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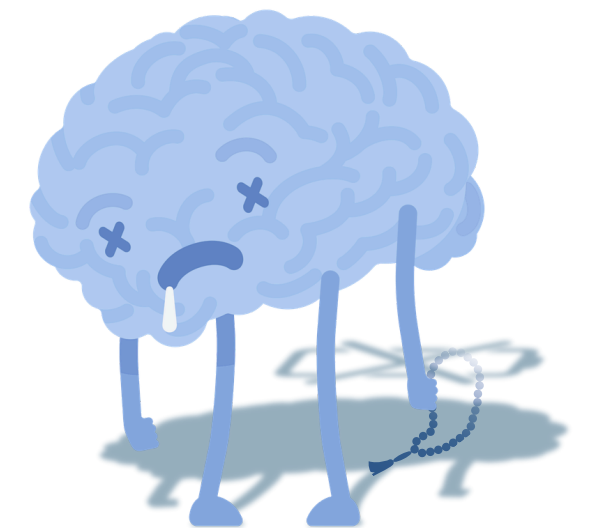
Lecture 3

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



Pathology Mind Maps

Stroke & increased intracranial pressure



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This file contains the lecture material presented through mind maps to make the information clearer, more organized, and easier to follow. It is designed to simplify studying and make revision more effective.

**We truly hope you find it beneficial.
If it helps you in any way, please remember us in
your prayers.**

Best of luck in your studies❤️!

CNS pathology

- **Stroke:** -Cerebrovascular diseases = CVA= stroke
- CVA is a major cause of death .
- CVA is the most common cause of neurologic morbidity.
- Stroke: clinical term applies to all three when **symptoms are acute**.

→ Increased intracranial pressure

Stroke

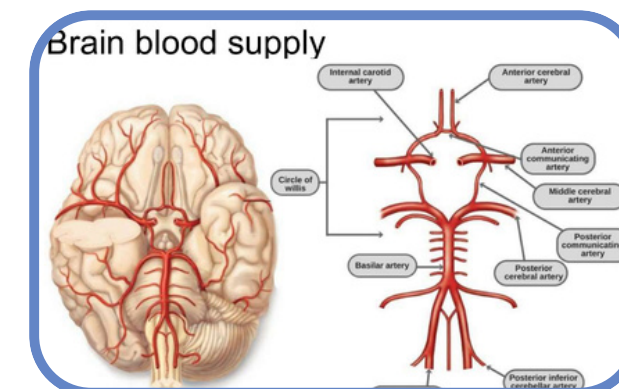
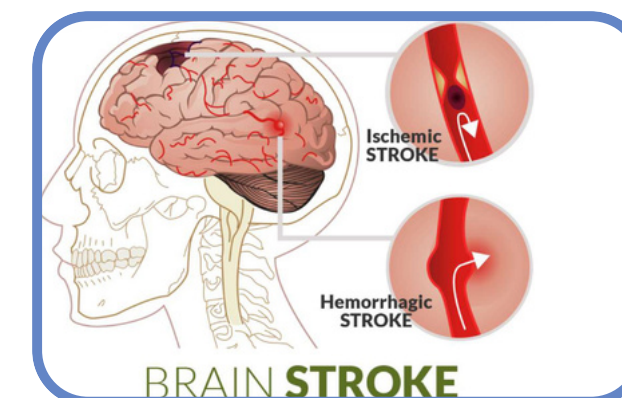
→ **Mechanisms:** thrombi, emboli, vascular rupture

→ **Definition:** Stroke: **rapidly** developing symptoms and signs of loss of focal CNS function lasting for **24 hours** or leading to death.

-Symptoms develop **quickly** (within seconds or minutes) but they persist for at least 24 hours.

-If the symptoms last for **less than 24 hours**, it is called: transient ischemic attack (TIA).

→ **Types:** It's very important to distinguish between the two types because **ischemic stroke** is treated by **anticoagulants**, whereas if you use anticoagulants in hemorrhagic stroke you might kill the patient.



→ **1. Ischemic stroke:** caused by vascular obstruction by a thrombus or an embolus
Ischemic strokes account for 85% of strokes.

→ **1. Thrombotic occlusions:** Atherosclerosis of cerebral arteries causing thrombosis.

Common sites:

1. Carotid bifurcation
2. Origin of middle cerebral artery
3. Ends of basilar artery

→ **2. Embolic infarcts:** More common than thrombotic infarcts

• Source:

1. cardiac mural thrombi, arise due to myocardial dysfunction, valvular disease, and atrial fibrillation

2. arterial atheroma in carotid arteries or aortic arch

3. venous thrombi crossing to arterial circulation through cardiac defects =

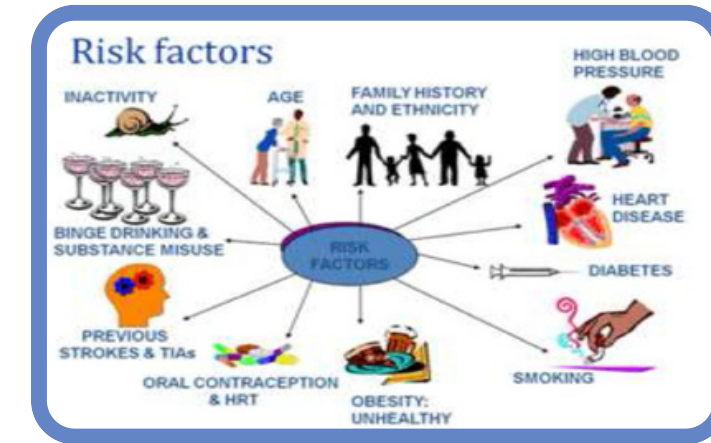
paradoxical embolism.. DVT, fat emboli

• Most common site of embolic occlusion : **middle cerebral artery**, a direct extension of the internal carotid.

• Emboli lodge where vessels **branch** or in **stenotic** areas caused by atherosclerosis

→ **2. Hemorrhagic stroke:** caused by vessel rupture secondary to several vascular diseases, like hypertension or vasculitis.

→ **Stroke risk factors:** basically these are the same risk factors of atherosclerosis



→ **Clinical features** Signs and symptoms= FAST

- The main symptoms of stroke can be remembered with the word **FAST**: Face-Arms-Speech-Time.
- **Face**– the face may have dropped on one side, the person may not be able to smile or their mouth or eye may have dropped.
- **Arms**– the person with suspected stroke may not be able to lift both arms and keep them there because of arm weakness or numbness in one arm.
- **Speech**– their speech may be slurred or garbled, or the person may not be able to talk at all despite appearing to be awake.
- **Time**– it is time to dial emergency team immediately if you see any of these signs or symptoms.

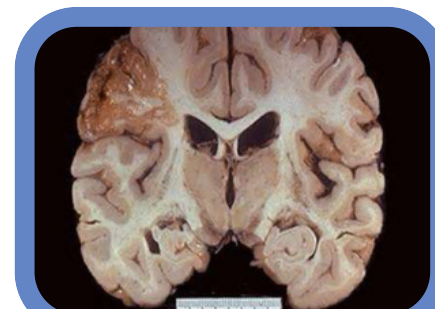


→ **Morphology/ non-haemorrhagic infarcts macroscopic appearance:** -By **48 hours**¹: pale, soft swollen area.

-**Day 2-10**: gelatinous and friable.

-**Day 10 to week 3**²: liquefaction ending in a fluid filled cavity.

1



Brain infarct

2



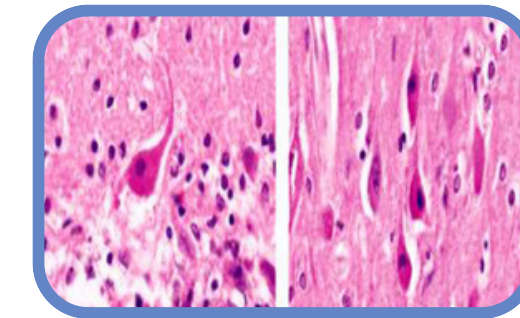
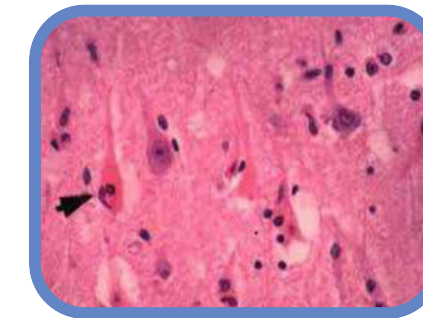
Ischemic damage to the brain causes liquefactive necrosis.



Old infarct: the infarct is resolved leading a cavity.

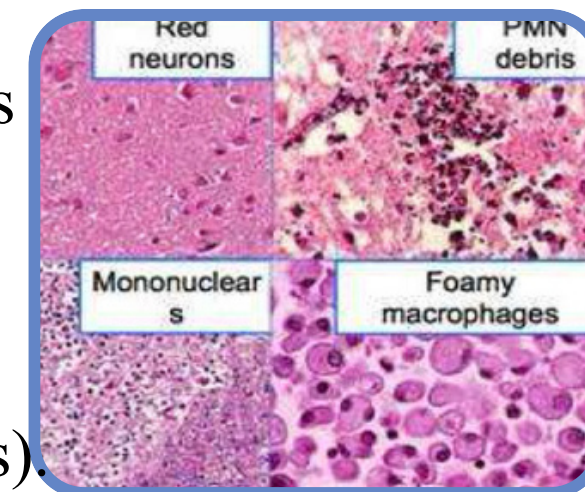
Morphology / non-hemorrhagic microscopic appearance

- **Early changes:** • (first 24 hours): red neurons + edema + neutrophils
 • Acute neuronal cell damage = red neurons, followed by cytoplasmic eosinophilia then **pyknosis** and **karyorrhexis**
 • Similar changes later on glial cells
 • Then: **neutrophilic infiltrate.**



Red neurones

- **Subacute changes:** - (24 hours to 2 weeks) macrophages, gemistocytic astrocytes.
 - Necrosis, Macrophages, Vascular proliferation, Reactive gliosis

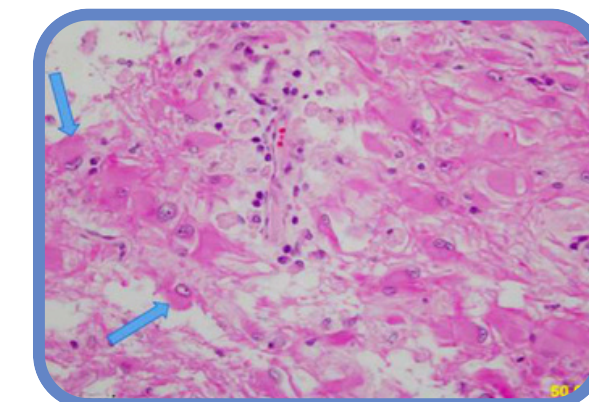


- **Repair:** - (after 2 weeks): gemistocytes regress, cavity persists
 - Removal of necrotic tissue, Gliosis, Loss of organised CNS structure
 Astrocytes are the main cells responsible for repair and scar formation (gliosis).

• Injury Causes:

1. hypertrophy and hyperplasia in astrocytes.
2. enlarged nuclei
3. prominent nucleoli.
4. increased pink cytoplasm.
5. increased, ramifying processes

**These changes in astrocytes: gemistocytic astrocyte



gemistocytes

→ **Transient ischemic attack (TIA):** - Sometimes, stroke is preceded by **transient ischemic attacks (TIA)**.

- These are important to be recognized clinically because they are a warning sign that a full-blown stroke is imminent.
- TIA means that the supply of blood to the brain is temporarily interrupted, causing a "**mini-stroke**" often lasting between 30 minutes and several hours.
- TIAs should be treated seriously as they are often a warning sign that there is risk of having a full stroke in the near future

Summary regarding Stroke.

- Stroke = CVA, is a clinical term describing acute neurological symptoms caused by vascular disease.
- stroke can be ischemic or hemorrhagic. Ischemic is commoner
- Ischemic stroke can be embolic or thrombotic. Embolic is commoner.
- Most common site of embolic occlusion is the middle cerebral artery.
- Ischemic strokes might be preceded by TIA= vascular occlusion causing symptoms lasting from minutes to several hours.
- TIAs predict a full stroke and should be treated promptly.
- Ischemic infarcts in the brain cause liquefactive necrosis.
- in the acute stage we see red nuclei and neutrophilic infiltrate
- in subacute stage we see macrophages ,gemistocytes and gliosis.
- in the late stages, gemistocytes disappear leaving a cavity behind.

Intracranial pressure

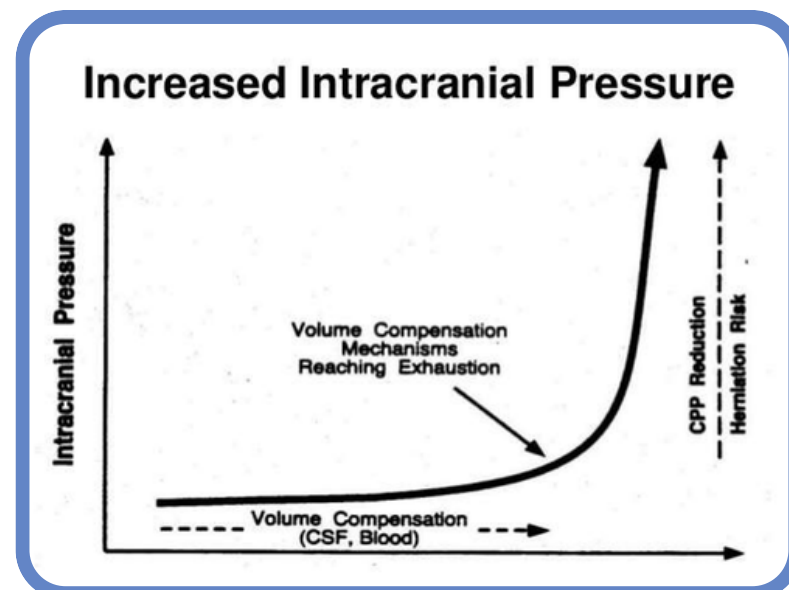
- **Cranium:** • The brain is enclosed within the skull, which is a rigid box that protects it .
- In adults, skull bones **cannot expand**
 - So if the material within the cranium increases.
- **Pressure will increase = increased intracranial pressure



- **Cranium content :** • ROUGHLY:
- 80% brain tissue (including intracellular and interstitial fluid which is around 75% of brain weight)
 - 10% blood
 - 10% CSF (cerebrospinal fluid)

→ **Note:** If any of these components increases, the intracranial pressure increases.

→ **Monro- Kellie hypothesis :** • intracranial volume= $V(\text{CNS}) + V(\text{CSF}) + V(\text{Blood}) + V(\text{lesion})$



- This hypothesis indicated that any space occupying lesion in the brain will increase the volume inside the cranium and this will result in increased intracranial pressure.
- Space occupying lesions occur with all major brain diseases (except degenerative diseases). Examples: brain tumours, trauma, stroke, haemorrhage.

- **Definition:**
- It is the pressure inside the skull and is measured in **millimetres of mercury**
 - at rest, it is normally **7–15 mmHg for a supine adult**.
 - If pressure in the cranium is higher than this upper limit -> increased intracranial pressure (intracranial hypertension).

→ **Causes :**

→ **Mass effect :** brain tumor, hematoma, or abscess.

→ **Generalized brain swelling:** ischemia, hypertension

→ **Increase in venous pressure:** heart failure

→ **Obstruction to CSF flow and/or absorption or increased CSF production:** hydrocephalus

→ **Idiopathic or unknown**

→ **Clinical presentation:**

→ **Early stage :** non specific symptoms like **headache** and **vomiting**.

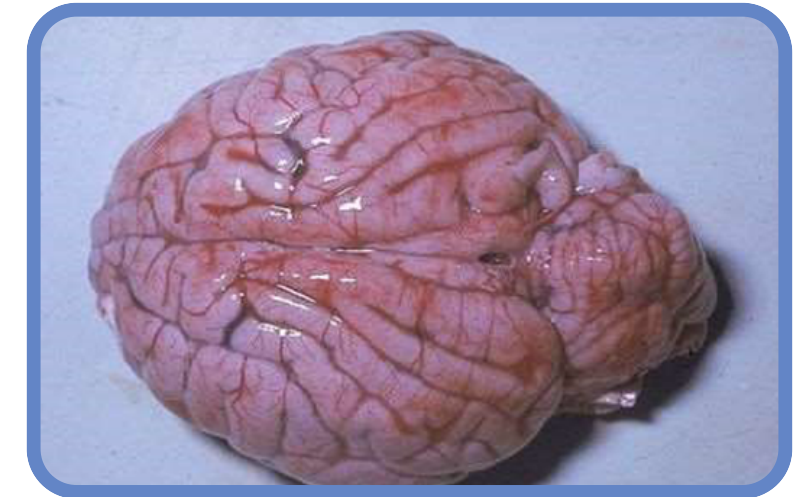
*patients might have **Cushing reflex** (Cushing response or Cushing triad) which manifests by:
increased blood pressure, bradycardia and irregular breathing.

→ **Advances cases:** patients have **neurological manifestations** including disturbed level of consciousness.

→ **Later stage:** complications can occur, mainly **herniation and seizures**.

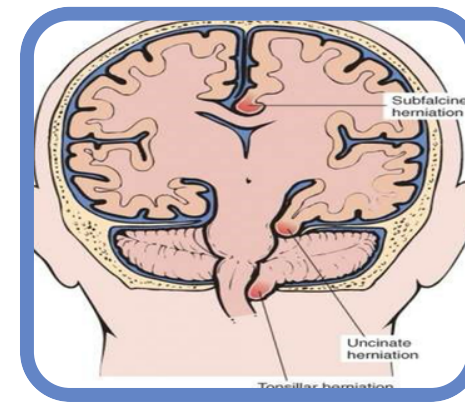
Brain edema (cerebral edema)

- **Etiology** : accumulation of excess fluid within the brain parenchyma.
- **Types** : vasogenic and cytotoxic edema.. Usually coexist
- **Note** : the distinction between gyri and sulci is diminished because the sulci are filled with fluid making them narrow and the gyri are widened by the fluid
- **complication** : Herniation



Herniation (Expansion) :

- **Etiology** :
 - Increased volume of tissue inside the skull causes Increased intracranial pressure which causes focal expansion of the brain tissue .
 - Because the cranial vault is subdivided by rigid dural folds (falx and tentorium).... The expanded brain tissue is displaced in relation to these folds.
 - Expansion= herniation
 - SO: herniation is a complication of increased intracranial pressure and it occurs in relation to margins of the dural folds



Types of Herniation

→ **Cingulate (Subfalcine) :** -Cingulate gyrus displaced under edge of falx
-Can cause compression of **anterior cerebral artery**; so the territory supplied by this artery can suffer ischemic damage and infarction if severe.

→ **Transtentorial (uncinate) :**

- Medial aspect of temporal lobe compressed against the free margin of the tentorium.
- so the brain tissue is forced from supra-tentorial towards the infra-tentorial compartment.
- **Third cranial nerve compressed..** Dilated pupil, impaired ocular movement on the side of the lesion (ipsilateral side)
- **Posterior cerebral artery** can be affected.. Ischemic injury to tissues supplied by it including visual cortex.
- **can cause hemorrhage in the midbrain and pons (Duret haemorrhage) which is usually fatal.**

→ **Tonsillar :**

- Displaced cerebellar tonsils through foramen magnum
- Brain stem compression... respiratory and cardiac centres in medulla compromised.
- **LIFE THREATENING**

→ Duret hemorrhage:

→ **Definition:** Small lineal areas of bleeding in the midbrain and upper pons of the brainstem.

→ **Etiology :** The end result of temporal medial lobe (transtentorial) herniation is compression of the brainstem (midbrain and pons) and stretching of small arterial branches.

→ **Cause:** caused by downward displacement of the brainstem.

→ **Note:** They are named after Henri Duret.



اللهم أنت ربّي لا إله إلا أنت خلقتني وأنا عبدك وأنا على عهدك
ووعدك ما استطعت، أعوذ بك من شر ما صنعت، أبوء لك
بنعمتك علي وأبوء لك بذنبي فاغفر لي فإنه لا يغفر الذنوب إلا أنت

A 54 year old man complained of severe headache and vomiting. imaging studies showed a large subdural hematoma. Two days later he had dilated pupil of the right eye with and his visual acuity decreased. Which of the following is incorrect about his condition?

- A. Can be complicated by haemorrhage in the pons.
- B. His eye symptoms could be related to ischemic injury to the visual cortex
- C. The medial aspect of his temporal lobe is compressed against the free margin of the tentorium
- D. The dilated pupil indicated damage of the left third cranial nerve
- E. He might develop fatal brain stem complications

The scenario describes **increased ICP due to hematoma**. The complications he had indicate herniation, and the symptoms are those of **transtentorial herniation**.

A. Correct, it describes Duret hemorrhage.

B. Correct, note that the decreased visual acuity is due to effect on the visual cortex (ischemic damage due to compression on the posterior cerebral artery) , however, the dilated pupil and impaired ocular movement are effects of compression on the third cranial nerve.

C. Correct, it simply describes his main complication (transtentorial herniation)

D. Incorrect the lesion is related to the ipsilateral nerve (at the same side of the lesion).. so his right third cranial nerve is compressed.

E. Correct, again it describes Duret haemorrhage.

اللهم لك الحمد حتى ترضى، ولك الحمد إذا رضيت، ولك الحمد بعد الرضا

اللهم اجعل أجر هذا العمل صدقة جارية عن روح عمر عطيه عوده المرابي

• اللَّهُمَّ اغْفِرْ لَهُ وَارْحَمْهُ، وَاعْفُ عَنْهُ وَعَافِهِ، وَأَكْرِمْ نُزُلَهُ، وَوَسِّعْ مُدْخَلَهُ، وَ اغْسِلْهُ بِمَاءٍ وَتَلْجٍ وَبَرْدٍ، وَنَقِّهِ مِنَ الْخَطَايَا
كما يُنَقِّي الثَّوْبَ الْأَبْيَضُ مِنَ الدَّنَسِ.

• اللَّهُمَّ أبدله داراً خيراً من داره، وأهلاً خيراً من أهله، وأدخله الجنة، وأعدّه من عذاب القبر ومن عذاب النار.
• اللَّهُمَّ يَمِّنْ كتابه، ويسر حسابه، وثقل بالحسنات ميزانه، وثبّت على الصراط أقدامه، وأسكنه في أعلى الجنات،
بجوار حبيبك محمد صلى الله عليه وسلم.

• اللهم اغفر لحينا وميتنا وشاهدنا وغائبنا وصغيرنا وكبيرنا وذكرنا وأنثانا اللهم من أحييته منا فأحيه على
الإسلام ومن توفيته منا فتوفه على الإيمان اللهم لا تحرمنا أجره ولا تضلنا بعده.
• اللهم اغفر له وارفع درجته في المهديين، واخلفه في عقبه في الغابرين، واغفر لنا وله يا رب العالمين، وافسح
له في قبره، ونور له فيه.

• اللَّهُمَّ أنزل على أهله الصبر والسلوان وارضهم بقضائك.

اللهم لا تفجعنا بأنفسنا ولا أهلنا ولا أحبتنا، اللهم أعوذ بك من فواجع الأقدار ومن مصائب الدنيا وتقلب
حوادثها، اللهم إنا نخاف الفقد فلا تحملنا ما لا طاقة لنا به.