



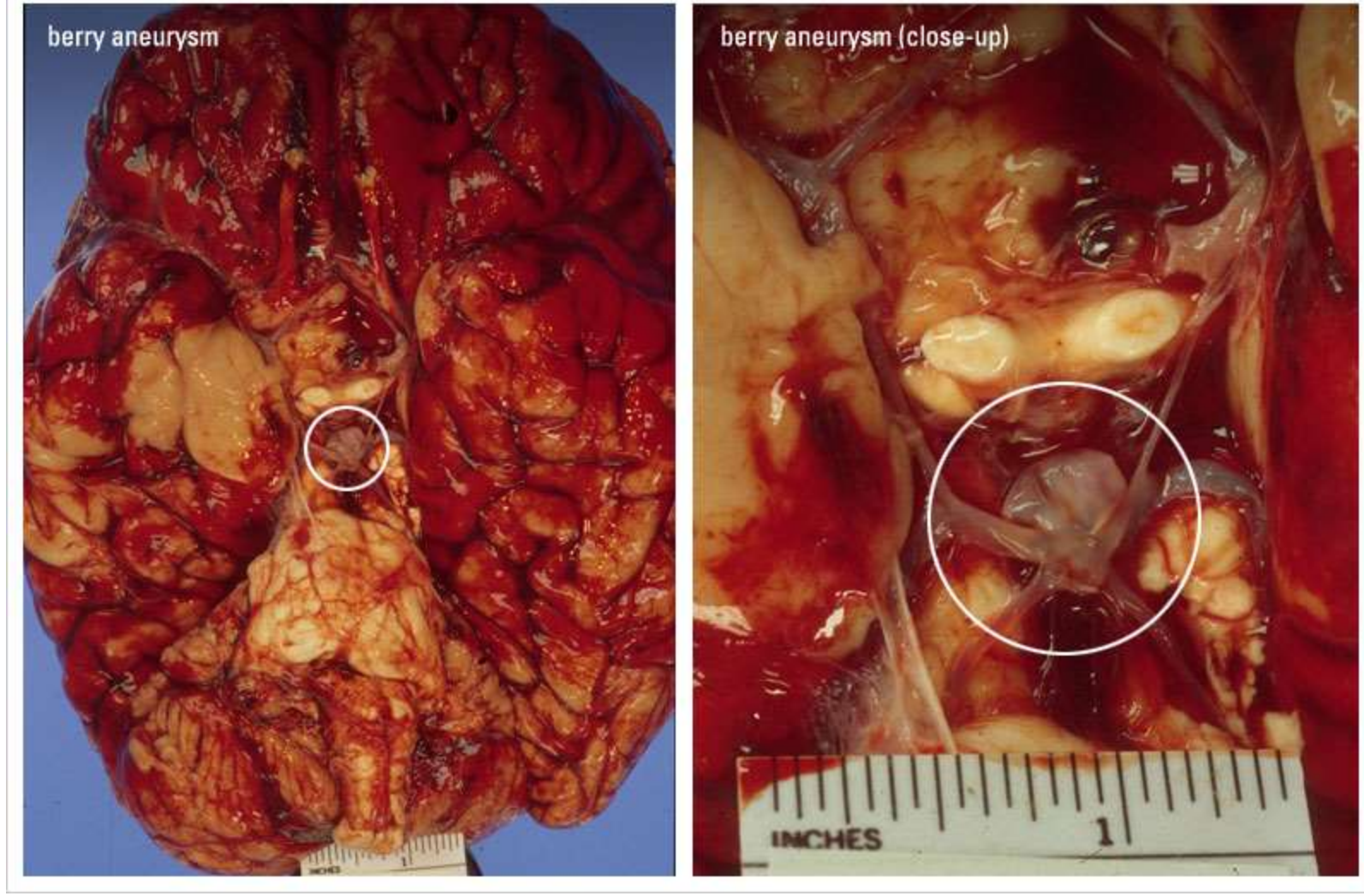
Berry aneurysm

- 90% in the anterior circulation
- Near major arterial branching points
- Multiple in 20 – 30 % of cases

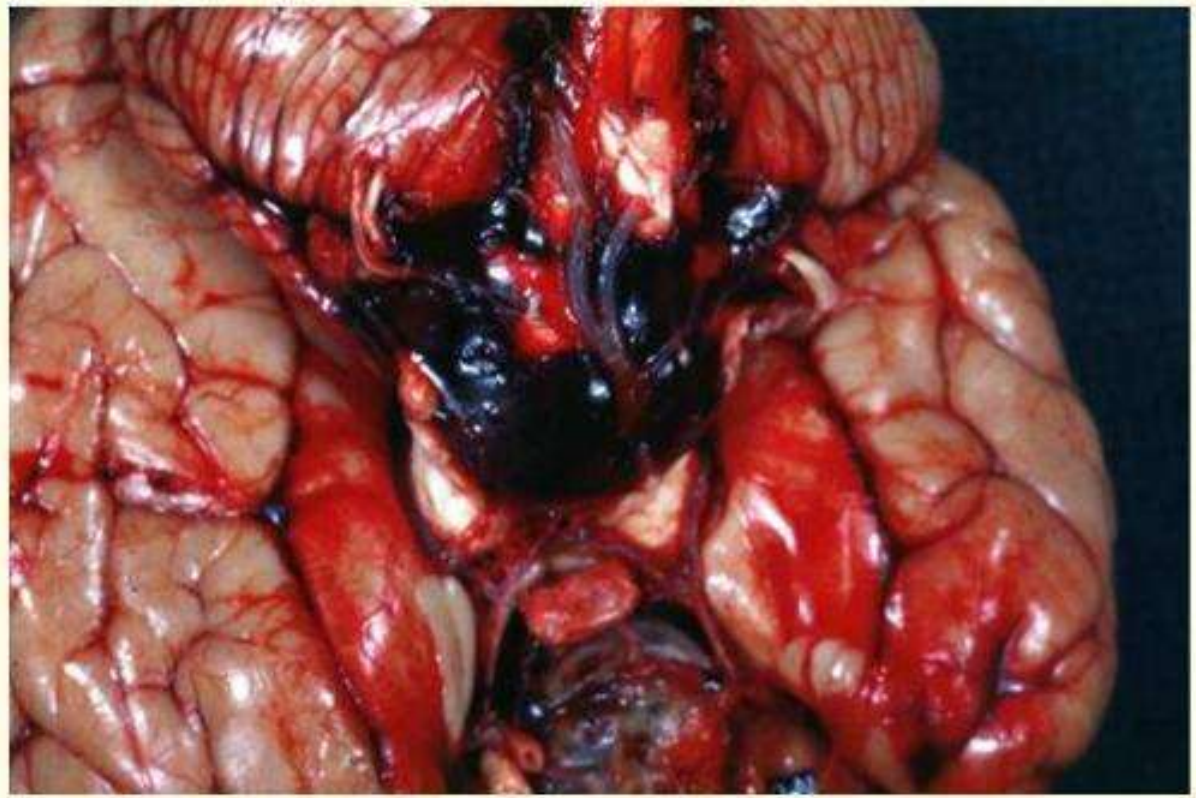

Anterior cerebral artery
Anterior communicating artery
40%
Middle cerebral artery
Internal carotid artery
20%
34%
4%
Posterior cerebral artery
Posterior communicating artery
Basilar artery

Morphology

- Berry aneurysm: thin walled outpouching of an artery


berry aneurysm
berry aneurysm (close-up)
INCHES
1

Subarachnoid Hemorrhage



*** Restricted use. PEIR; University of Alabama at Birmingham, Department of Pathology**

5. Vascular malformations

- Arteriovenous malformations
- Cavernous malformations
- Capillary telengectasia
- Venous angioma

AV malformation

- Most common type of vascular malformation
- Males more than females
- Present at 10-30 years of age
- Symptoms: seizures and intracranial hemorrhage

Morphology of AV malformation

- Network of disorganised vascular channels

Traumatic lesions

- Trauma to CNS causes mortality or disability
- Outcome depends on extent of trauma and site affected.
- Spinal cord trauma.. can cause severe disability.
- Brain stem trauma… can be fatal

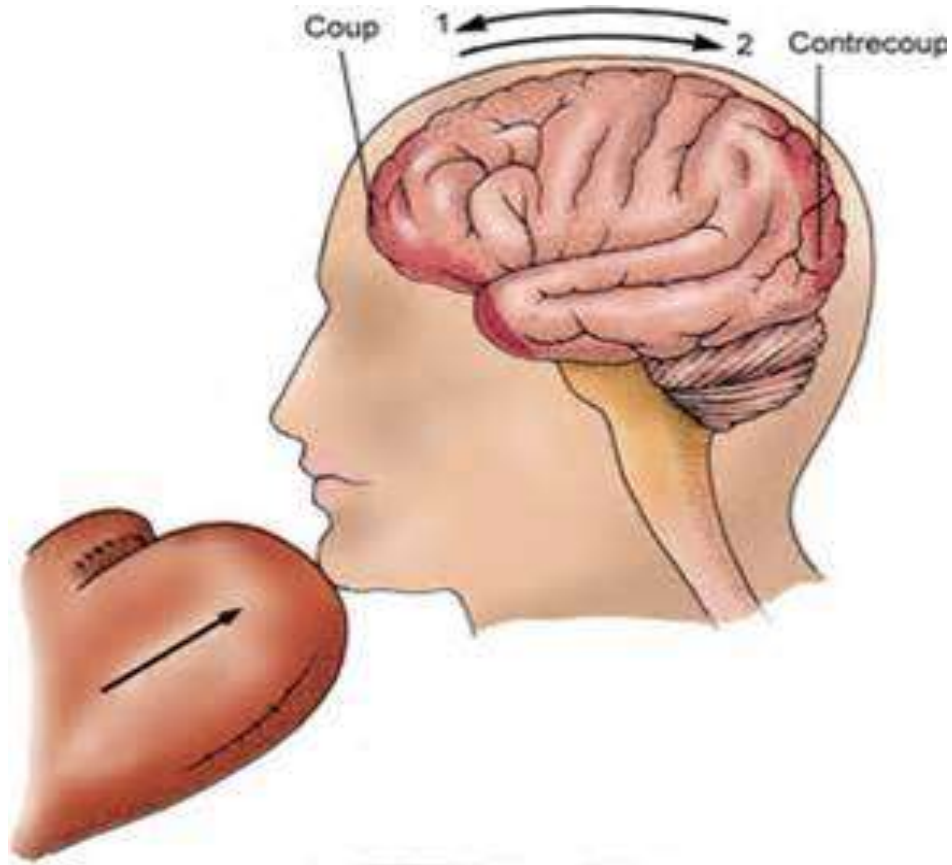
Head injury

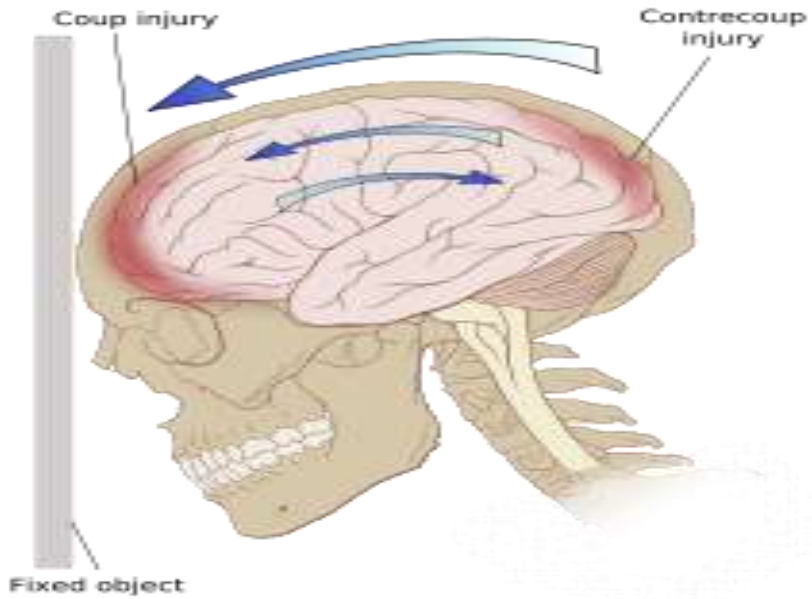
- Blunt or penetrating.
- Open or closed.
- Severe brain damage can occur without external signs of head injury
- Lacerations and even skull fractures are not necessarily associated with brain damage

Traumatic parenchymal injury

When an object impacts the head:

- Injury of brain at site of impact: coup injury
- Injury opposite to site of impact: countercoup
- Both are contusions


Coup
1
2
Contrecoup


Coup injury
Contrecoup injury
Fixed object

Note:

- Repetitive episodes of trauma can later lead to neurodegenerative process e:g Alzheimer

Brain injury

- Concussions
- Contusions
- Lacerations
- Diffuse axonal damage

concussions

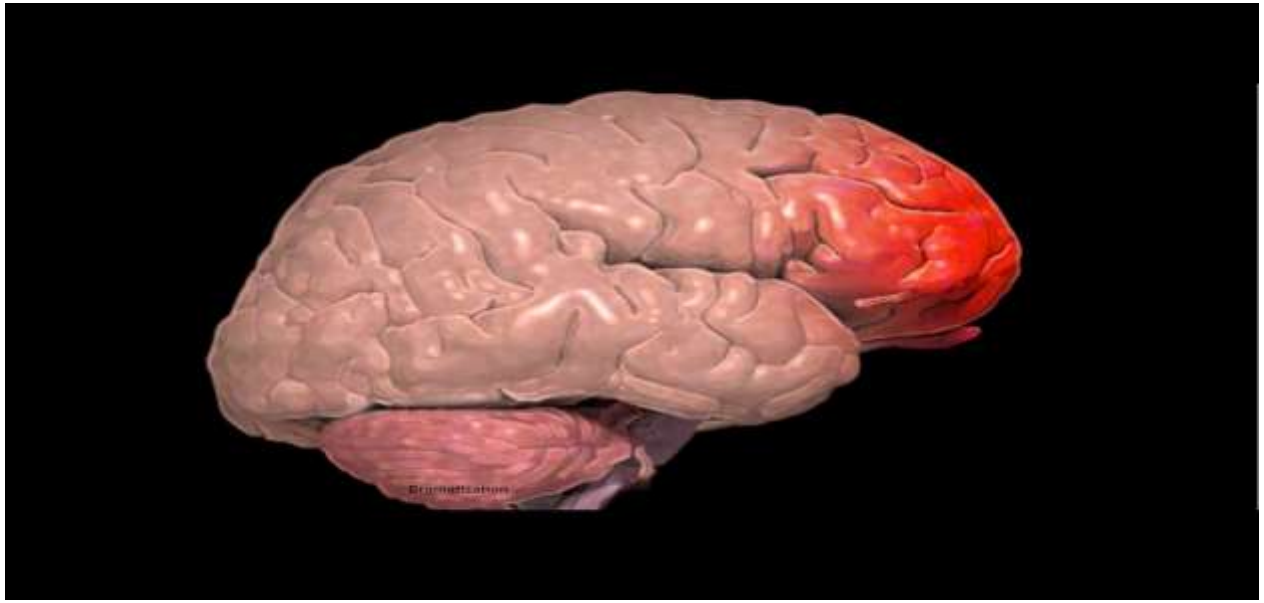
- Reversible altered consciousness after head injury in the absence of contusions
- Transient dysfunction in the form of: loss of consciousness, temporary respiratory arrest, loss of reflexes.
- Pathogenesis: unknown
- Recovery is complete but amnesia of the episode.

contusion

- Caused by rapid tissue displacement , disruption of vascular channels with subsequent haemorrhage, tissue injury and edema.
- Common in areas overlying rough and irregular bone surface: orbitofrontal region, temporal lobe tips.

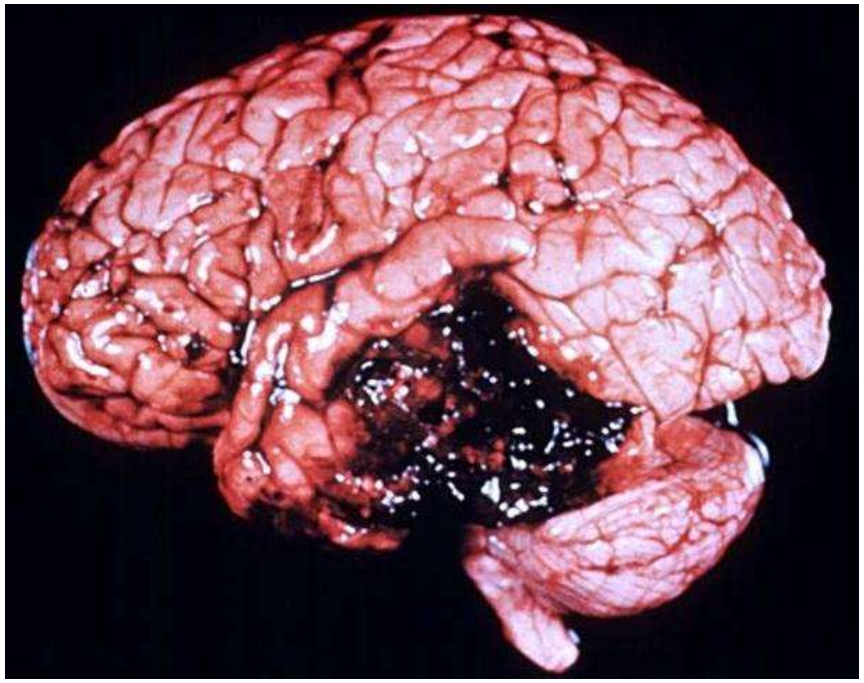
Contusion/morphology

- Wedge shaped, widest aspect closest to point of impact.
- Edema and extravasated RBCs.
- Superficial aspects of cortex affected more (contrary to ischemic injury)



lacerations

- Penetrating injuries cause skull fractures and brain lacerations
- Laceration: tissue tearing and hemorrhage.



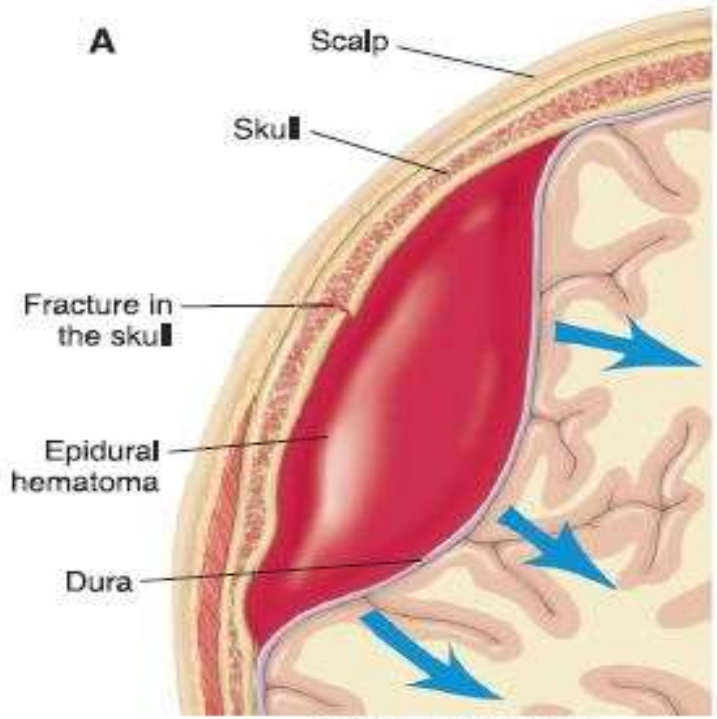
- Old traumatic injury: depressed, retracted, yellow brown patches involving the gyri.
- Larger lesions: cavity, resembling remote infarcts

Diffuse axonal injury

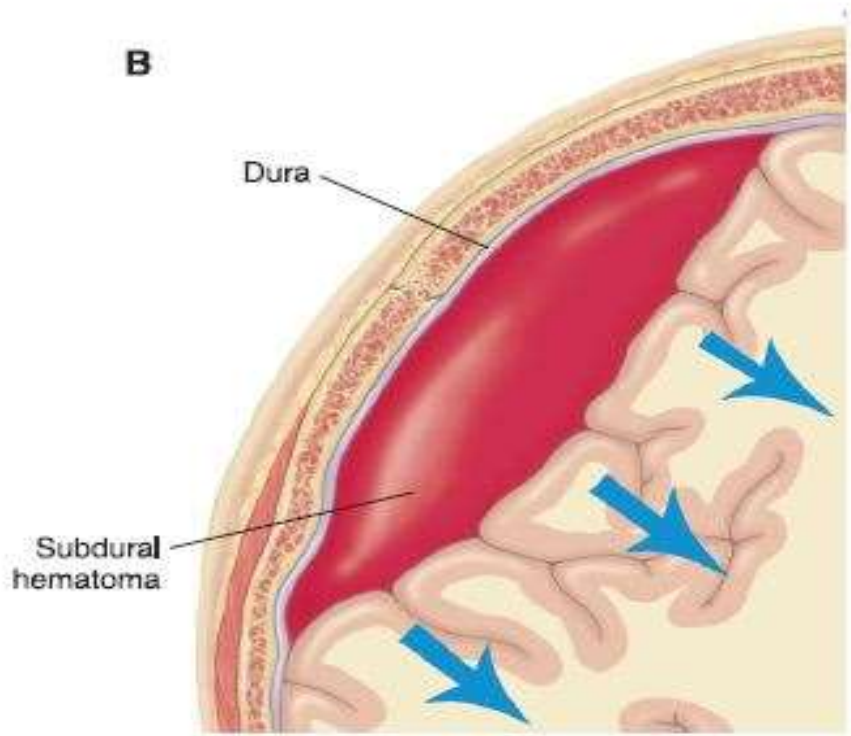
- Brain trauma can cause subtle widespread injury to axons within the brain:= diffuse axonal injury
- Movement of one region of the brain relative to another.. disrupt axonal integrity.
- Appear under LM as axonal swelling
- Can lead to severe irreversible neurologic deficit.

Traumatic vascular injury

- Epidural
- Subdural
- Subarachnoid
- intraparenchymal



Epidural hematoma



Subdural hematoma

Epidural hematoma

- Dural vessel torn due to fracture.
- Usually: middle meningeal artery is torn
- Blood accumulates under arterial pressure and dissects the dura, compressing the brain parenchyma

Epidural hematoma

This s a CT scan showing blood between the dura and the skull

note the biconvex shape.. this is typical of epidural hematoma.

Subdural hematoma

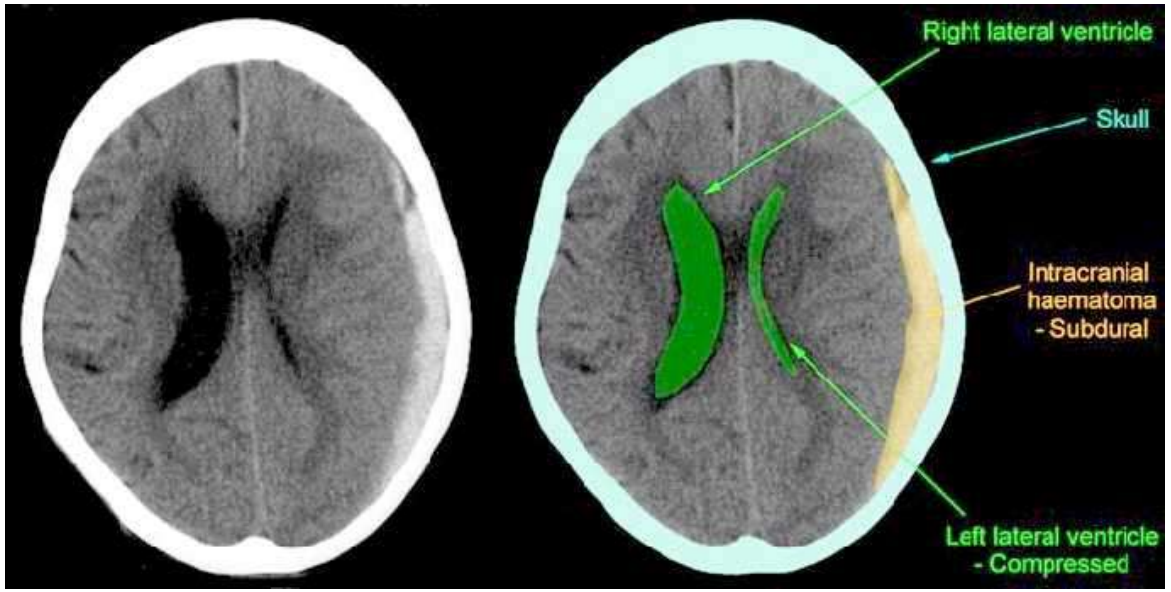
- Rapid movement of brain during trauma.. Can tear the bridging veins
- This leads to bleeding in the subdural space

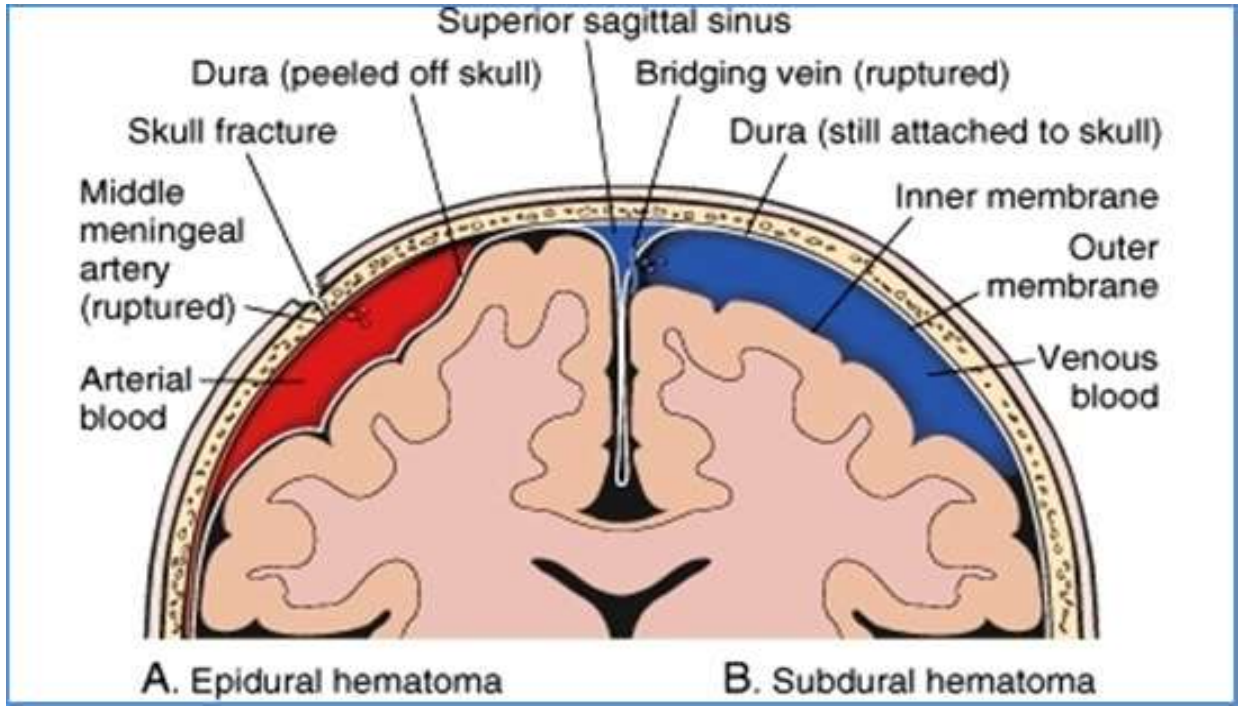
Subdural hematoma

here the blood collects between the dura and the brain tissue

It shows a crescentic shape.

Subdural hematoma




Superior sagittal sinus
Dura (peeled off skull)
Bridging vein (ruptured)
Skull fracture
Dura (still attached to skull)
Middle meningeal artery (ruptured)
Inner membrane
Outer membrane
Arterial blood
Venous blood
A. Epidural hematoma
B. Subdural hematoma

Summary 1/2

- Intracranial haemorrhage can traumatic or non traumatic.
- Intracranial haemorrhage can be intra-parenchymal, subarachnoid, epidural or subdural; the first two can be traumatic or non traumatic whereas the last two are usually traumatic.
- the most common cause of intraparenchymal haemorrhage is spontaneous haemorrhage which occurs in older individuals who are hypertensive.
- Hypertension causes haemorrhage via weakening blood vessel walls through hyaline arteriolosclerosis or micro-aneurysm formations.
- Hypertension also uses slit haemorrhages, lacunar infarcts and acute hypertensive encephalopathy.

SUMMARY 2/2

- Other causes of intraparenchymal haemorrhage include: amyloid antipathy, infections, autoimmune vasculitis, arteriovenous malformations and other causes.
- Subarachnoid haemorrhage can be traumatic but is mainly caused by a ruptured aneurysm.
- Traumatic brain haemorrhage can be subdural, epidural, intra-parenchymal or subarachnoid.
- epidural hematoma caused by arterial vessel (middle meningeal) torn due to fracture.Blood accumulates under arterial pressure and dissects the dura, compressing the brain parenchyma
- Subdural hematoma occurs due to rapid movement of brain during trauma.. Can tear the bridging veins.This leads to bleeding in the subdural space :


thank
you