MENINGES ,VENTRICLES & CSF

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OBJECTIVES

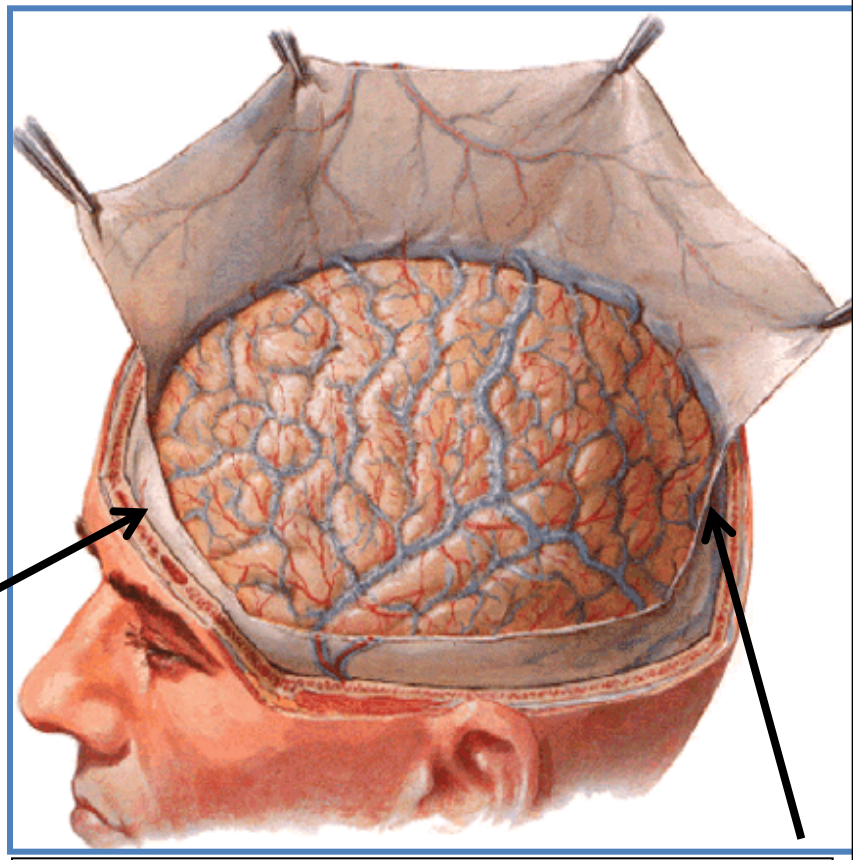
- ***By the end of the lecture the student should be able to:***
- *Describe the **cerebral meninges** & list the main dural folds.*
- *Describe the **spinal meninges** & locate the level of the termination of each of them.*
- *Describe the importance of the **subarachnoid space**.*
- *List the **Ventricular system of the CNS** and locate the site of each of them.*
- *Describe the **formation, circulation, drainage, and functions of the CSF.***
- *Know some **clinical point about the CSF***

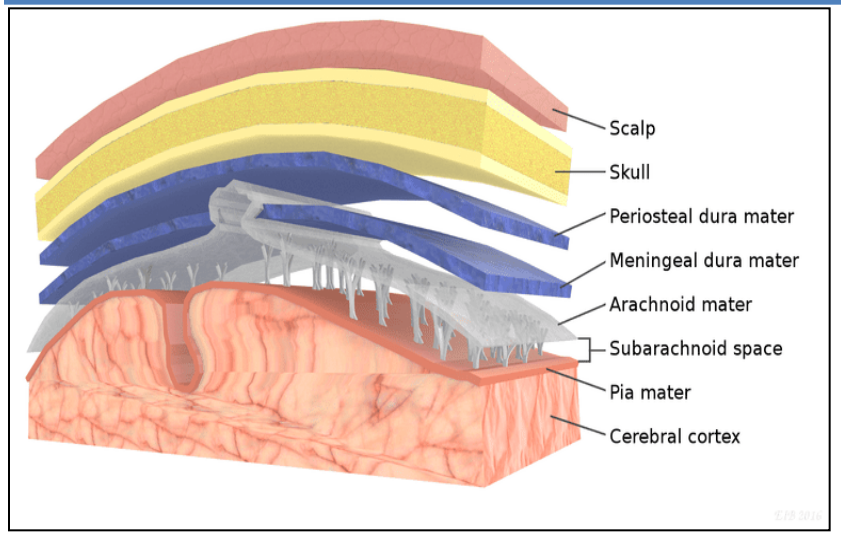
MENINGES

- The **brain and spinal cord** are invested by three concentric membranes ;
- The outermost layer is the **dura matter.**
- The middle layer is the **arachnoid matter.**
- The innermost layer is the **pia matter.**

DURA MATER

- The **cranial dura** is a two layered tough, fibrous, thick membrane that surrounds the brain.
- It is **formed of** two layers; **periosteal** and **meningeal.**
- **The periosteal layer** is attached to the skull.
- **The meningeal layer** is folded forming the **dural folds : falx cerebri,** and **tentorium cerebelli.**
- **Sensory innervation of the dura** is mostly from : meningeal branches of the trigeminal and vagus nerves & C1 to C3(upper cervical Ns.).





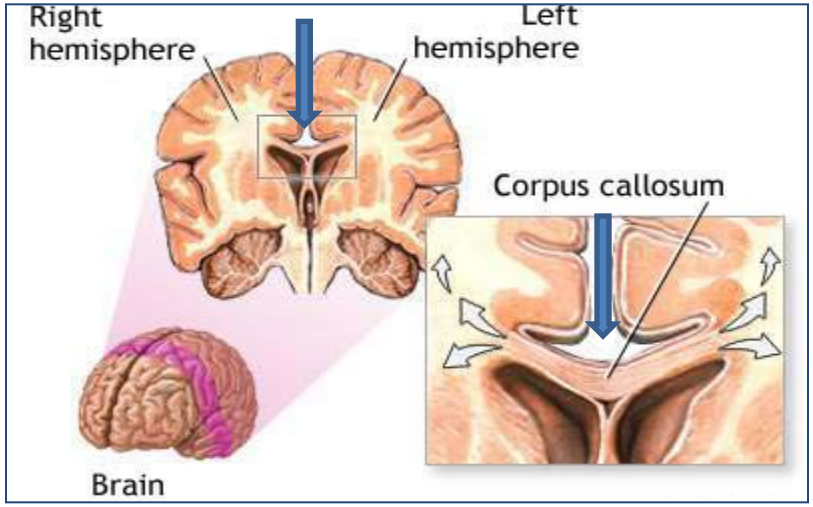
DURA MATER Folds

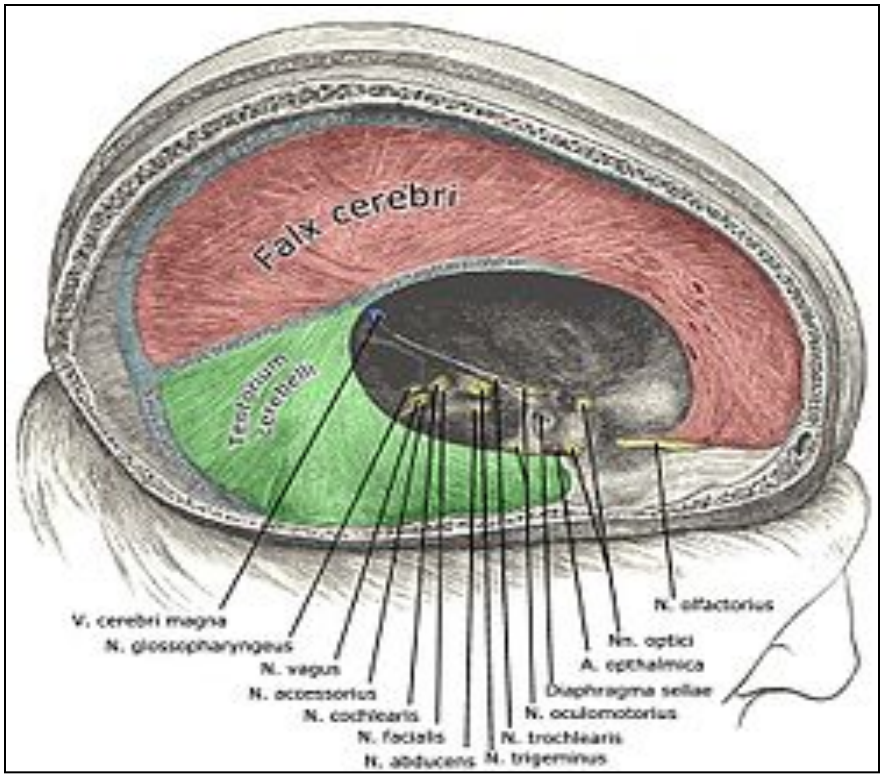
❑**Two large reflection of dura extend into the cranial cavity :**

1.The falx cerebri,

In the midline,

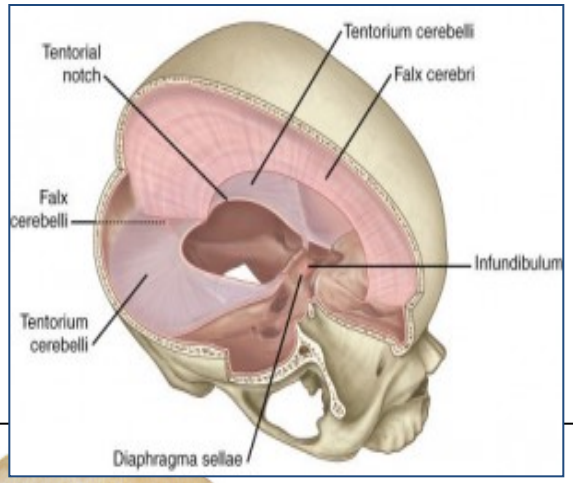
- It is a **vertical sickle-shaped** sheet of dura, **extends from** the **cranial roof into** the **great longitudinal fissure between the two cerebral hemispheres.**
- It has an **attached border adherent to the skull**.
- And a **free border** lies **above the corpus callosum.**

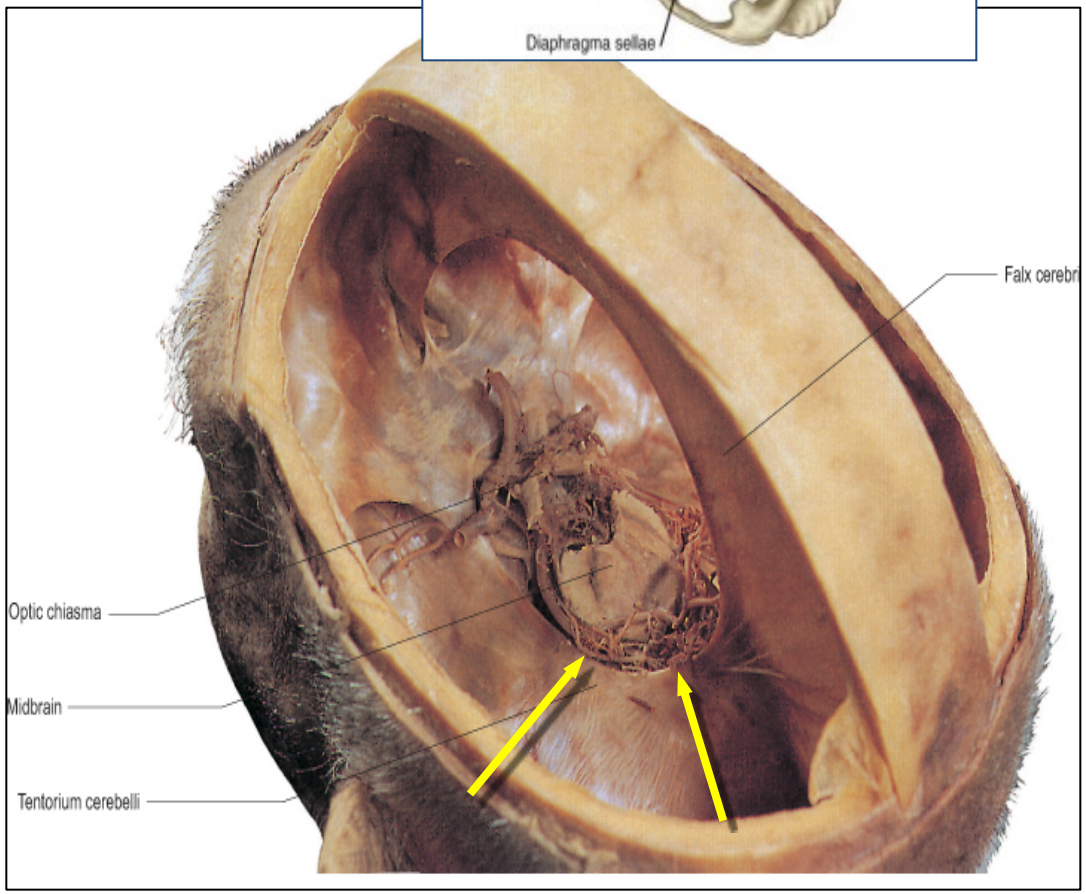




DURA MATER Folds

2. A horizontal shelf of dura, The tentorium cerebelli,
   - It lies between the posterior part of the cerebral hemispheres and the cerebellum.
   - It has a free border that encircles the midbrain.
   - In the middle line it is continous above with the falx cerebri.





Dural nerve supply
Arterial supply

Dural nerve supply:

Branches of trigeminal, vagus, and first three cervical nerves and branches from the sympathetic system.

The dura is sensitive to stretching (sense of headache)

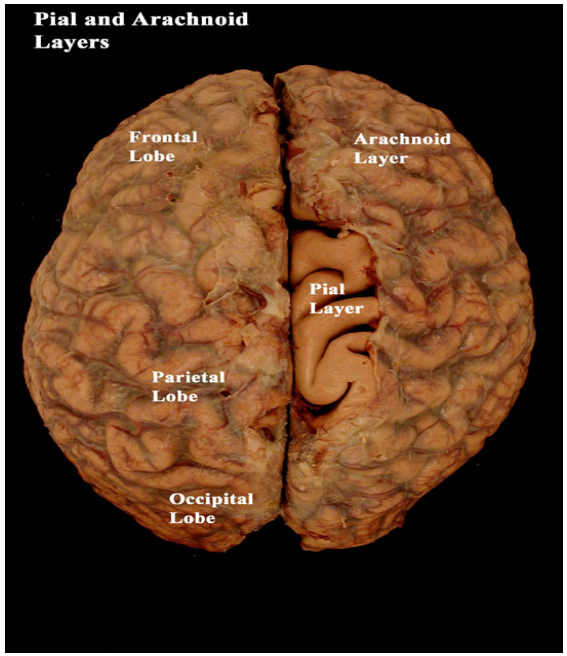
Arterial supply:

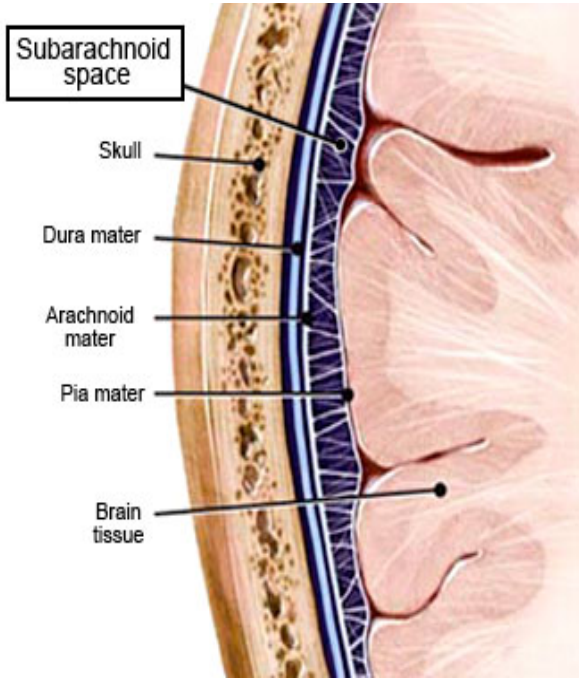
Branches from internal carotid, maxillary, ascending pharyngeal, occipital, and vertebral arteries.

Clinically the most important is the middle meningeal artery, which is commonly injured in head injuries.

Arachnoid Mater& Pia Mater

- **The arachnoid mater** is a soft, translucent membrane loosely envelops the brain.
- The arachnoid mater is separated from the dura by a narrow **subdural space.**
- **The pia mater** is the innermost, thin, delicate & highly vascular membrane that is closely adherent to the gyri and fitted into the sulci.
- Between the pia and arachnoid mater lies the **subarachnoid space which contains; fibrous trabechulae, main blood vessels and CSF.**

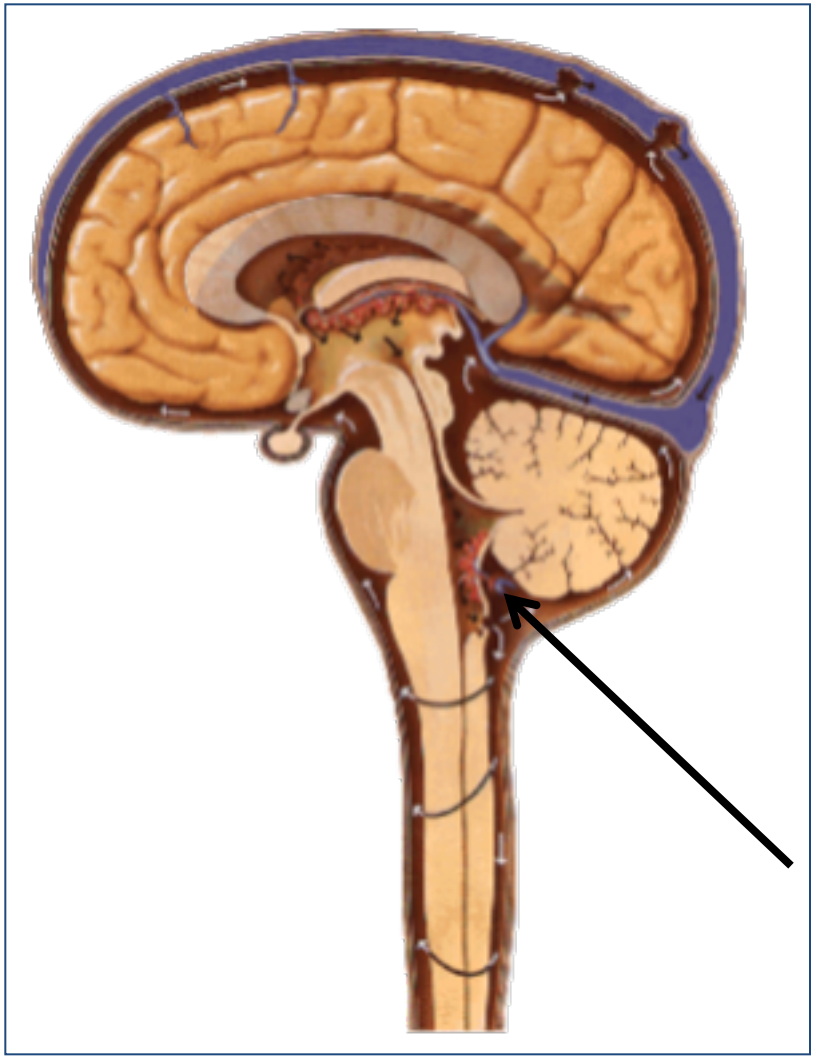




Subarachnoid Space

- It is **varied in depth** forming; **subarachnoid cisterns ;**

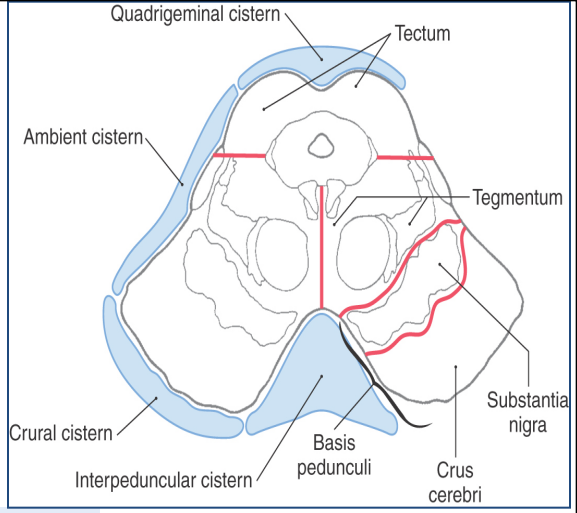
1. The **cisterna magna**, or **cerebllomedullary cistern** which lies between the inferior surface of the cerebellum and the back of the medulla.
   - At this cistern CSF flows out of the 4th ventricle **via** the two lateral apertures and median aperture.

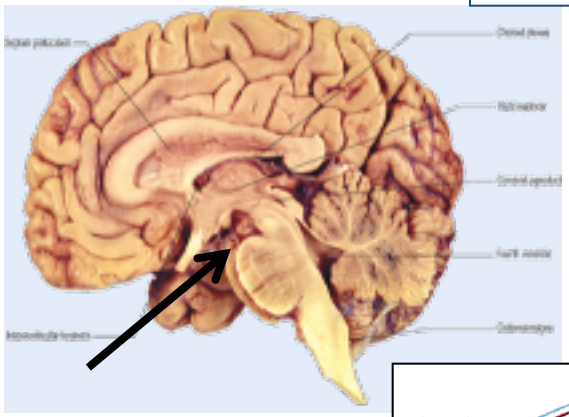


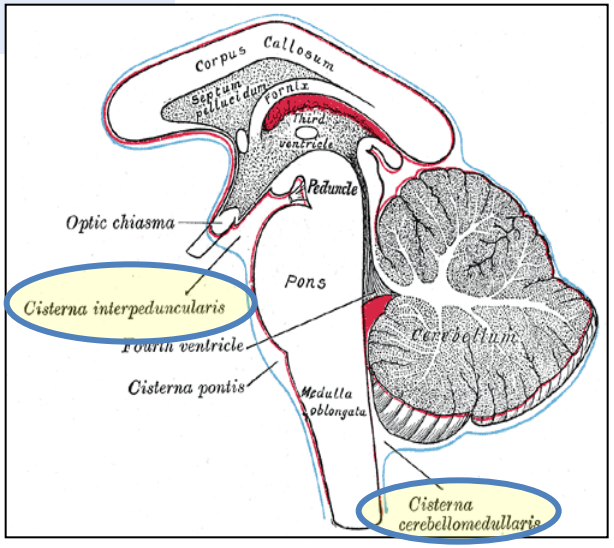
Subarachnoid Space

2. The interpeduncular cistern, which is located at the base of the brain, where the arachnoid spans between the two cerebral peduncles of midbrain.

- **This cistern contains** the optic chiasma & circulus arteriosus of Wills.







Spinal meninges

❑**The spinal cord**, is invested by **three meningeal coverings: pia mater, arachnoid mater** and **dura mater.**

❑ The **dura matter; The outer covering;** is a thick, tough fibrous membrane.

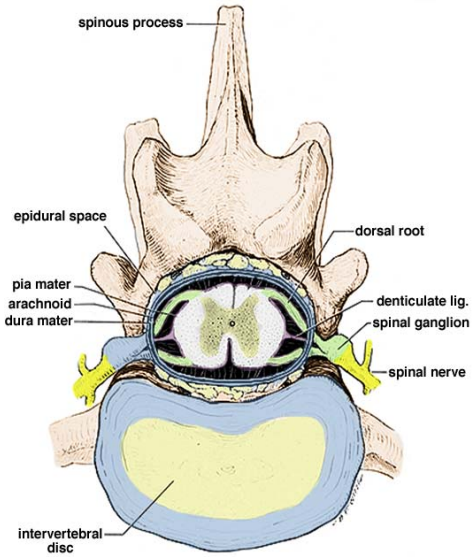
- It envelopes the cord **loosely.**
- **It is separated from arachnoid** matter by the **subdural space**, and **from the bony wall** of the **vertebral canal** by the **epidural space**.

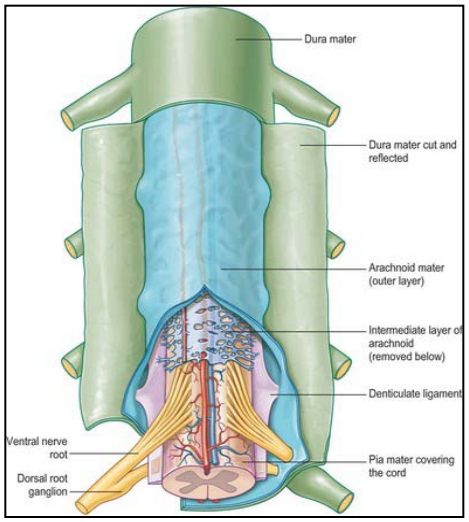
❑The **arachnoid matter** is a translucent membrane lies between the pia and dura,

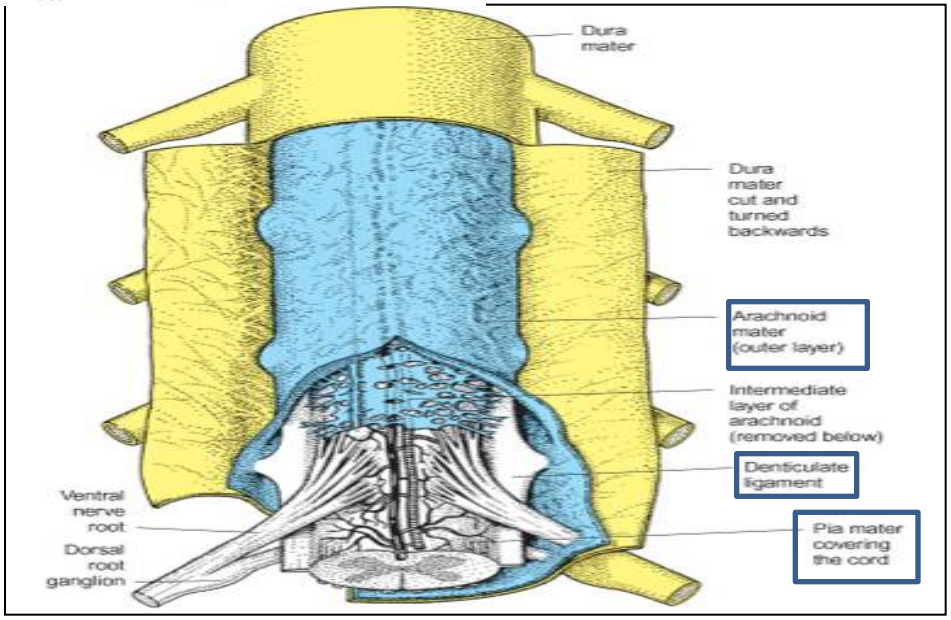
- **Between arachnoid** and **pia** lies the **subarachnoid space contains CSF.**

❑The **pia matter; The innermost covering,** is a delicate fibrous membrane **closely envelops the cord and nerve roots.**

- **It is attached** through the arachnoid **to the dura by** the **denticulate ligament.**

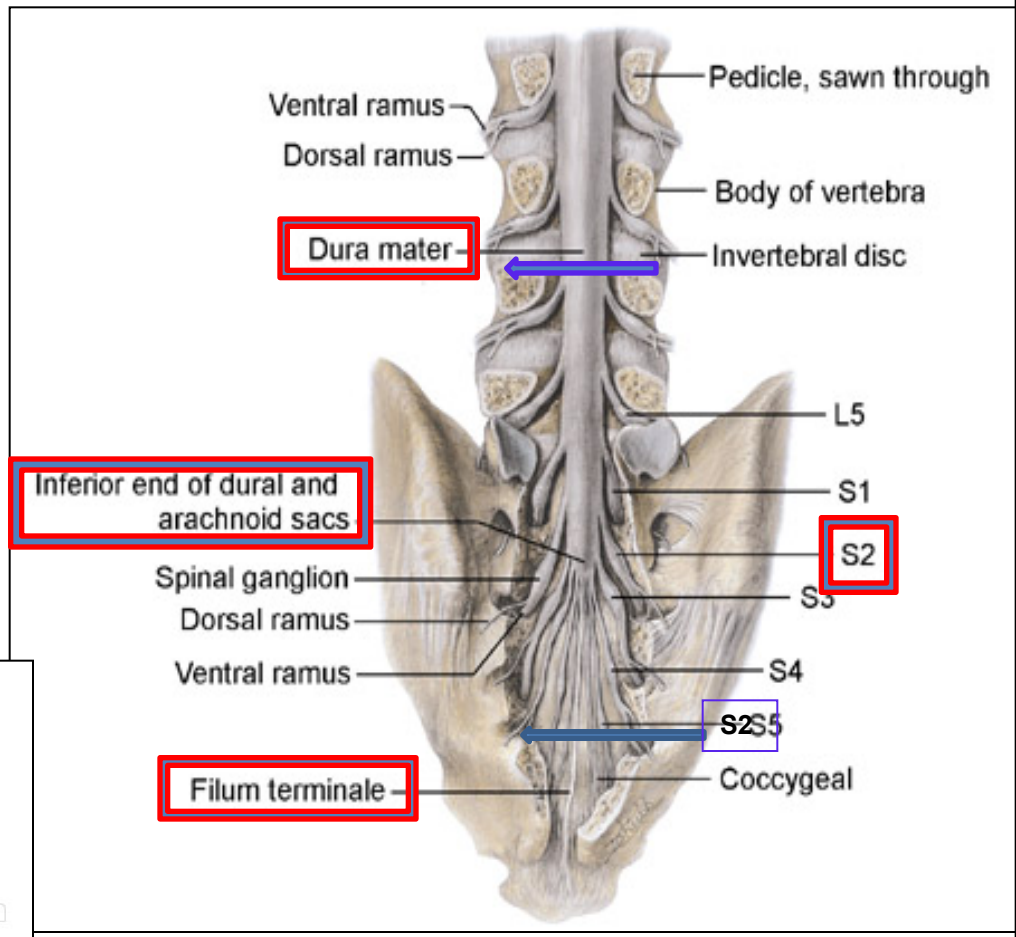


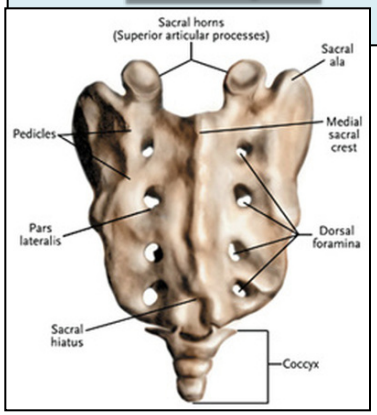


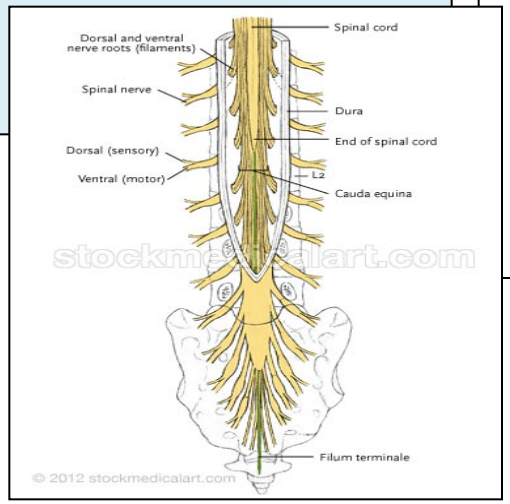


Spinal meninges

- **The spinal cord** terminates at level **L1-L2**, while
- **The dura and arachnoid** and, **subarachnoid space,** continue caudally to **S2.**
- **The pia** extends downwards forming the **filum terminale** which pierces **the arachnoid** and **dural sacs** and passes through the sacral hiatus to be attached **to the back** of the **coccyx.**

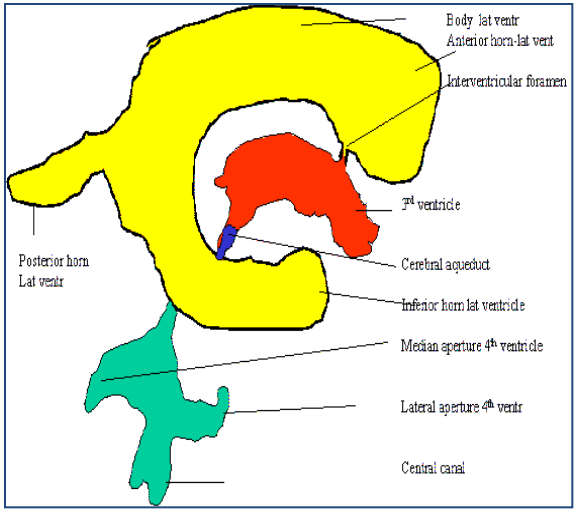


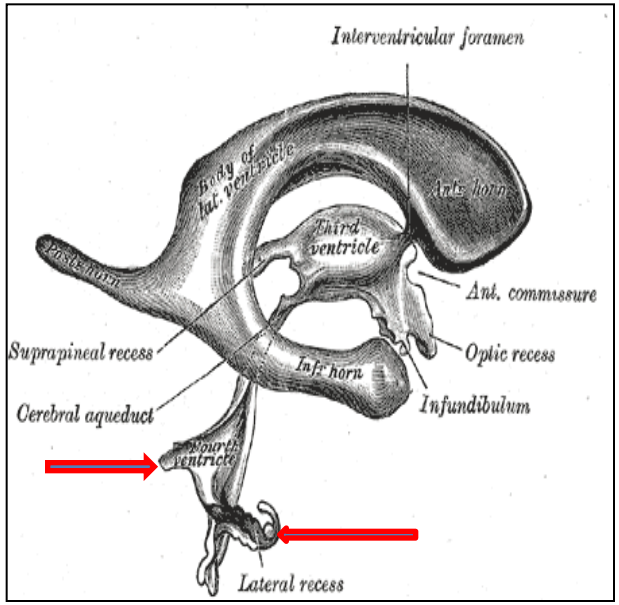




VENTRICULAR SYSTEM

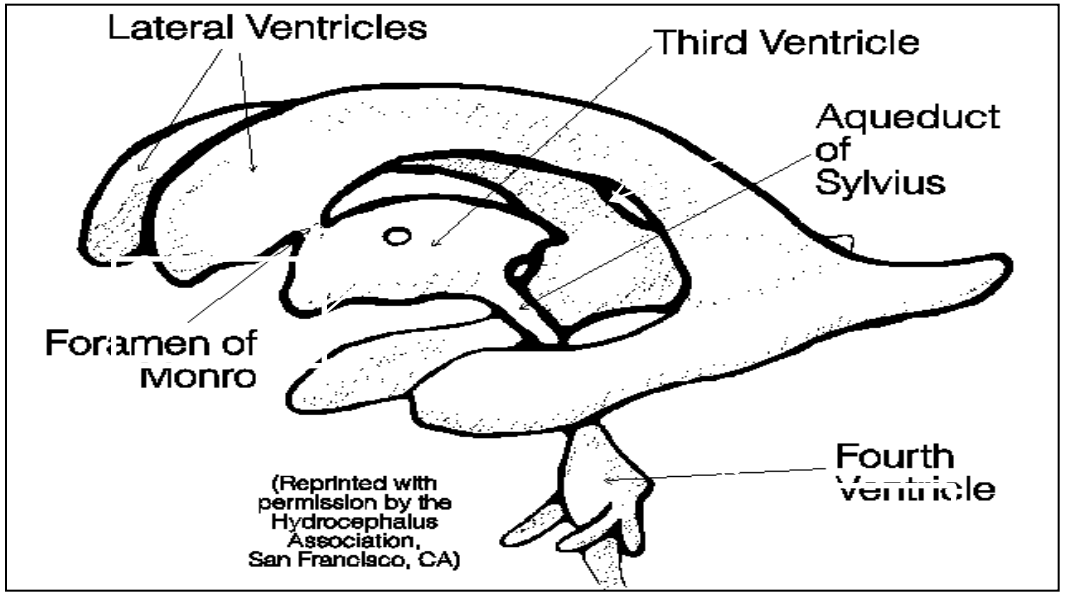
- **Interconnecting channels** within the CNS.
- In the spinal cord; represented by the **central canal.**
- Within the brain; a system of **ventricles** is found.
- The **central canal** of the spinal cord is **continuous upwards** to the **forth ventricle.**
- On each side of the **forth ventricle** laterally, **lateral recess** extend to open into lateral aperture (**foramen of Luscka**), central defect in its roof (**foramen of Magendie**)





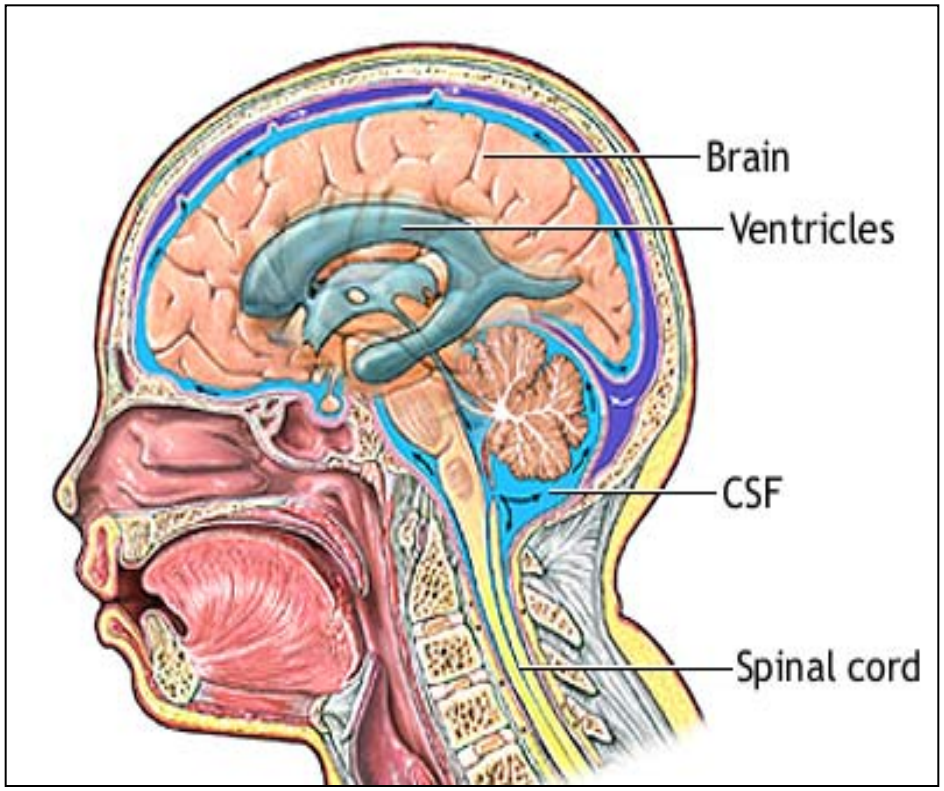
VENTRICULAR SYSTEM

- The **forth ventricle** is continuous up with the **cerebral aqueduct,** that opens in the **third ventricle.**
- The **third ventricle** is continuous with the **lateral ventricle** through the **interventricular foramen (foramen of Monro).**



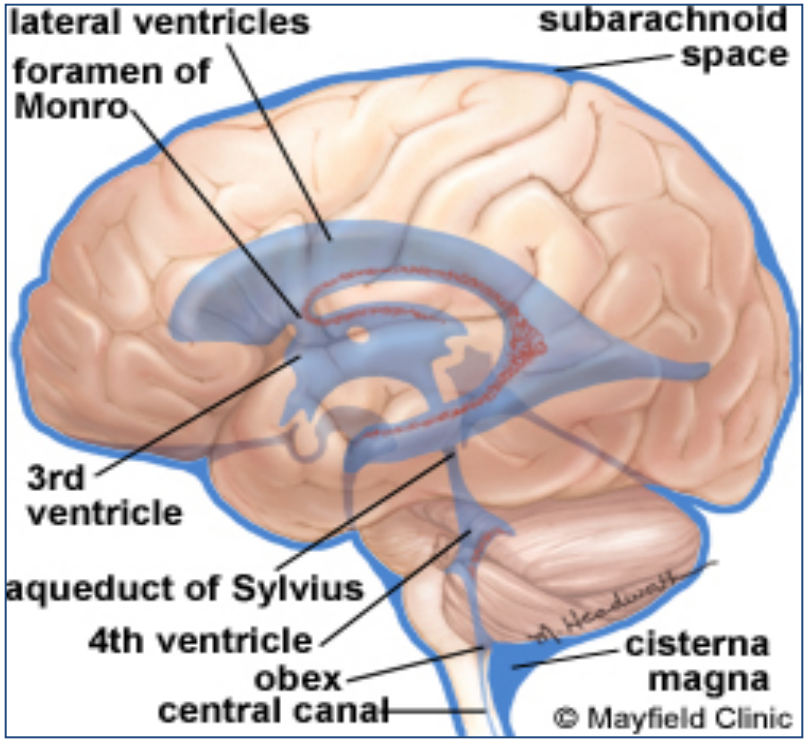
CEREBROSPINAL FLUID

- **Present in** the **ventricular system**, together with the cranial and spinal **subarachnoid spaces**.
- It is **colorless clear fluid** containing little protein and few cells.
- It is about **150** ml.
- It acts as a **cushion** for the brain from sudden movements of the head.



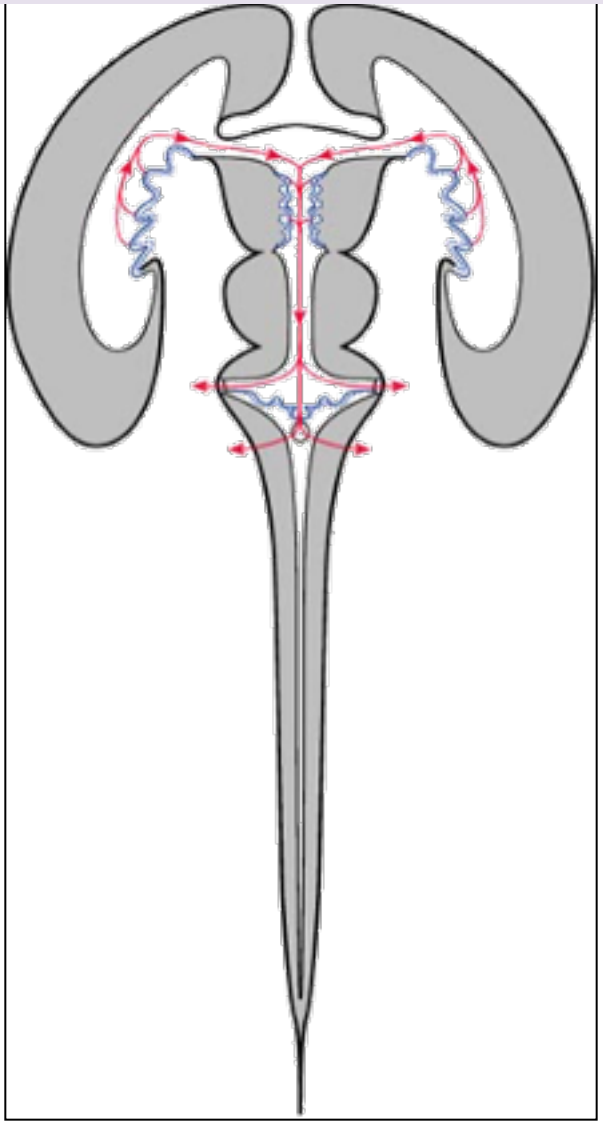
CEREBROSPINAL FLUID

- It is **produced by** the **choroid plexus,** which is **located in** the lateral, third & fourth **ventricles.**
- From lateral ventricle **it flows**: through the **interventricular foramen** into the **3rd ventricle** and, by way of the **cerebral aqueduct,** into the **4th ventricle**.



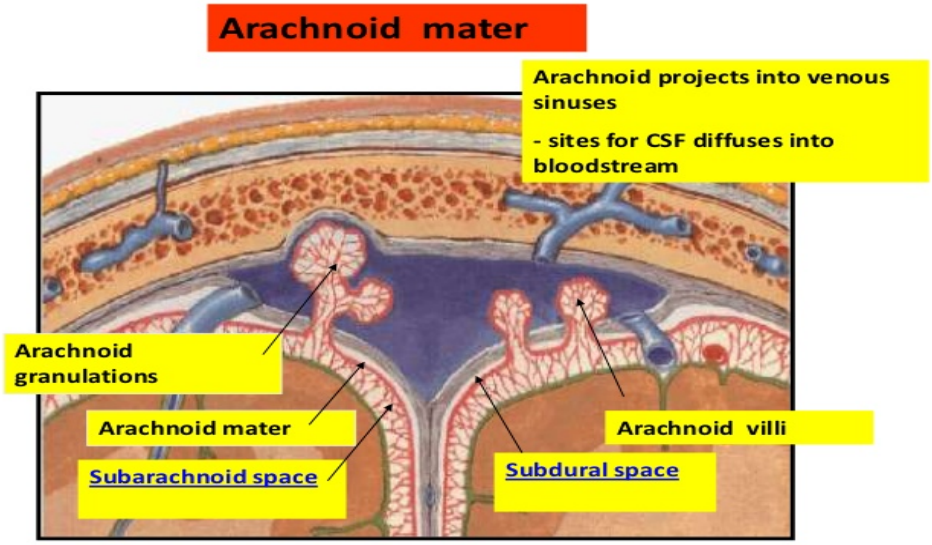
CEREBROSPINAL FLUID

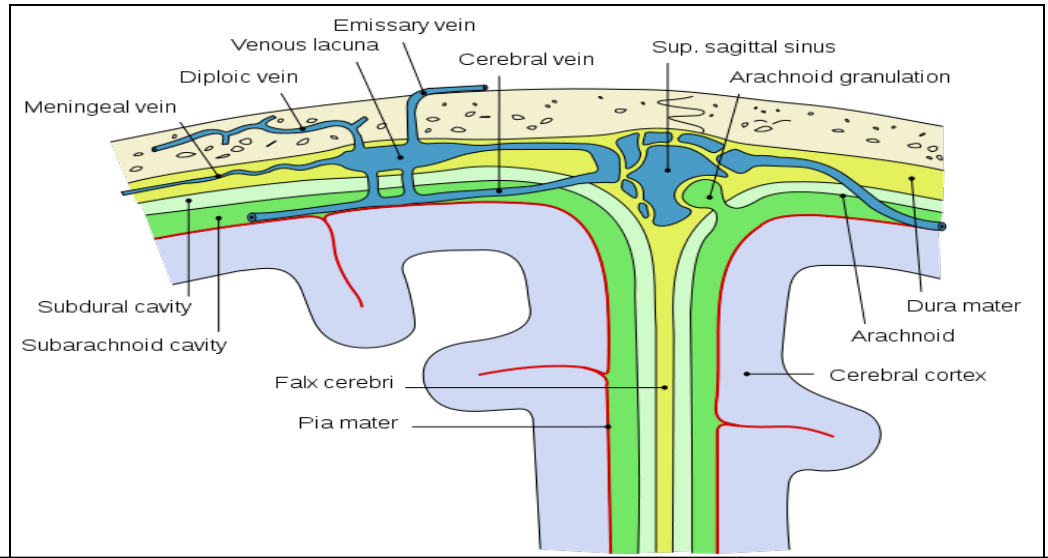
- **It leaves the ventricular** system through the **three apertures of the 4th ventricle (median foramen of Magindi & 2 lateral foraminae of Leushka),** to enters the **subarachnoid space.**



CEREBROSPINAL FLUID

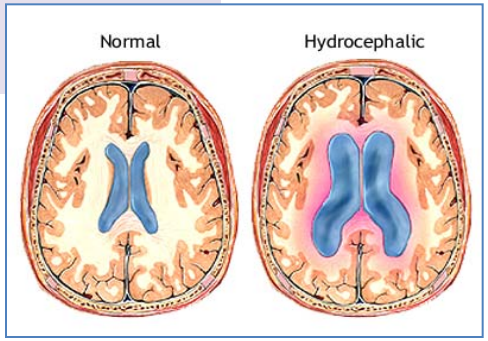
- **Reabsorbed finally** into the venous system **along**
- **arachnoid villi (small microscopic herniation of arachnoid mater), and**
- **arachnoid granulation (Macroscopic multilobulated structures)** that project **into** the **dural venous sinuses , mainly superior saggital sinus.**

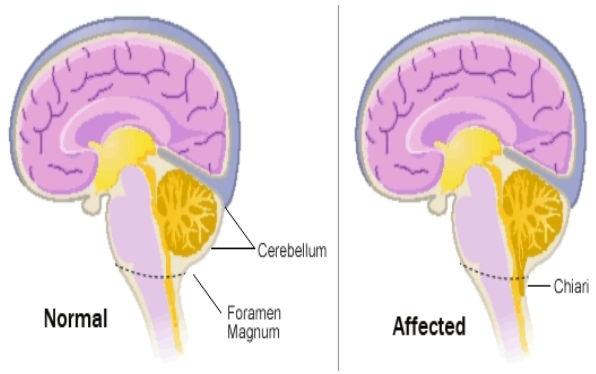




CEREBROSPINAL FLUID clinical point

❑The obstruction of the flow of CSF leads to a rise in fluid pressure causing swelling of the ventricles **(hydrocephalus).**





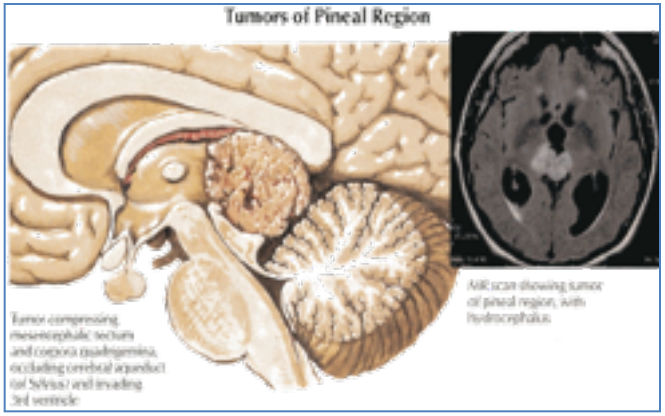
❑Causes :

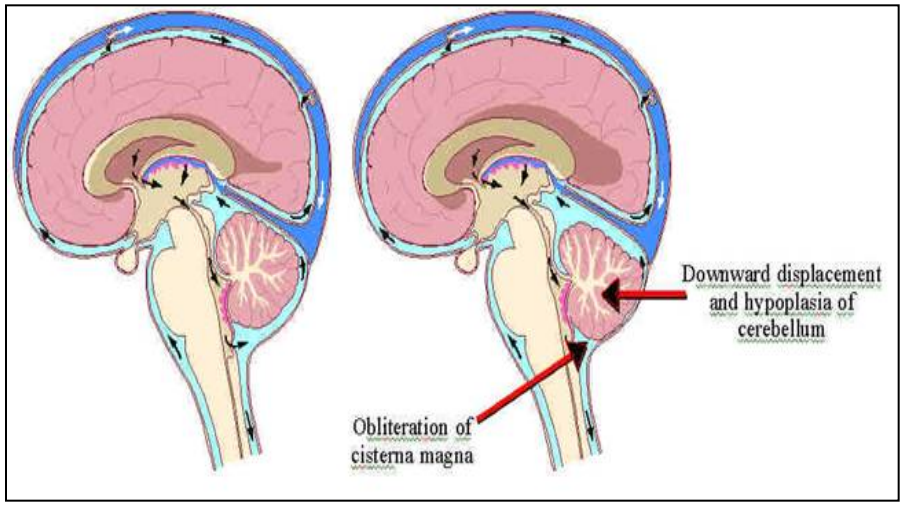
❑ **Congenital : (Arnold-Chiari malformation).**

❑***Acquired :***

➢Stenosis of the cerebral aqueduct by **tumor of pineal region.**

➢Obstruction of the interventricular foramina secondary to tumors, hemorrhages or infections such as meningitis

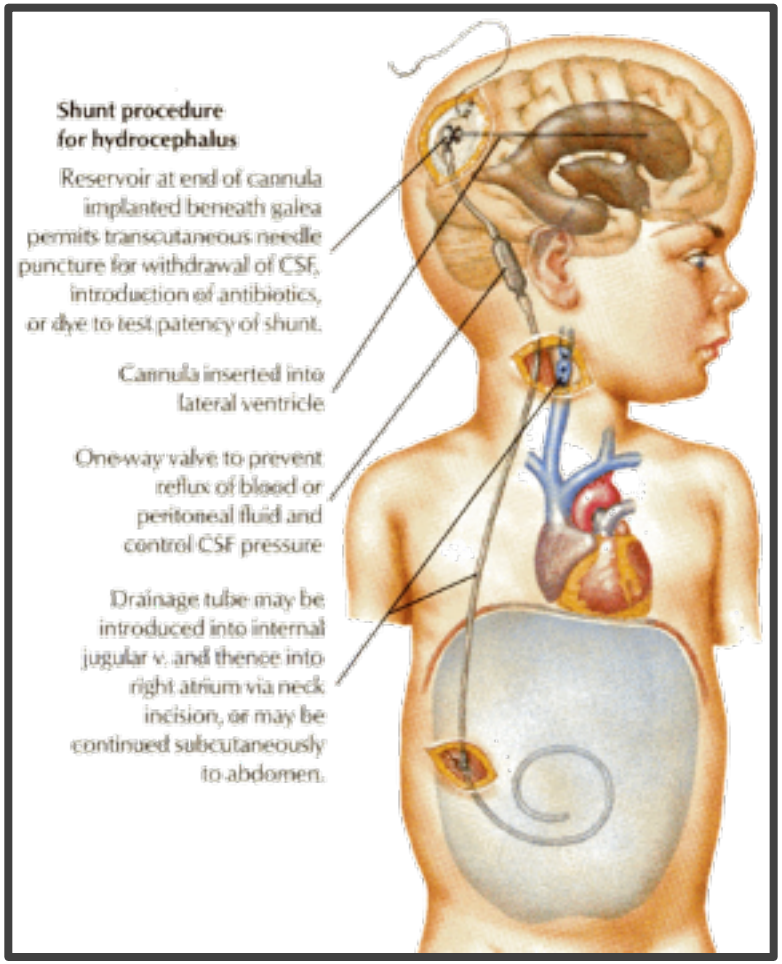




CEREBROSPINAL FLUID

clinical point

- **Decompression** of the **dilated ventricles** is achieved by **inserting a shunt** connecting the ventricles to the jugular vein **or** the abdominal peritoneum.



Thank U & Good Luck

Summary

- **The brain & spinal cord are covered by 3 layers of meninges :** dura, arachnoid & pia mater.
- **The important dural folds** inside the brain are the **falax cerebri** & **tentorium cerebelli.**
- **CSF is produced by** the choroid plexuses of the ventricles of the brain : lateral ,3rd & 4th ventricles.
- **CSF circulates** in the subarachnoid space.
- **CSF is drained into** the dural venous sinuses principally superior saggital sinus.
- **The subarachnoid space in the spinal cord terminates** at the 2nd sacral vertebra.
- Obstruction of the flow of CSF as in **tumors of the brain** leads to **hydrocephalus**.