

# CNS pathology

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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 aneurysms = تمدد كيسى 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

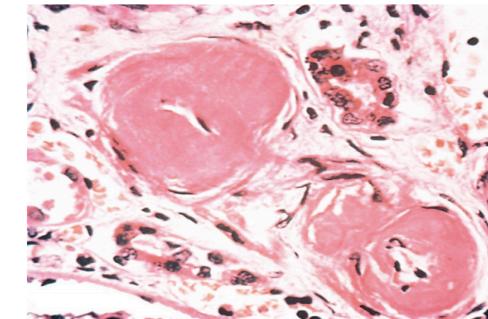
# Why hypertension causes parenchymal hemorrhage ?

- 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

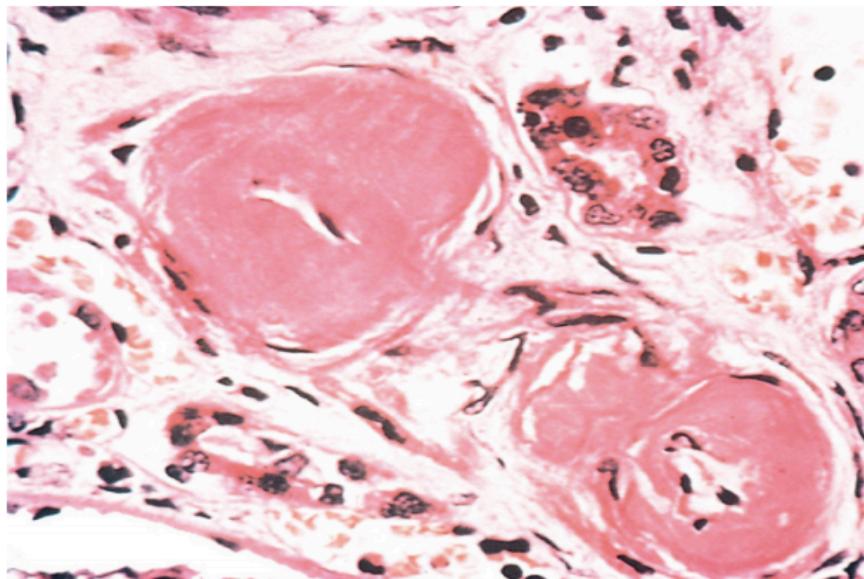
- Homogeneous pink hyaline thickening of the arteriolar walls with luminal narrowing and loss of underlying structural detail.
- Occurs due to leakage of plasma components across injured endothelial cells into vessel walls and increased extracellular matrix production by smooth muscle in response to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

[Hyaline arteriolosclerosis](#)



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

### Hyaline arteriolosclerosis



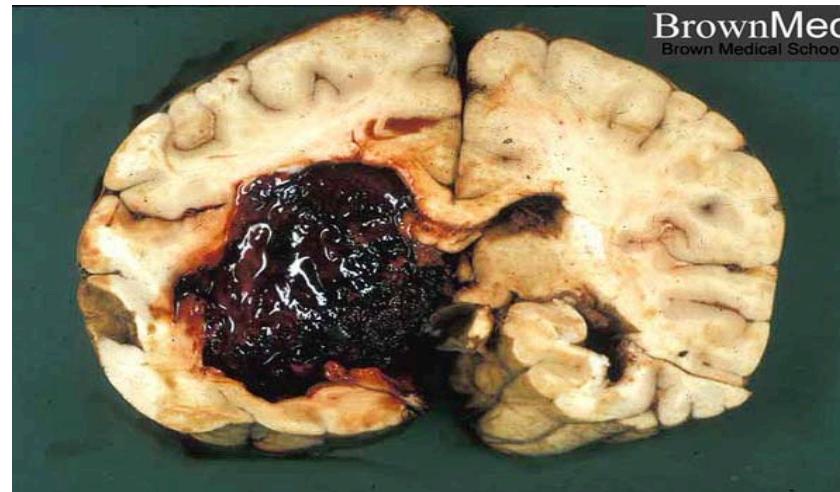
# Symptoms of parenchymal brain haemorrhage

- 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!

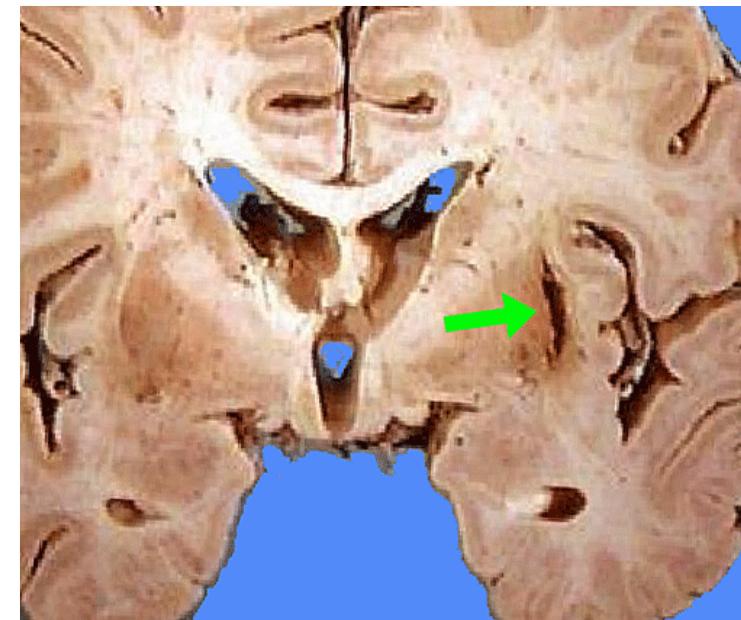


# Hypertension/ effects of hypertension on the brain:

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

# Vessel rupture

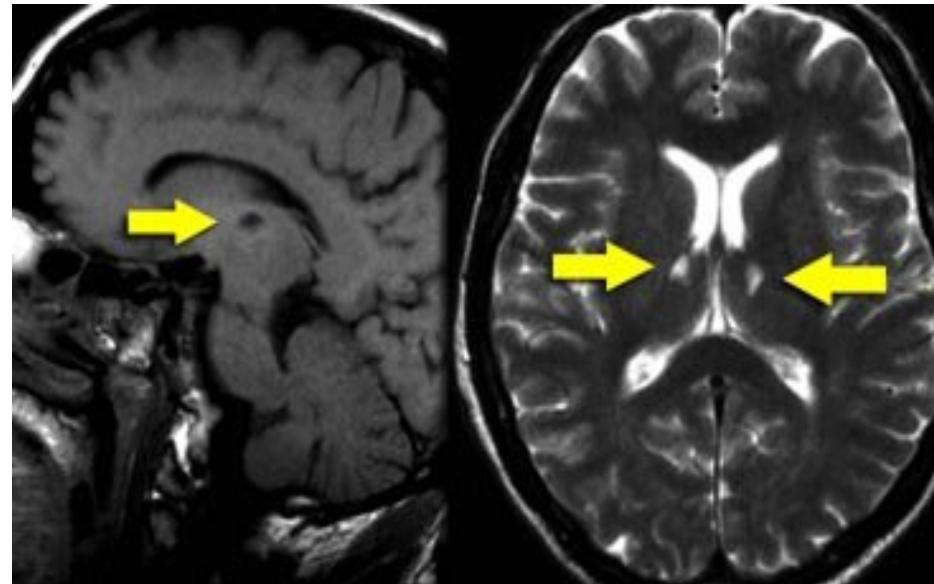
- Small penetrating vessels may rupture.
- Cause small haemorrhages = **slit haemorrhages**.



# 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

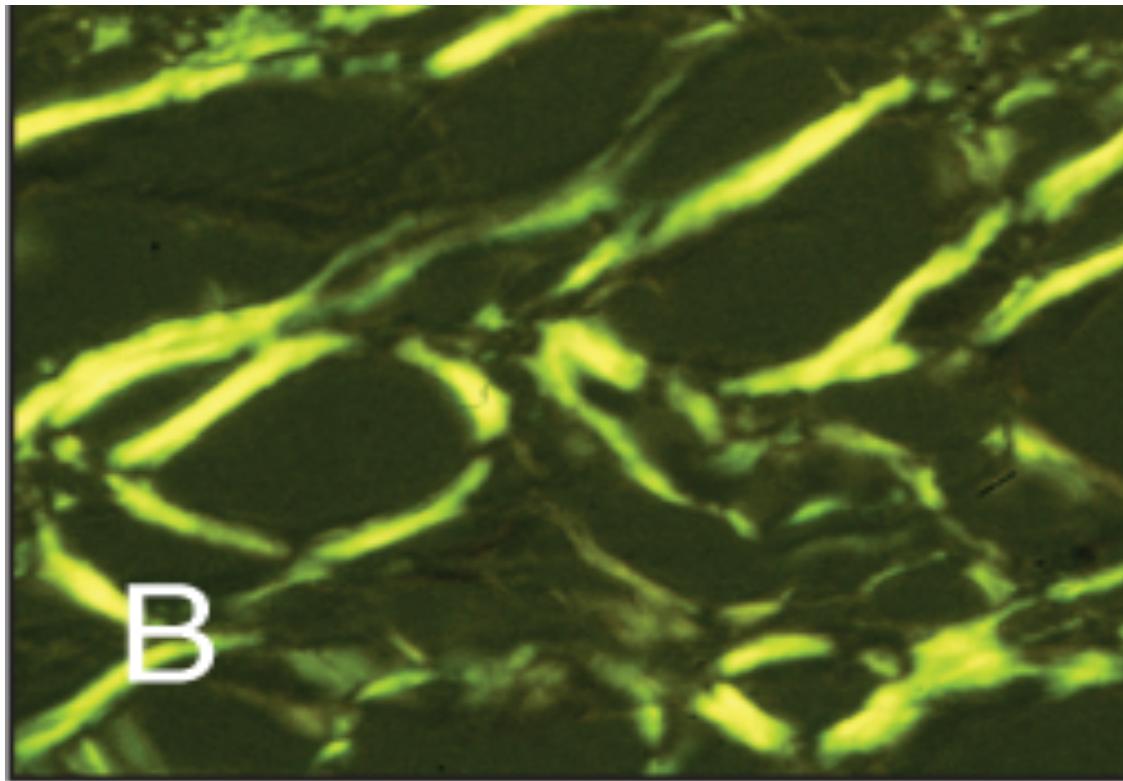
- Amyloid deposition in the walls of arteries
- Causes weakness in vessel wall
- Bleeding , usually in the lobes of cerebral cortex (lobar hemorrhage)

## 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).

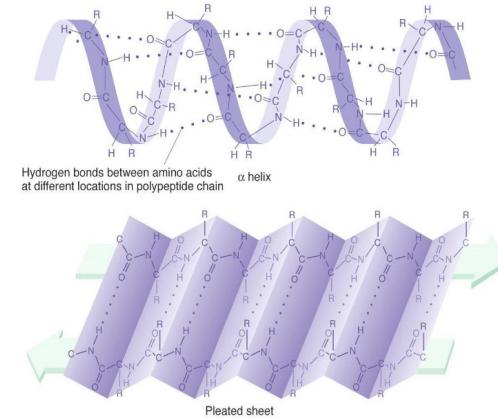
- Amyloid is deposited in the extracellular space in various tissues and organs of the body
- These fibrillary proteins are responsible for tissue damage and functional compromise

# 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- $\beta$ -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

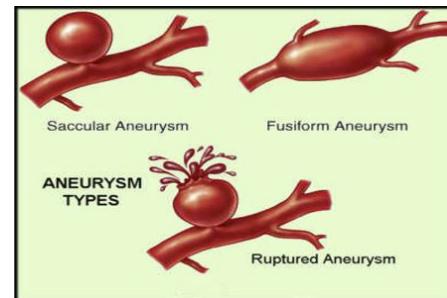
# Ruptured aneurysm

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

# Subarachnoid haemorrhage

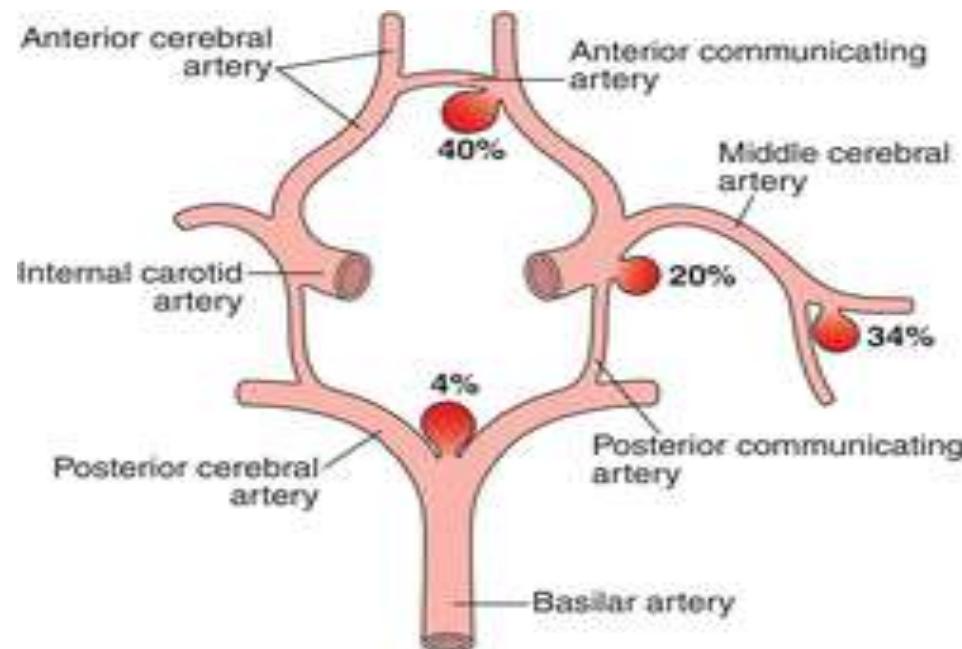
- Most common cause: ruptured berry aneurysm.
- Other causes: vascular malformations, trauma, tumours, haematological disturbances.

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

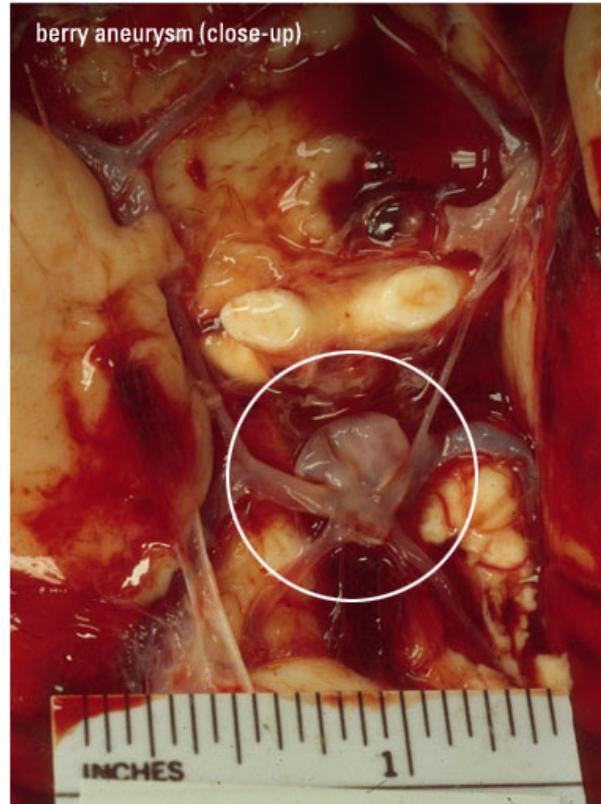
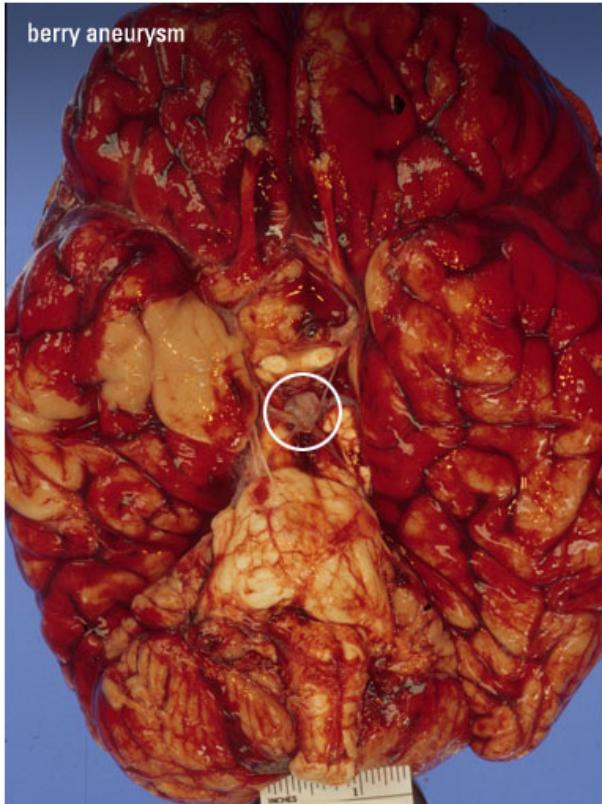


# Morphology

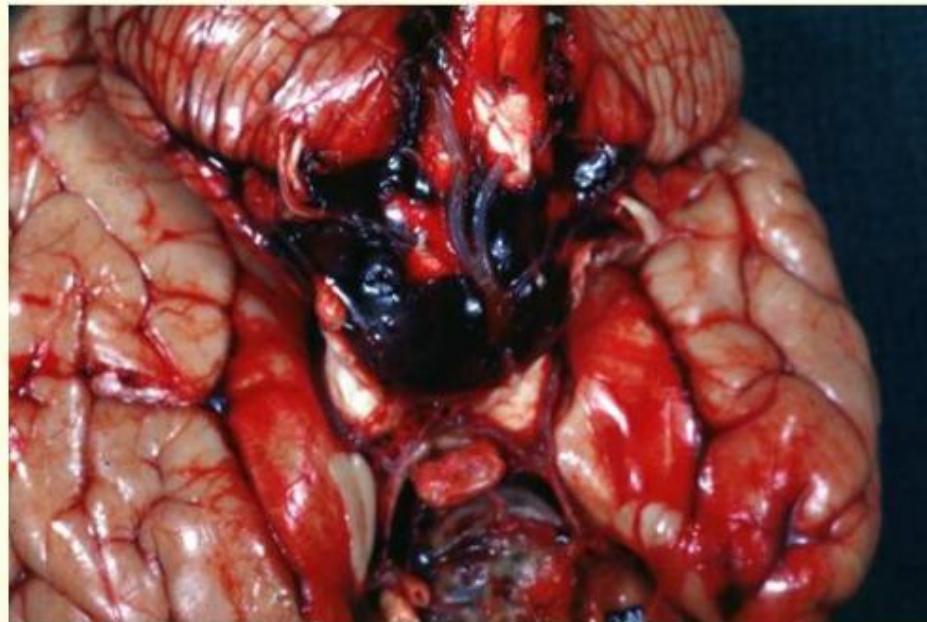
- Berry aneurysm: thin walled outpouching of an artery



2Y0452 [RM] (c) www.visualphotos.com



# Subarachnoid Hemorrhage



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

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(c) 2007, Michael A. Kahn, DDS/Lynn W. Solomon, DDS

## 5. Vascular malformations

- Arteriovenous malformations
- Cavernous malformations
- Capillary telangiectasia
- 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



M1360300 [RM] (c) www.visualphotos.com

# 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

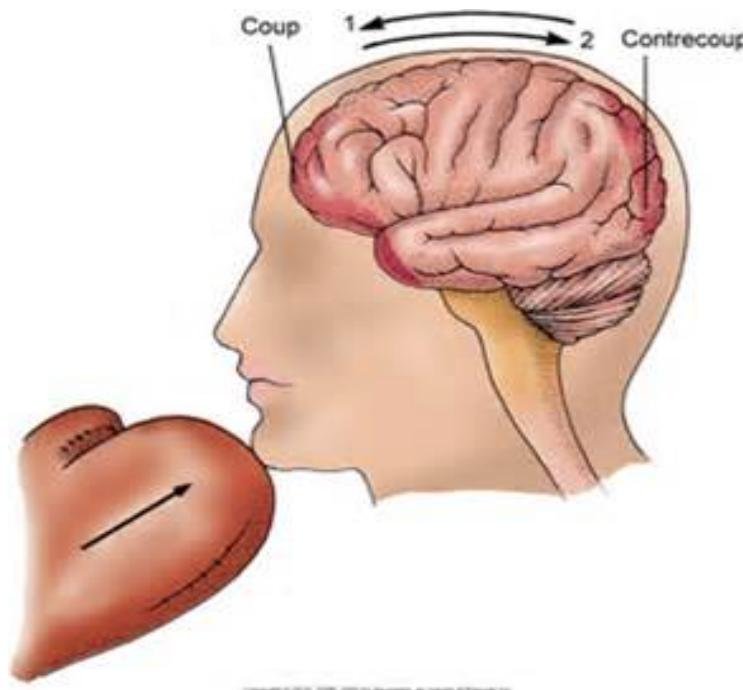
# Head injury

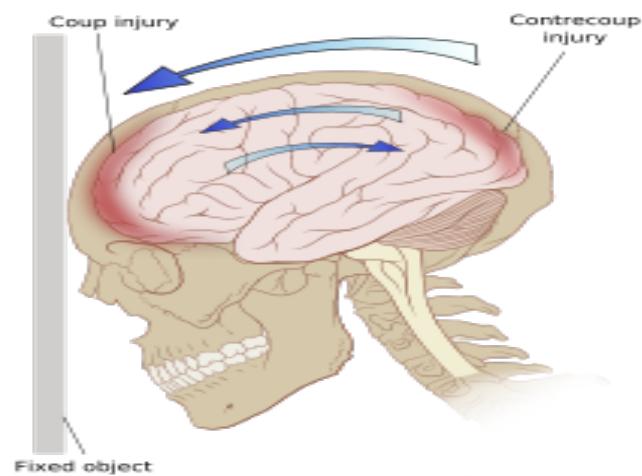
- Blunt or penetrating.
- Open or closed.
- Severe brain damage can occur without external signs of head injury
- Lacerations and even skull fractures are not necessarily associated with brain damage

# 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





## Note:

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

# Brain injury

- Concussions
- Contusions
- Lacerations
- Diffuse axonal damage

# concussions

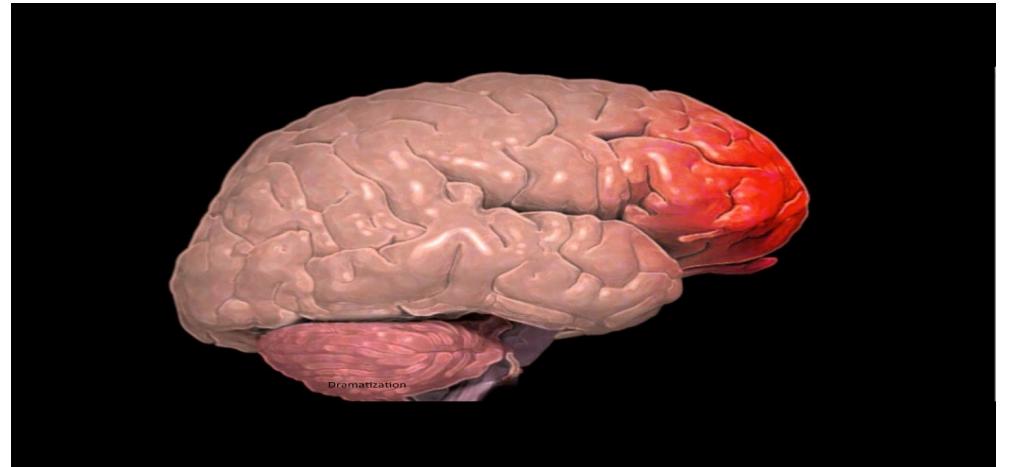
- Reversible altered consciousness after head injury in the absence of contusions
- Transient dysfunction in the form of: loss of consciousness, temporary respiratory arrest, loss of reflexes.
- Pathogenesis: unknown
- Recovery is complete but amnesia of the episode.

# 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.



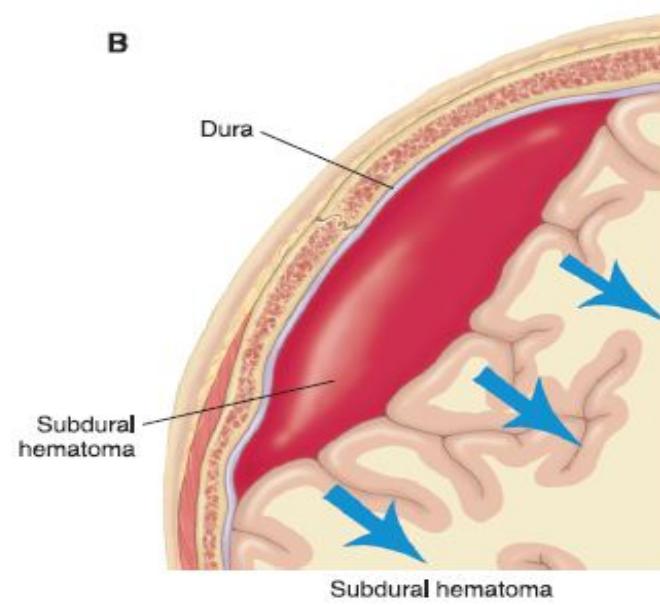
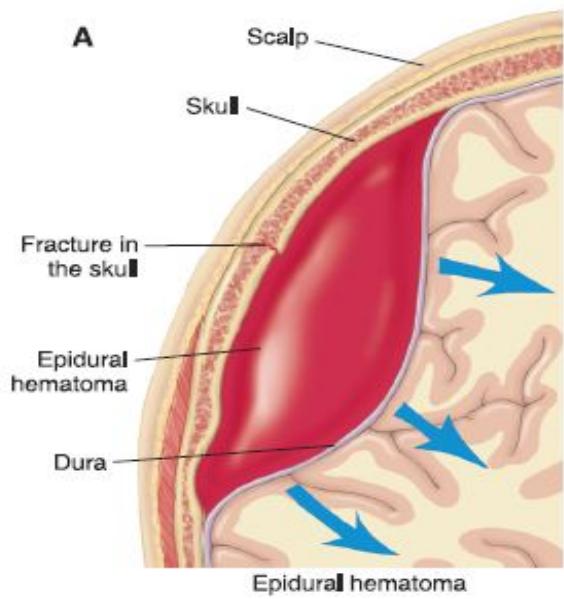
- Old traumatic injury: depressed, retracted, yellow brown patches involving the gyri.
- Larger lesions: cavity, resembling remote infarcts

# 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

- 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 is 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

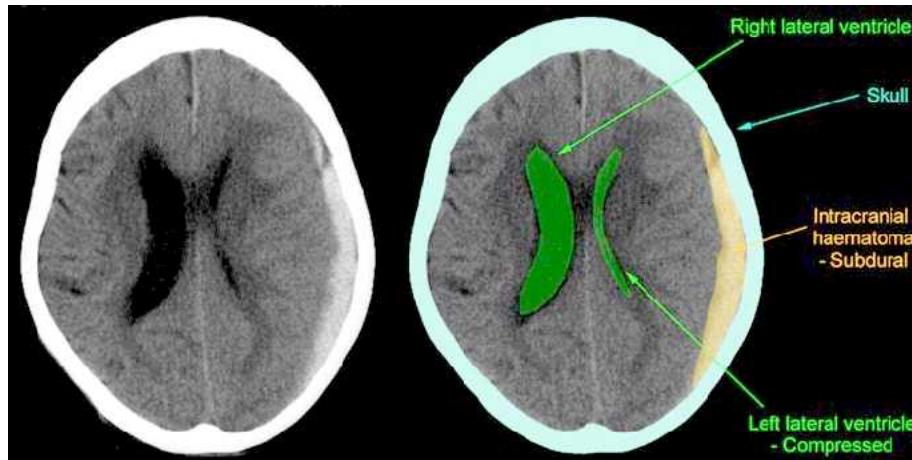
## Subdural hematoma

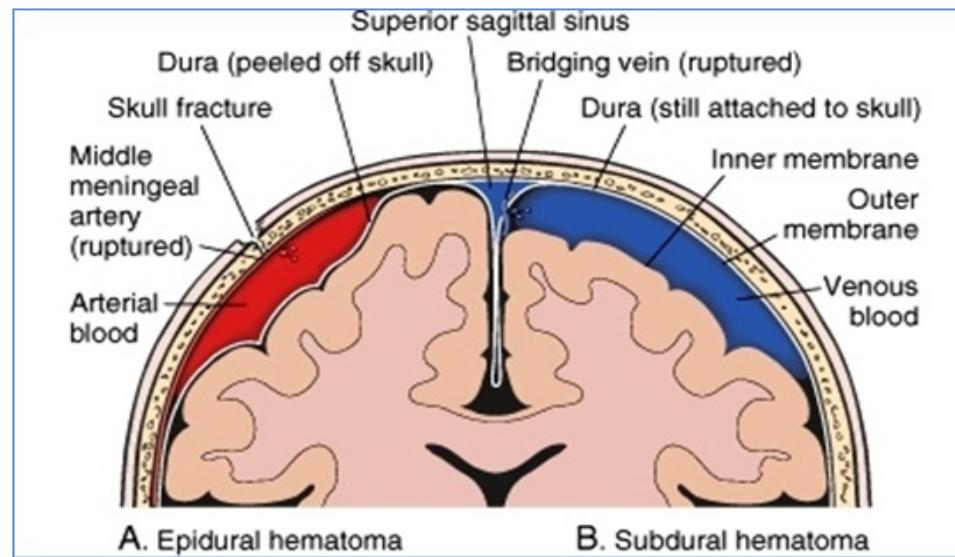
here the blood collects between the dura and the brain tissue

It shows a crescentic shape.



## Subdural hematoma





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# Summary 1/2

- Intracranial haemorrhage can be 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 causes 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, intraparenchymal 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

