

MENINGES , VENTRICLES & CSF

Dr. Sanaa Al-Shaarawy

Dr. Essam Eldin Salama

OBJECTIVES

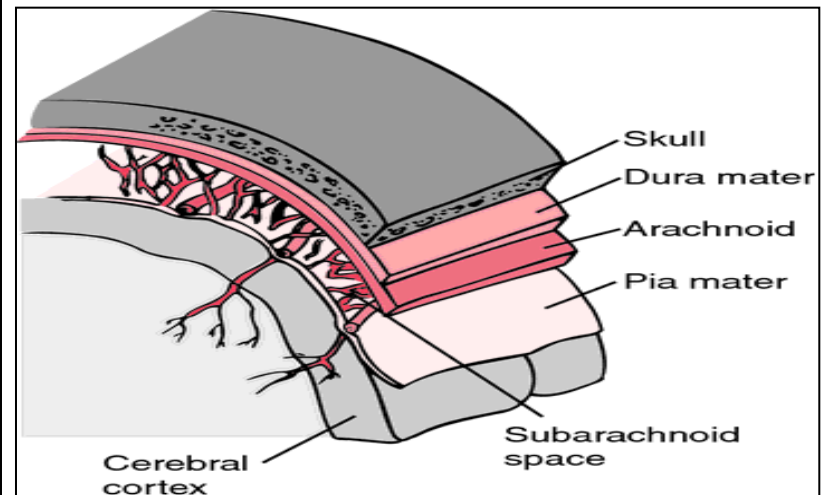
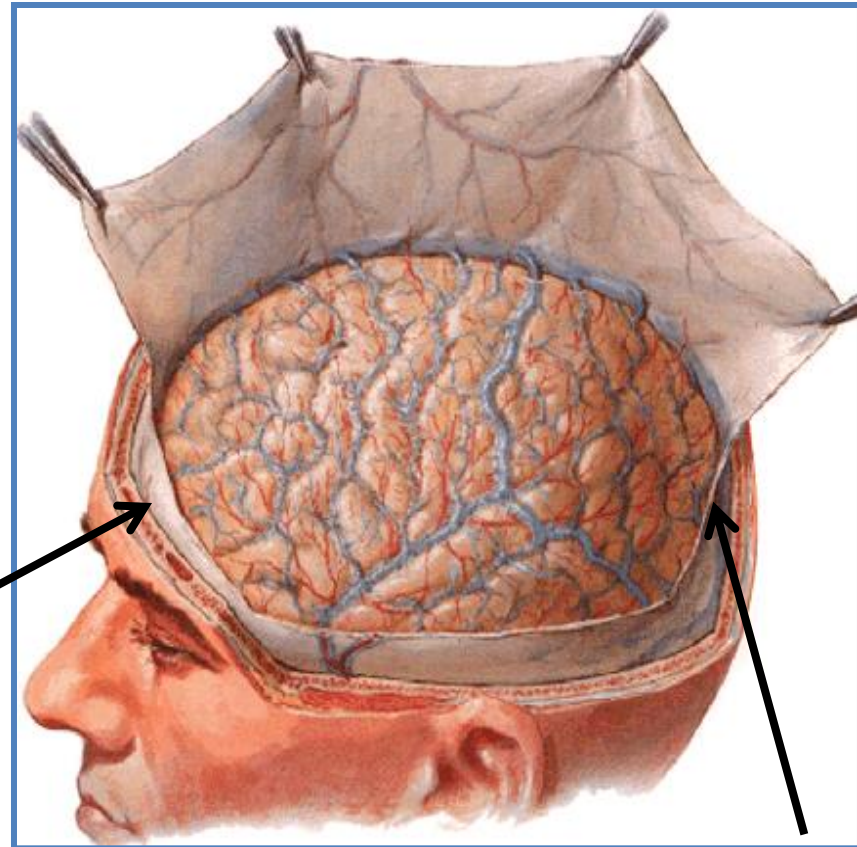
- *By the end of the lecture the student should be able to:*
- Describe the **cerebral meninges** & list the main dural folds.
- Describe the **spinal meninges** & locate the level of the termination of each of them.
- Describe the importance of the **subarachnoid space**.
- List the **Ventricular system 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 : the three meningeal branches of the trigeminal and vagus nerves & C1 to C3(upper cervical Ns.).



DURA MATER Folds

❑ Two large reflections of dura extend into the cranial cavity :

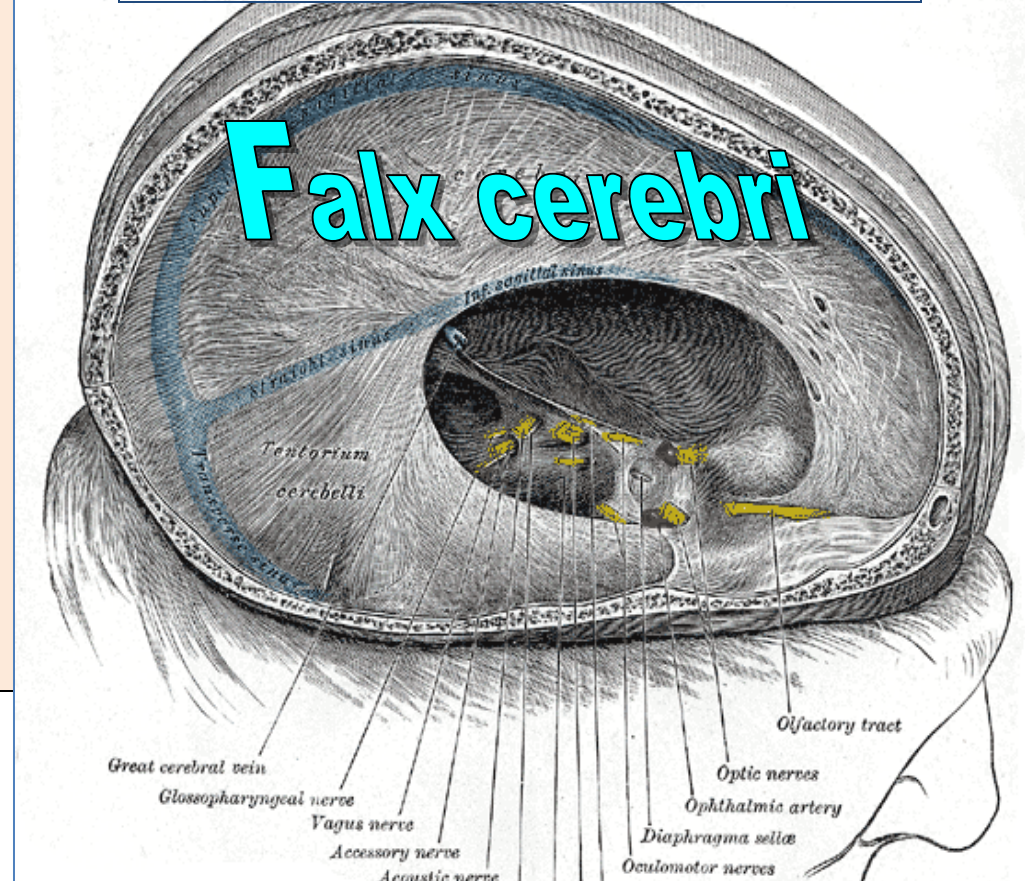
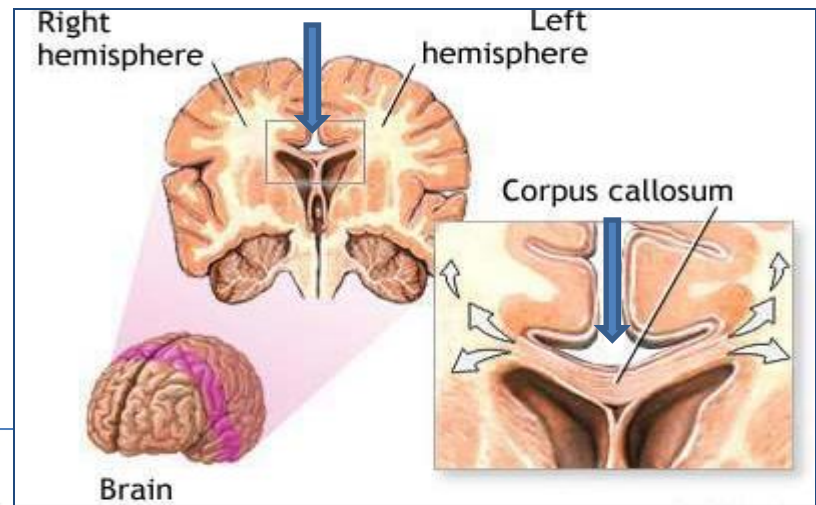
1. The falx cerebri,

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.

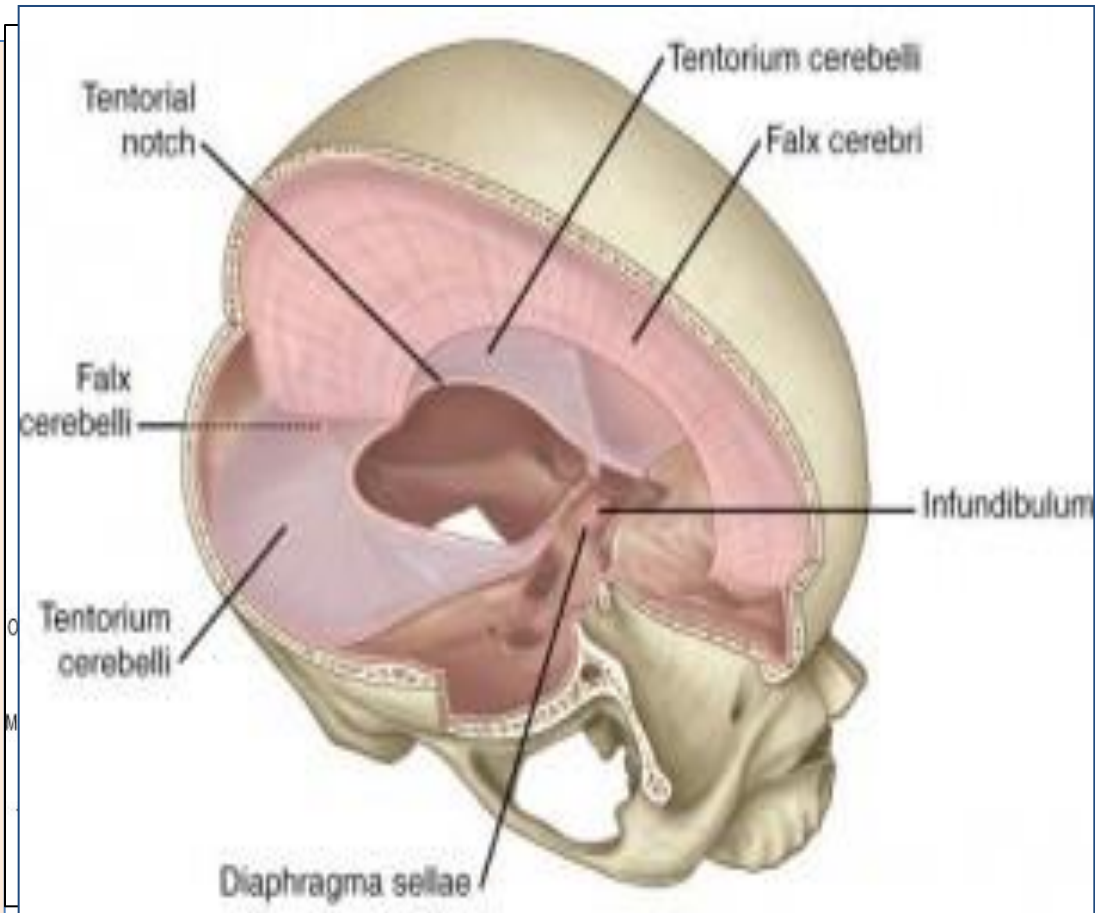
▪ And a **free border** lies above the corpus callosum.



DURA MATER Folds

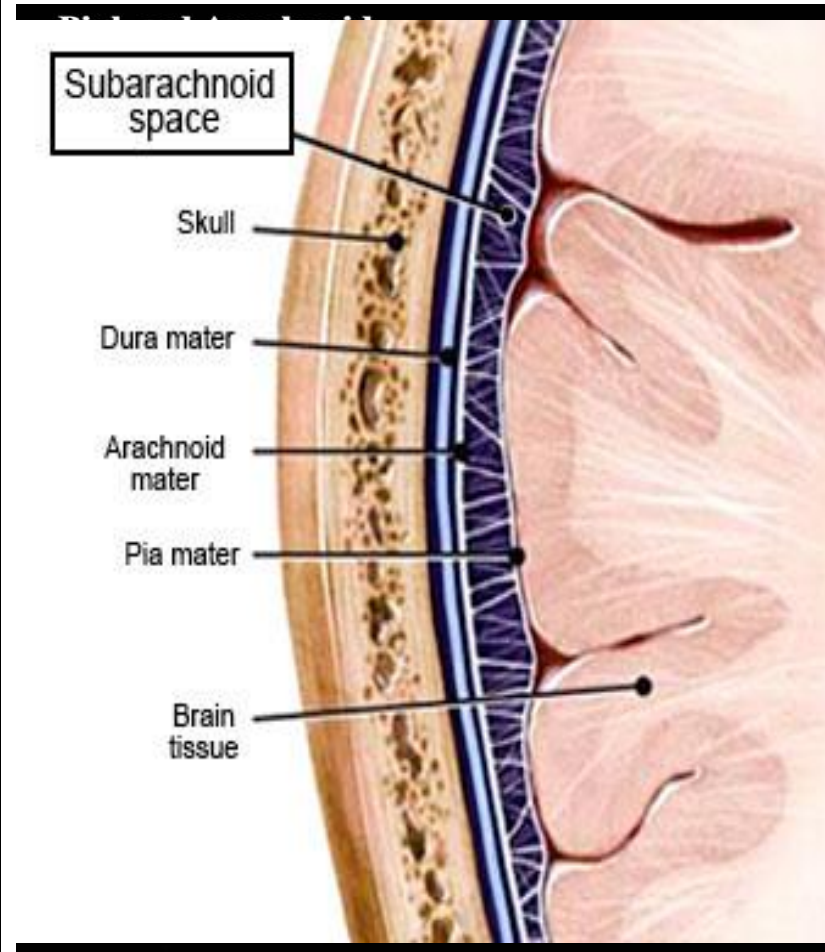
2. A horizontal shelf of dura, **The tentorium cerebelli,**

- 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 continuous above with the falx cerebri.



Arachnoid Mater & Pia Mater

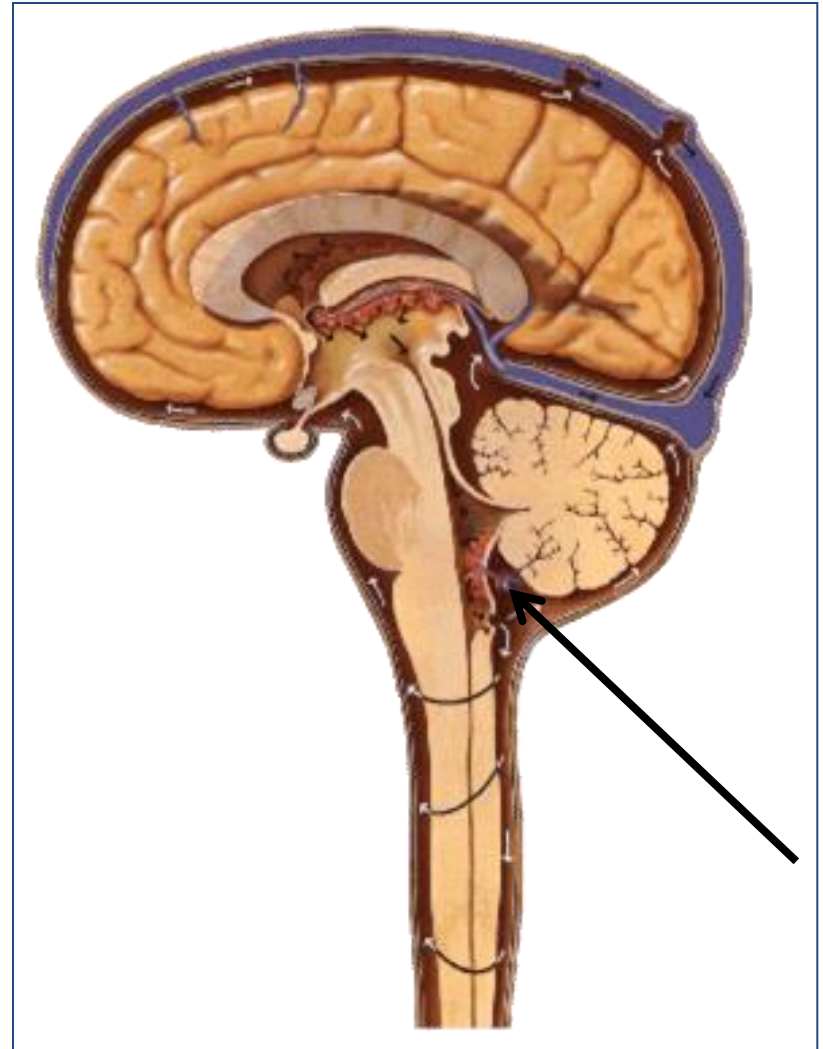
- **The arachnoid mater** is a soft, translucent membrane loosely envelops the brain.
- The arachnoid mater is separated from the dura by a narrow **subdural space**.
- **The pia mater** is the innermost, thin, delicate & highly vascular membrane that is closely adherent to the gyri and fitted into the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



Subarachnoid Space

■ It is **varied in depth** forming; **subarachnoid cisterns.**

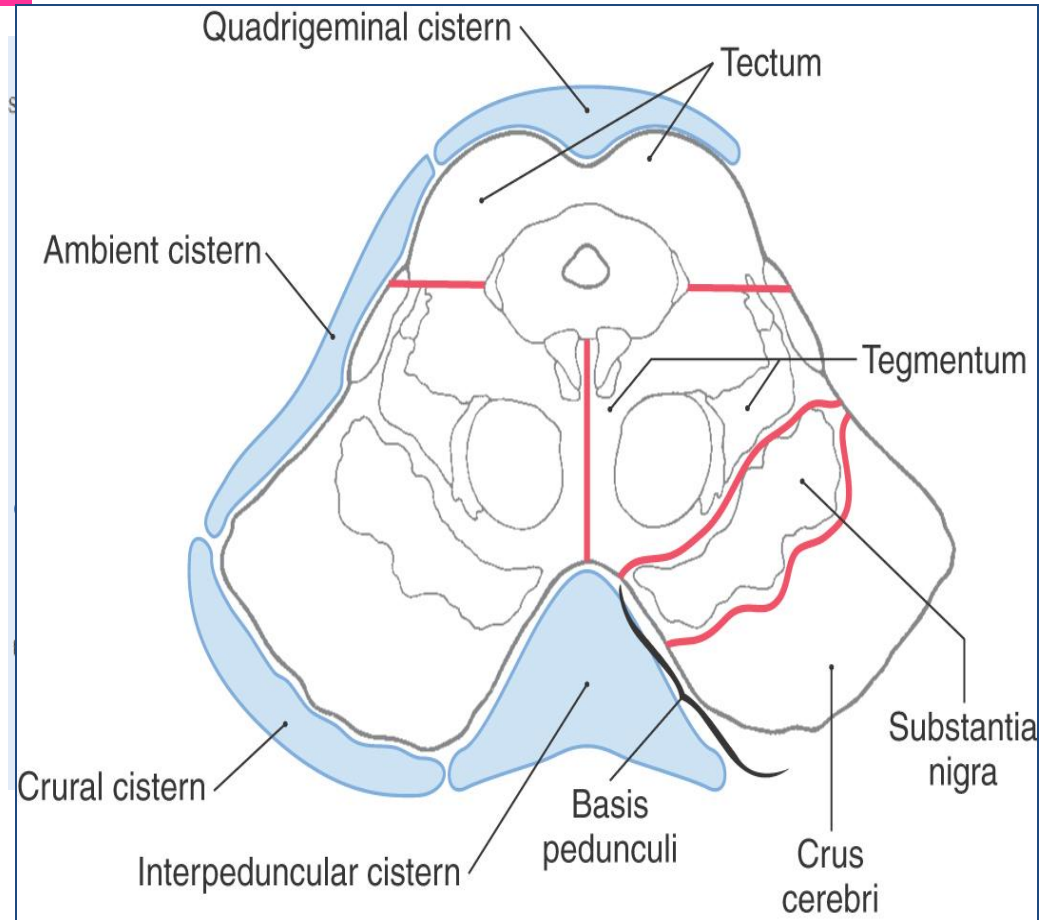
1. The **cisterna magna**, or **cerebellomedullary cistern** which lies between the inferior surface of the cerebellum and the back of the medulla.
 - At this cistern **CSF flows out of the 4th ventricle.**



Subarachnoid Space

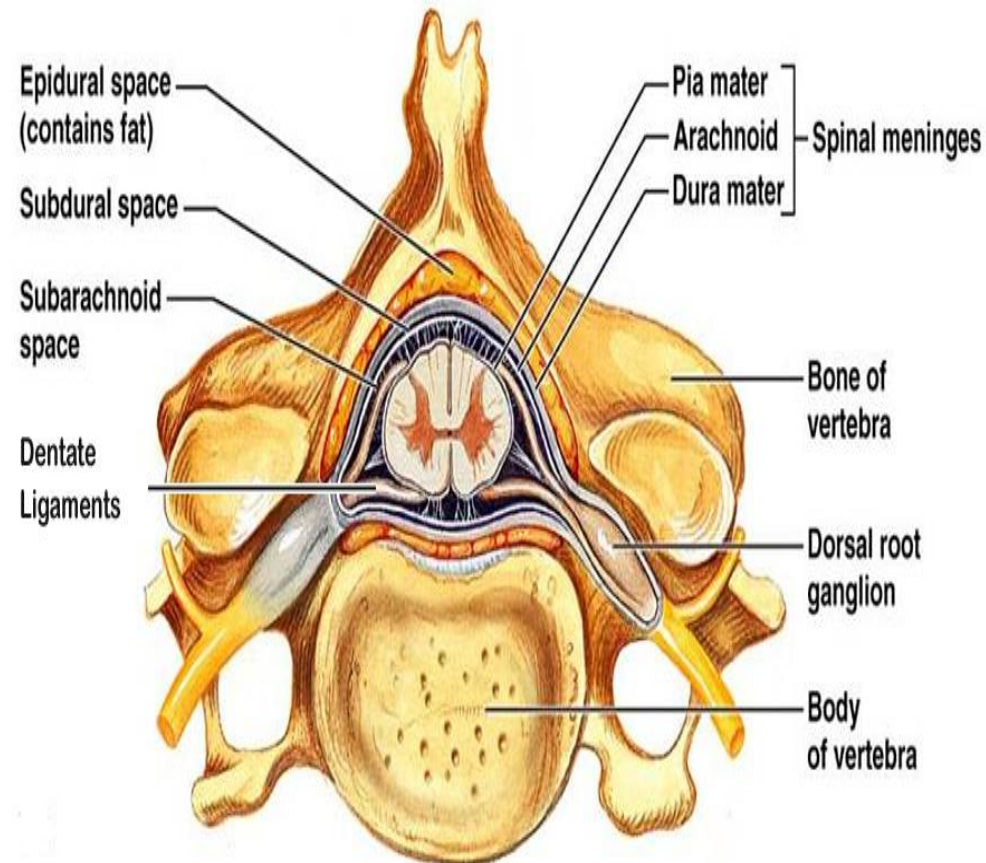
2. The **interpeduncular cistern**, which is located at the base of the brain, where the arachnoid spans the space between the two cerebral peduncles of midbrain.

- 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 **outer covering; the dura matter,** 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 it and pia** lies the **subarachnoid space** contains CSF.
- ❑ The **innermost covering** is the **pia matter,** 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.**

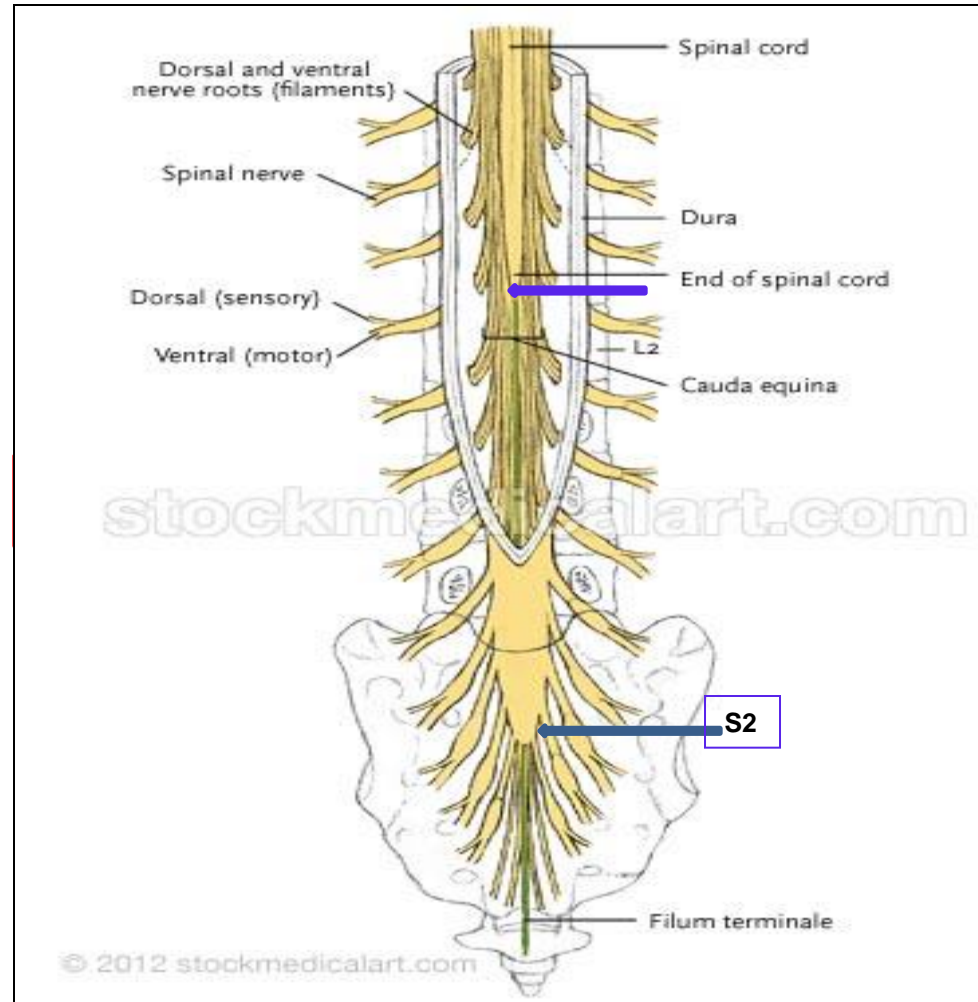


Spinal meninges

❑ The **spinal cord** terminates at level **L1-L2**, while

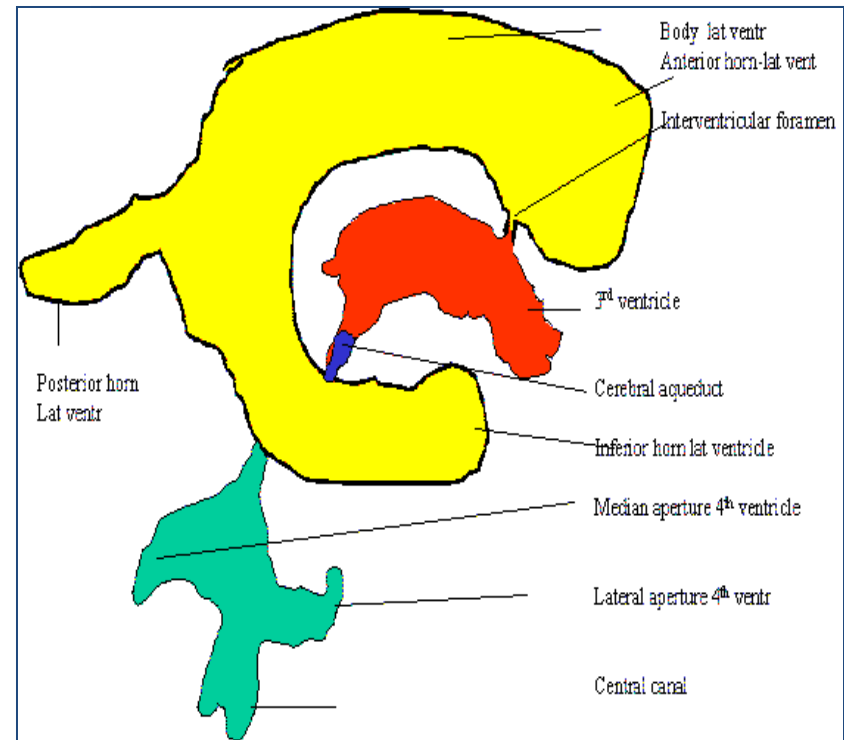
❑ The **dura and arachnoid** and, **subarachnoid space**, continue caudally to **S2**.

❑ 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

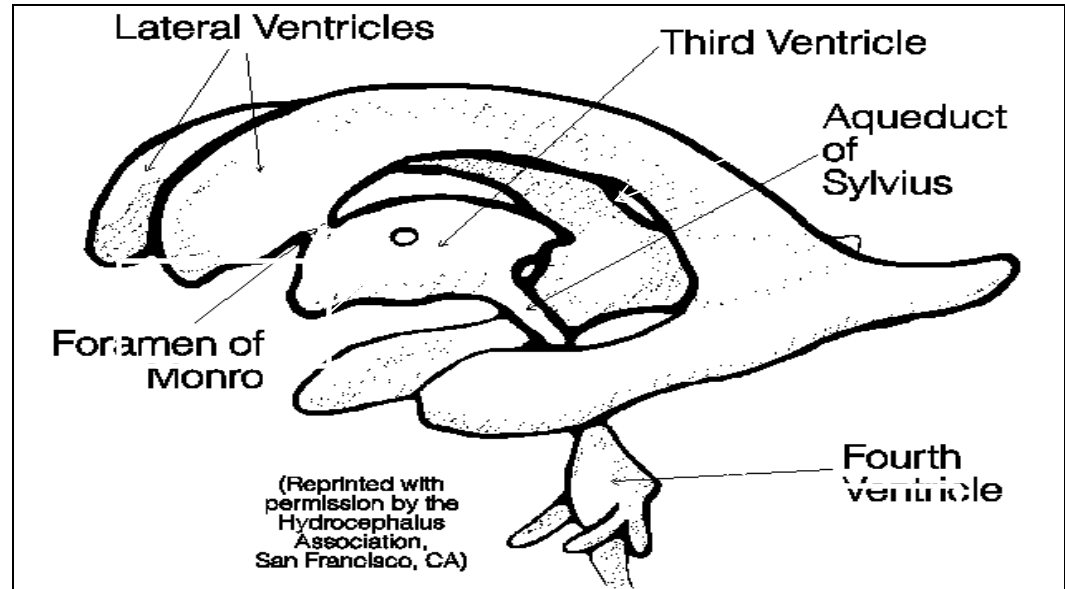
- ❑ **Interconnecting channels** within the CNS.
- ❑ In the spinal cord; represented by the **central canal**.
- ❑ Within the brain; a system of **ventricles** is found.
- ❑ The **central canal** of the spinal cord is **continuous upwards** to the **fourth ventricle**.
- ❑ On each side of the **fourth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



VENTRICULAR SYSTEM

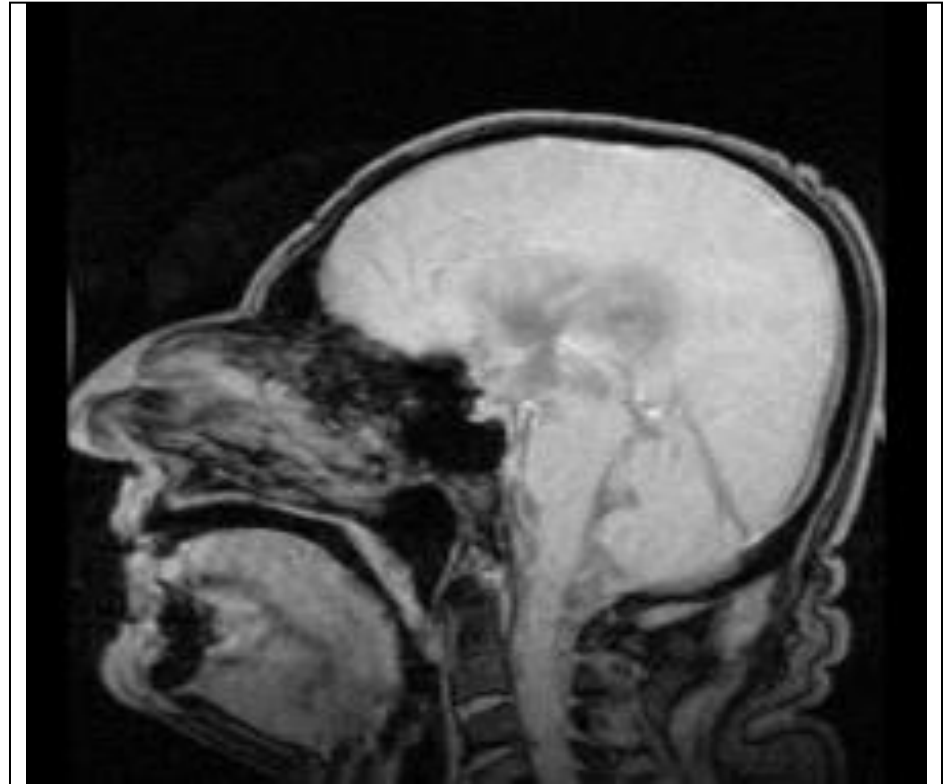
❑ The **forth ventricle** is continuous up with the **cerebral aqueduct**, that opens in the **third ventricle**.

❑ The **third ventricle** is continuous with the **lateral ventricle** through the **interventricular foramen (foramen of Monro)**.



CEREBROSPINAL FLUID

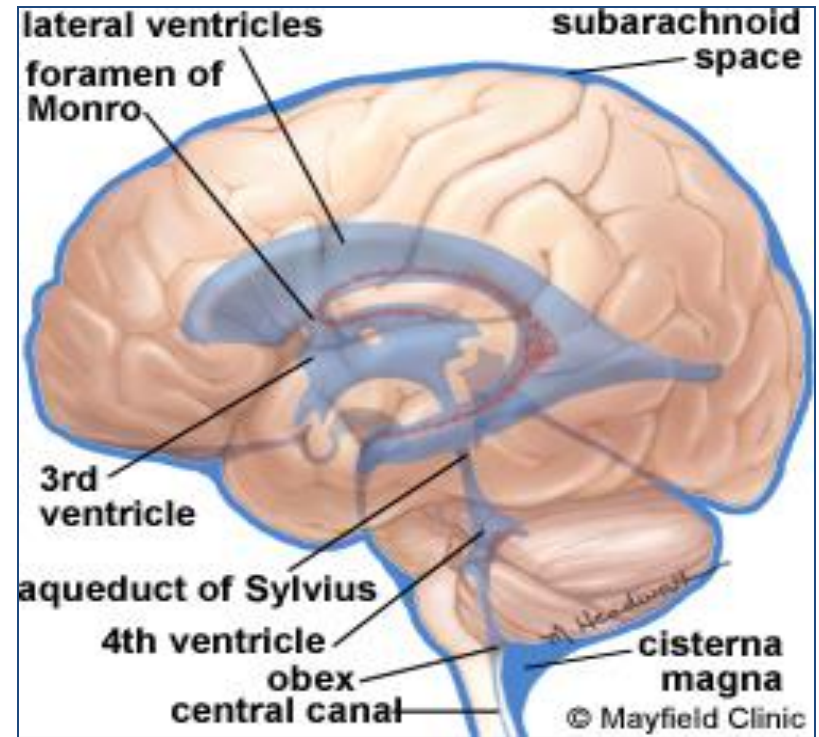
- ❑ Present in the ventricular system, together with the cranial and spinal **subarachnoid spaces**.
- ❑ It is **colourless clear fluid** containing little protein and few cells.
- ❑ It is about **150 ml**.
- ❑ It acts as a **cushion** for the brain from sudden movements of the head.



MRI showing pulsation of CSF

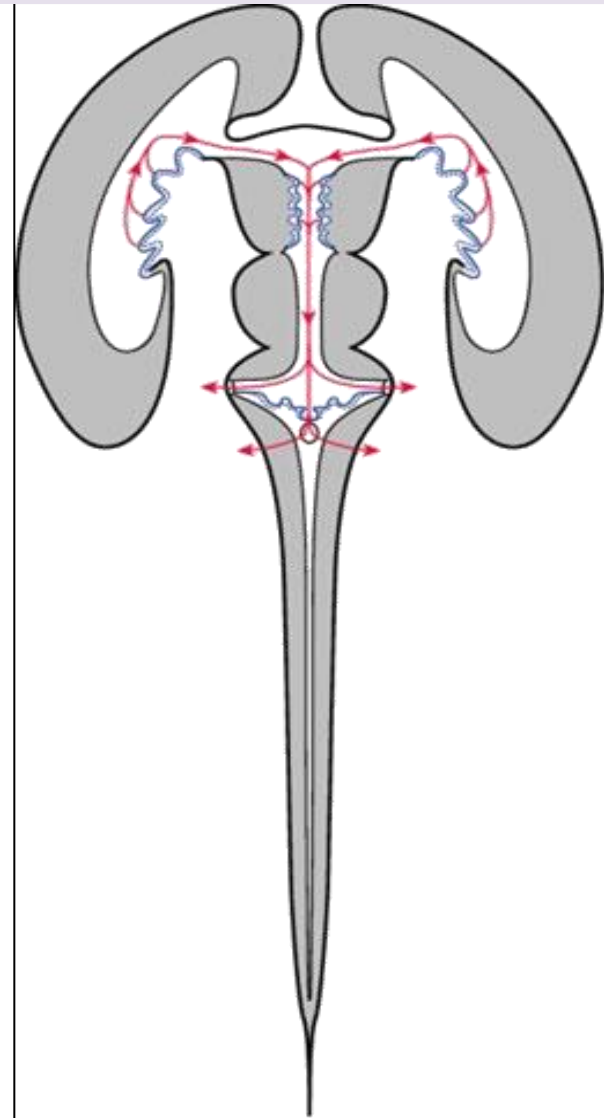
CEREBROSPINAL FLUID

- ❑ 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**.



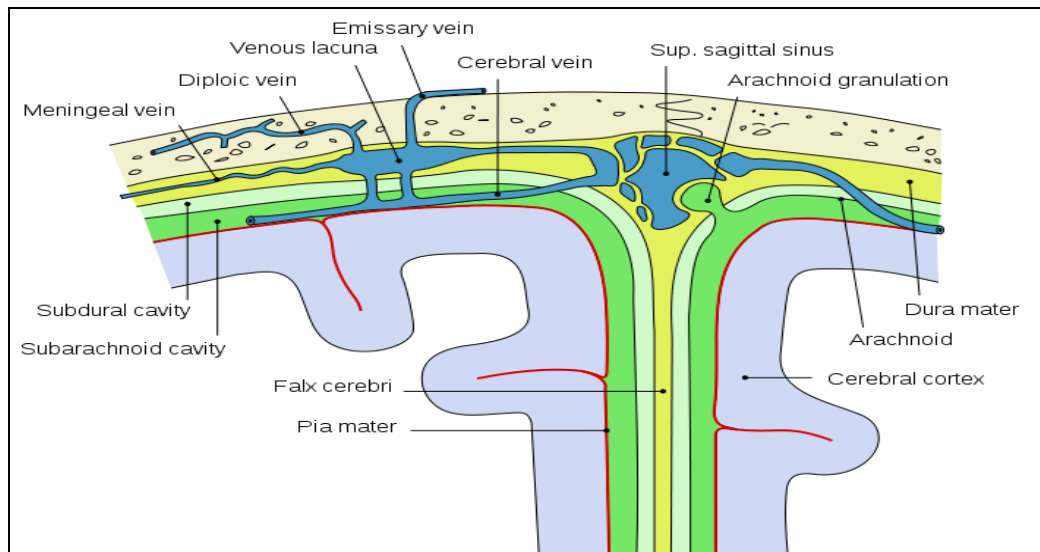
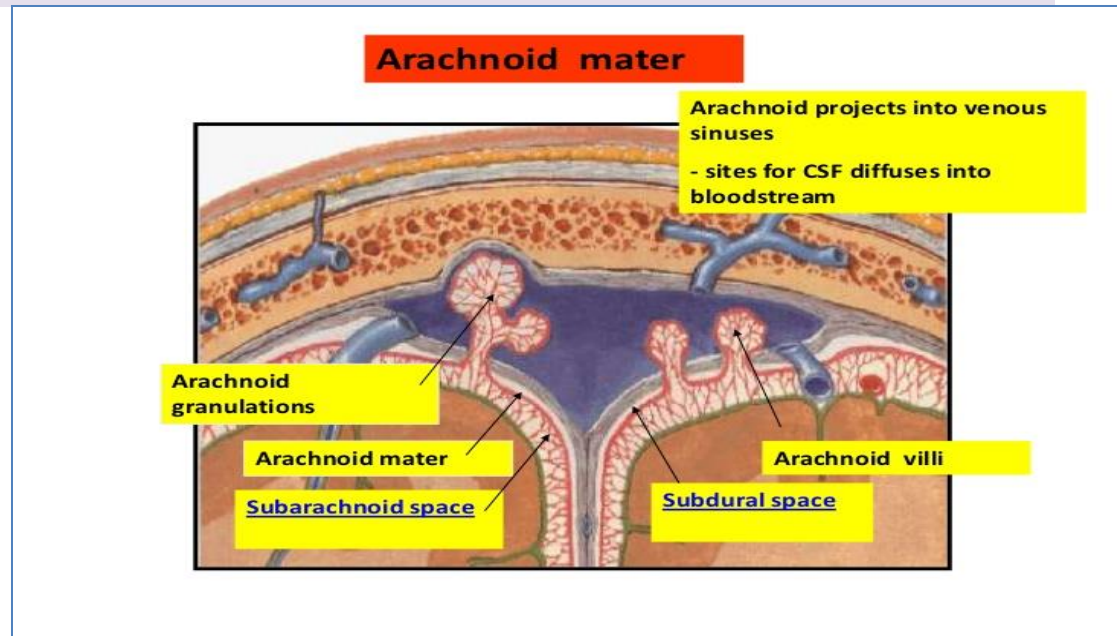
CEREBROSPINAL FLUID

□ 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,**
and
□ **arachnoid**
granulation that
project into the
dural venous
sinuses , mainly
superior sagittal
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).

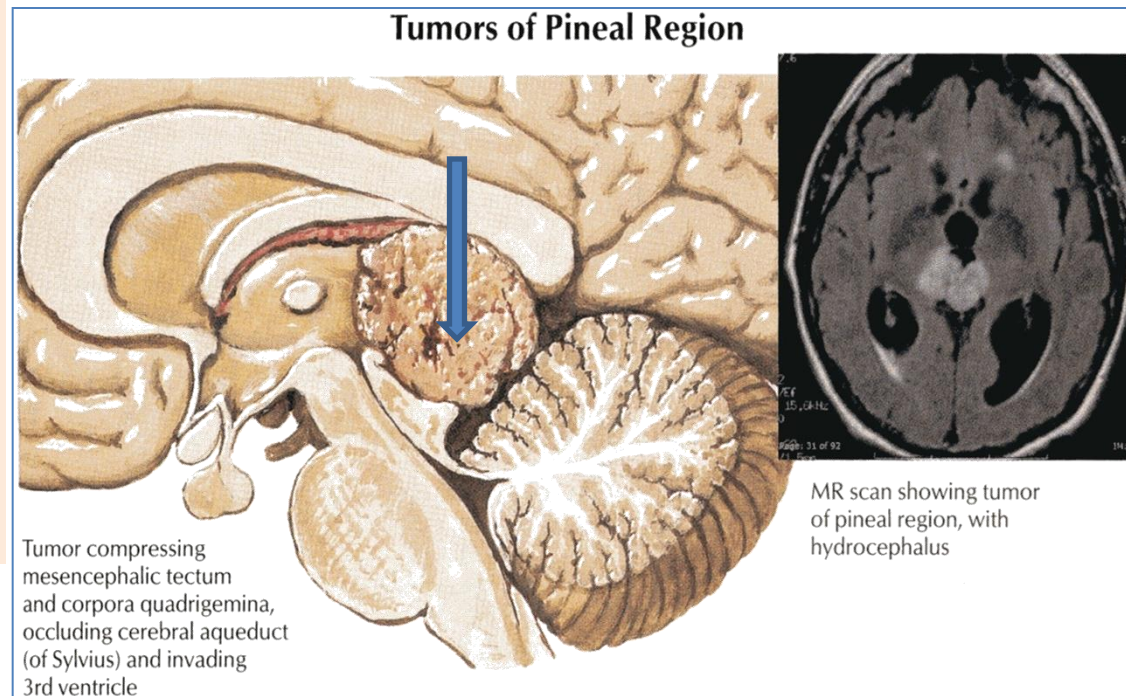
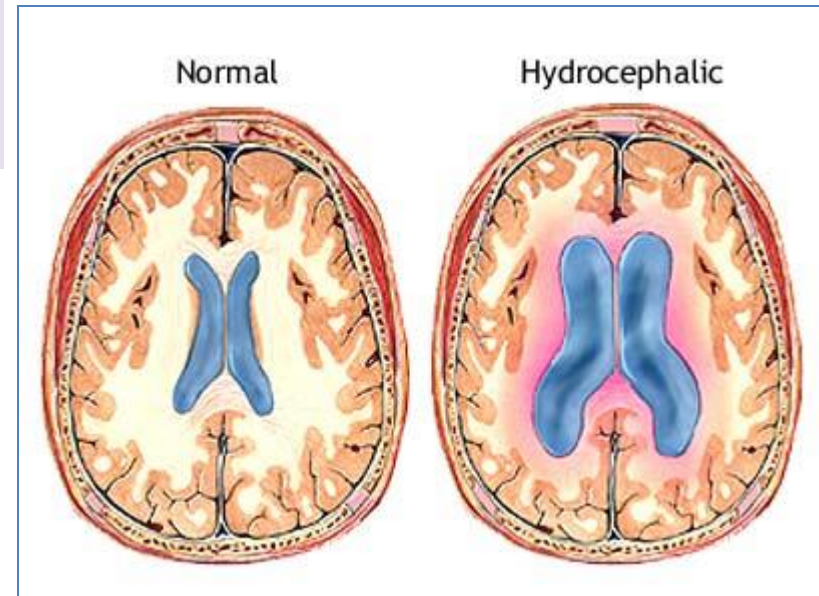
❑ Causes :

❑ **Congenital** : ([Arnold-Chiari malformation](#)) or

❑ **Acquired** :

➤ [Stenosis](#) of the [cerebral aqueduct](#) by tumor.

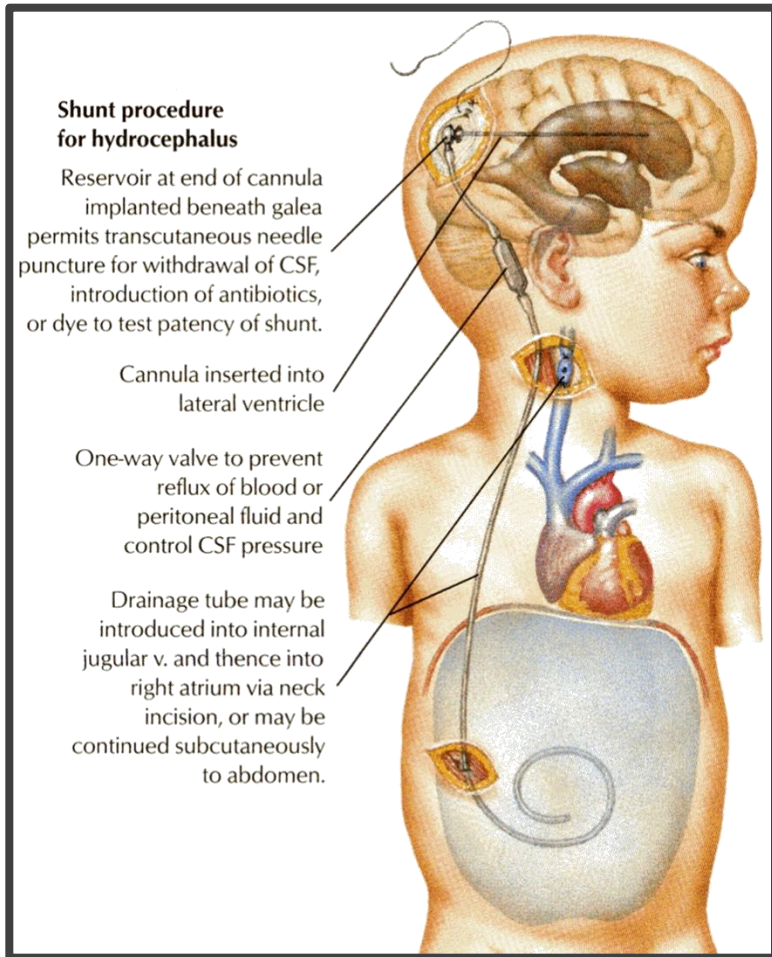
➤ Obstruction of the [interventricular foramina](#) secondary to [tumors](#), [hemorrhages](#) or [infections](#) such as meningitis



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 **falx 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 sagittal 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**.