

# ***Meninges ,ventricl es & CSF***

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# OBJECTIVES

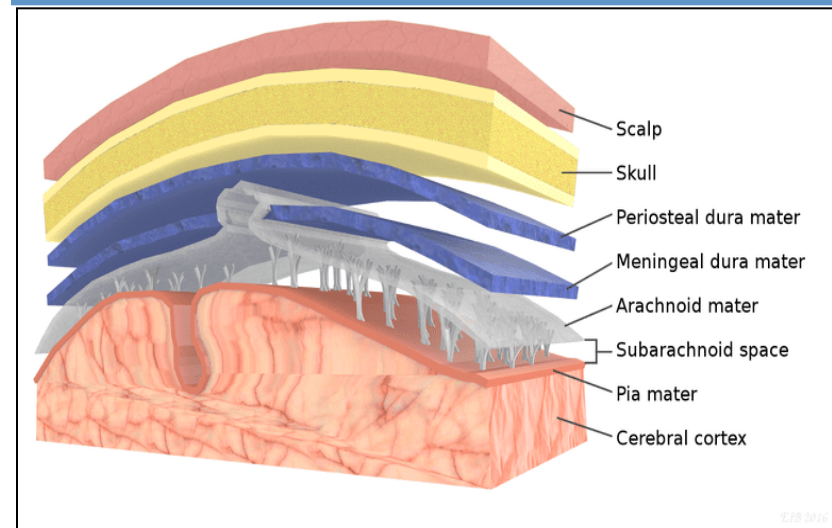
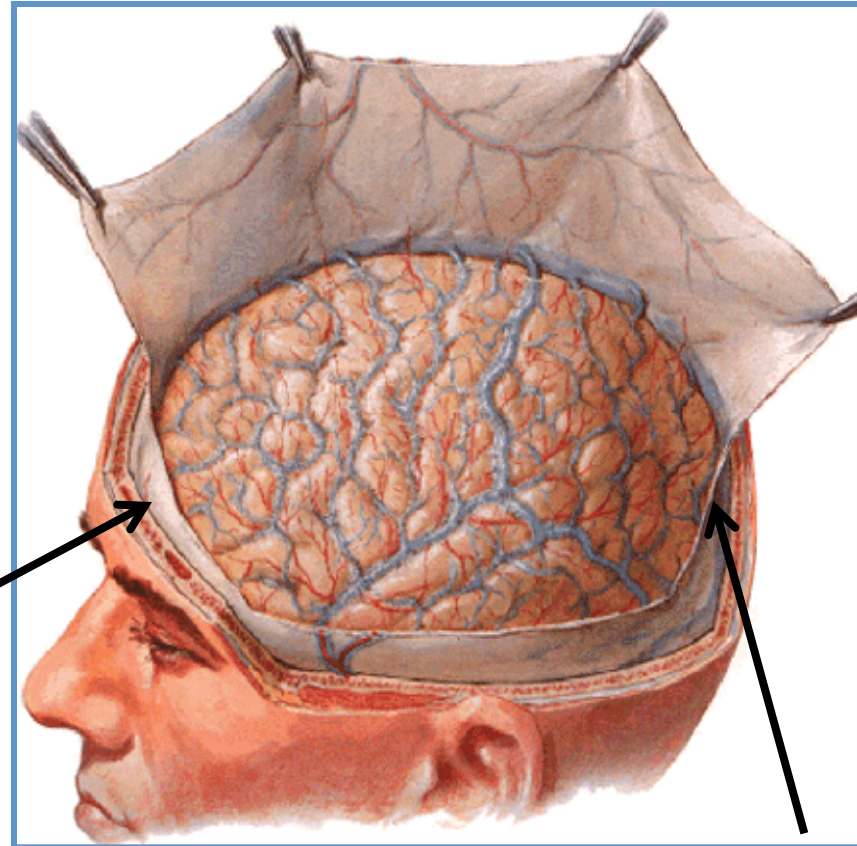
- *By the end of the lecture the student should be able to:*
- Describe the **cerebral meninges** & list the main dural folds.
- Describe the **spinal meninges** & locate the level of the termination of each of them.
- Describe the importance of the **subarachnoid space**.
- List the **Ventricular system 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** : **false 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 :

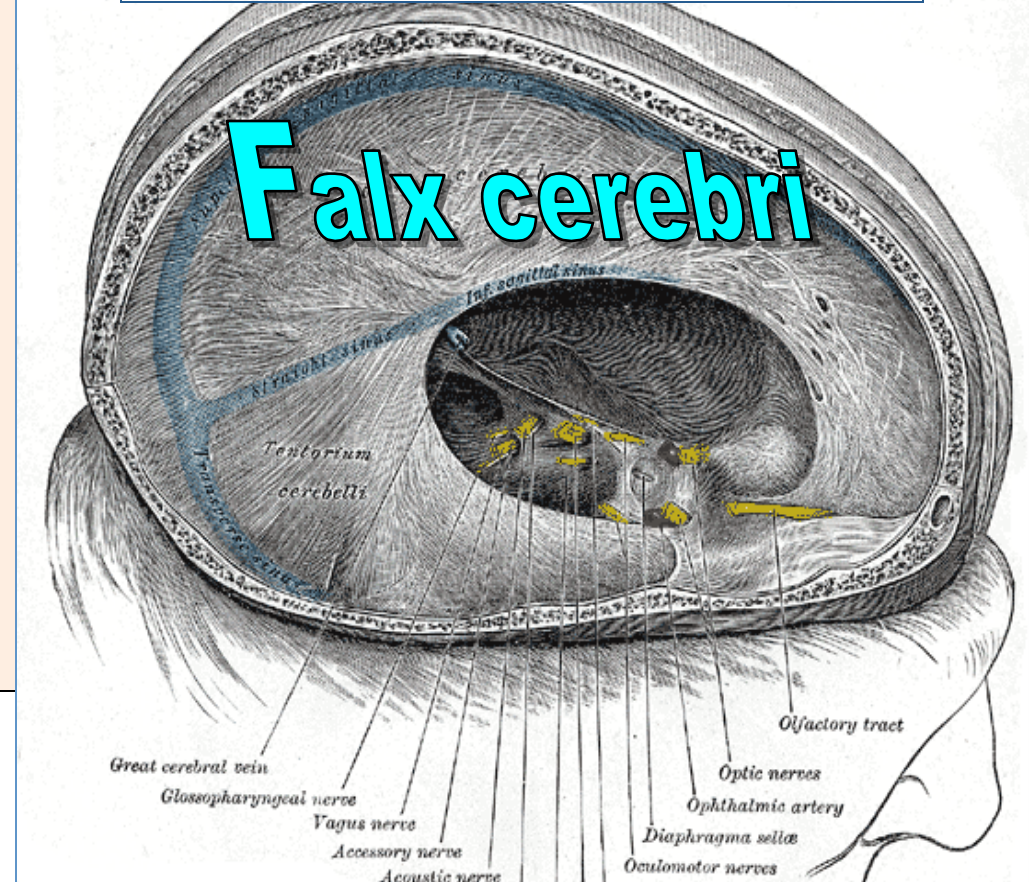
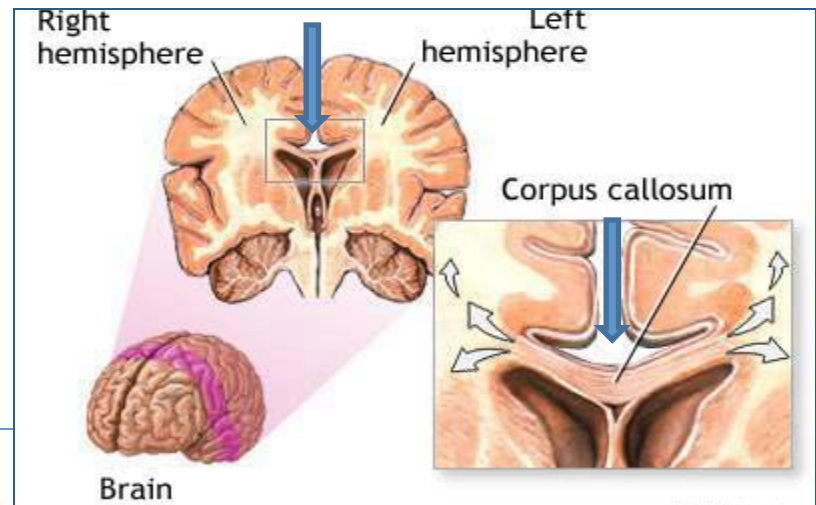
## 1. The falx cerebri,

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.

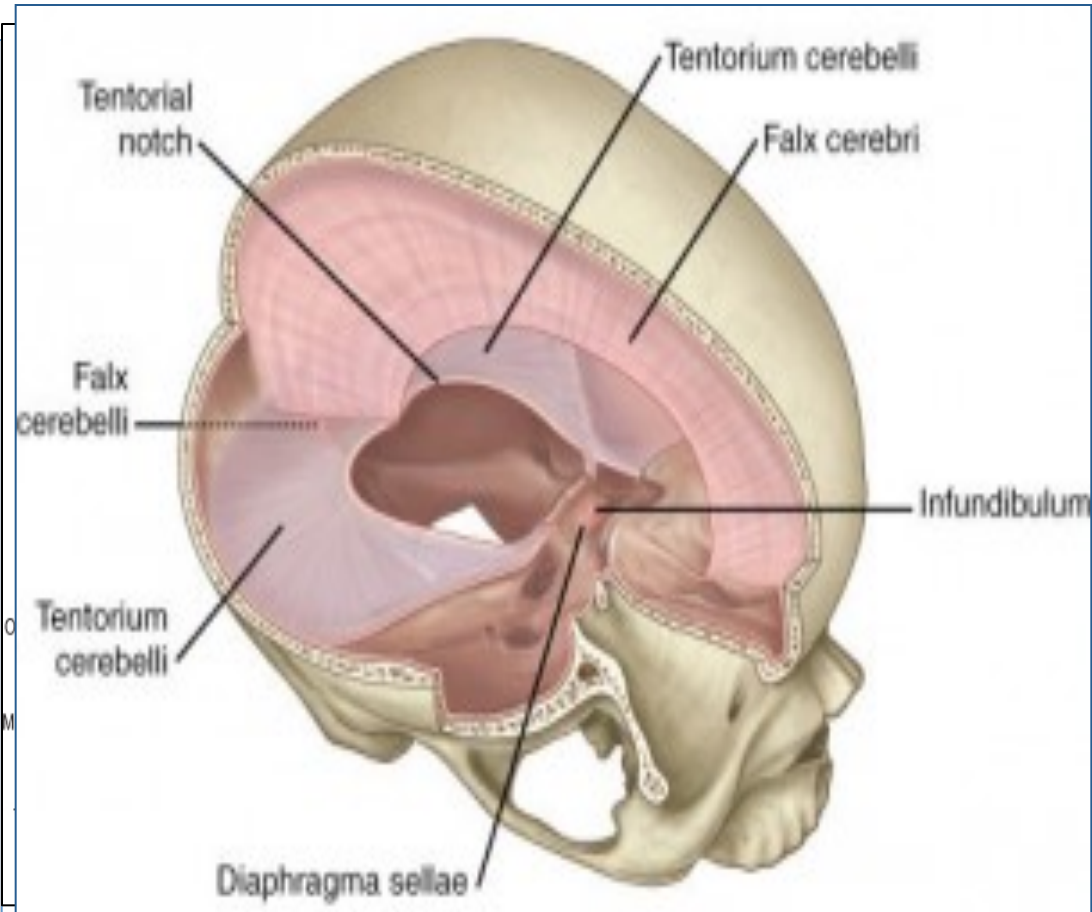
▪ It has an attached border adherent to the skull.

▪ And a free border lies above the corpus callosum.



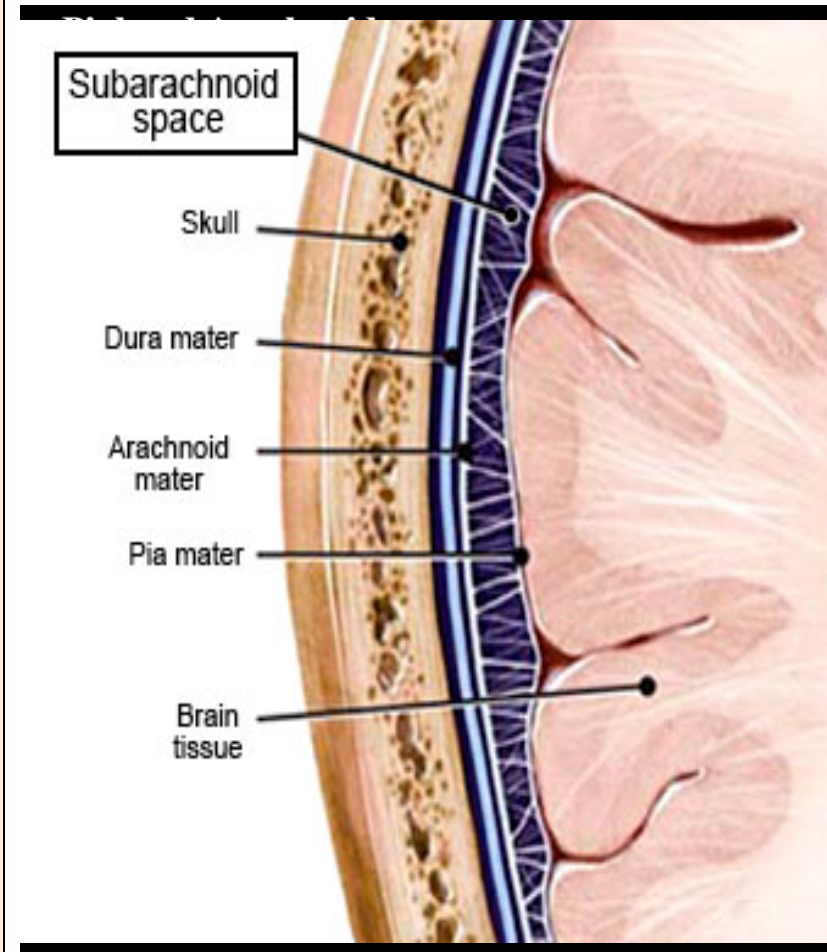
# DURA MATER Folds

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 continous 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.

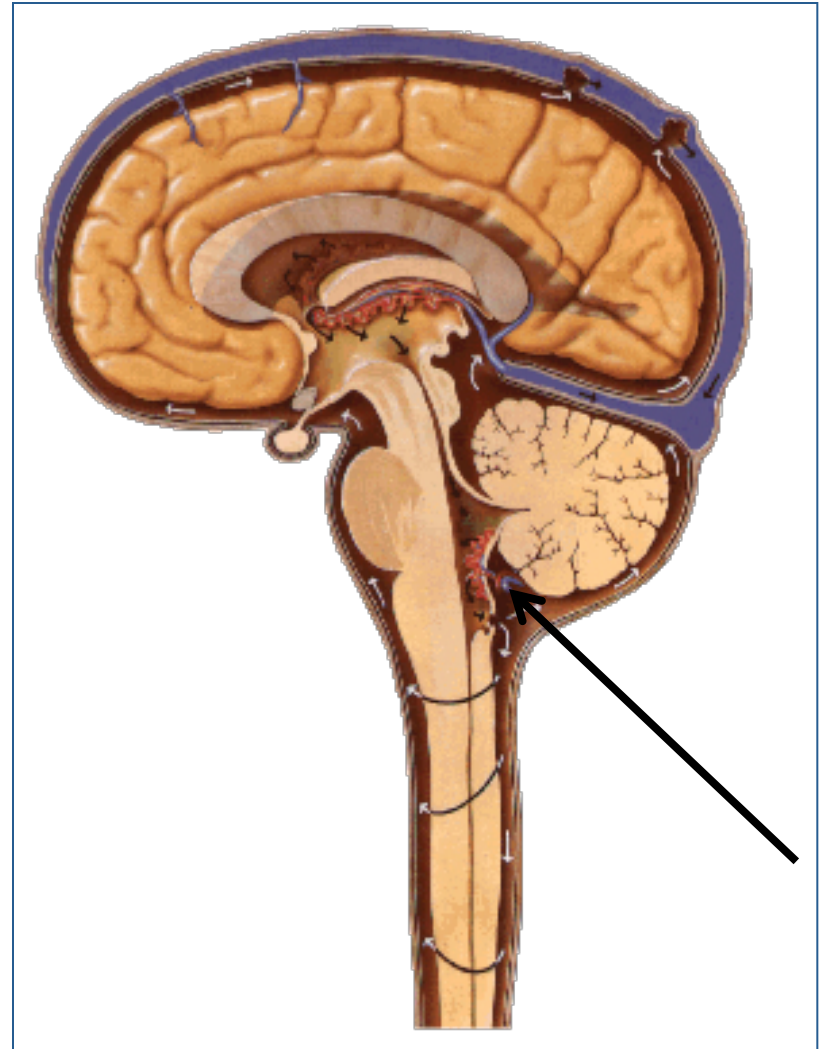




# Subarachnoid Space

■ 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 4<sup>th</sup> ventricle.

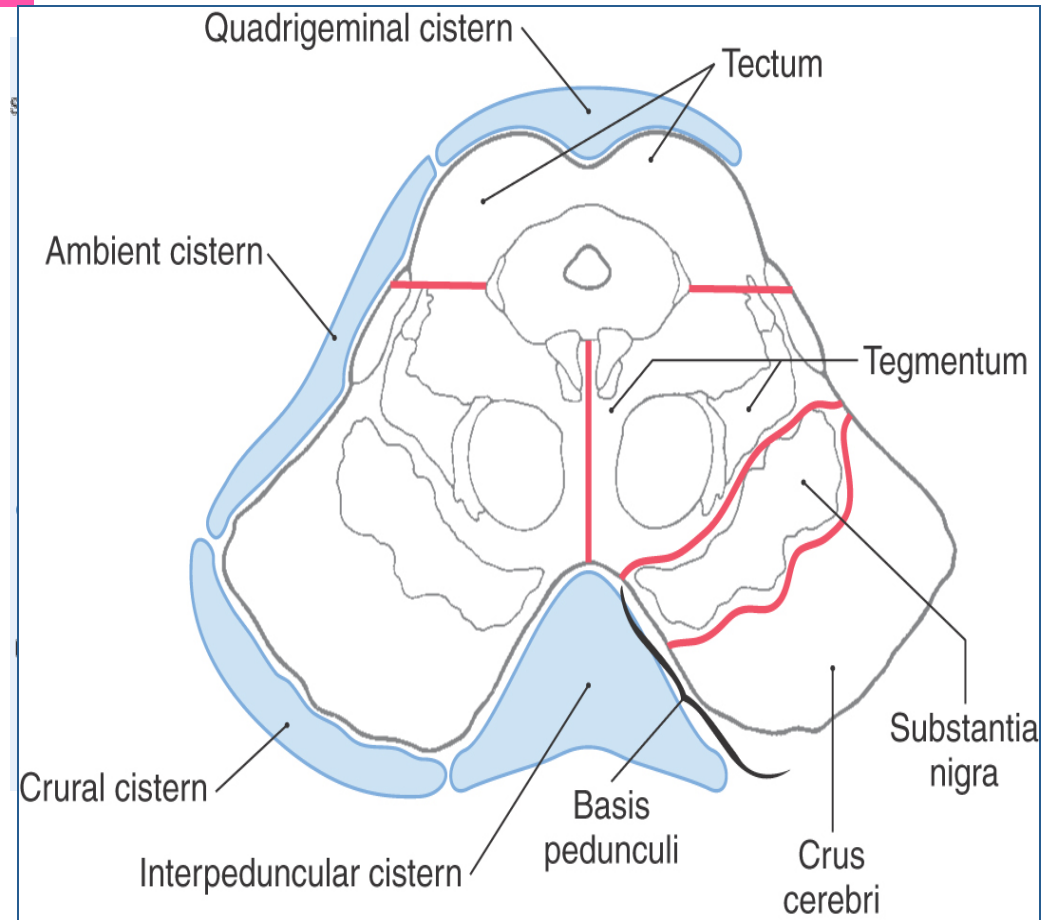




# Subarachnoid Space

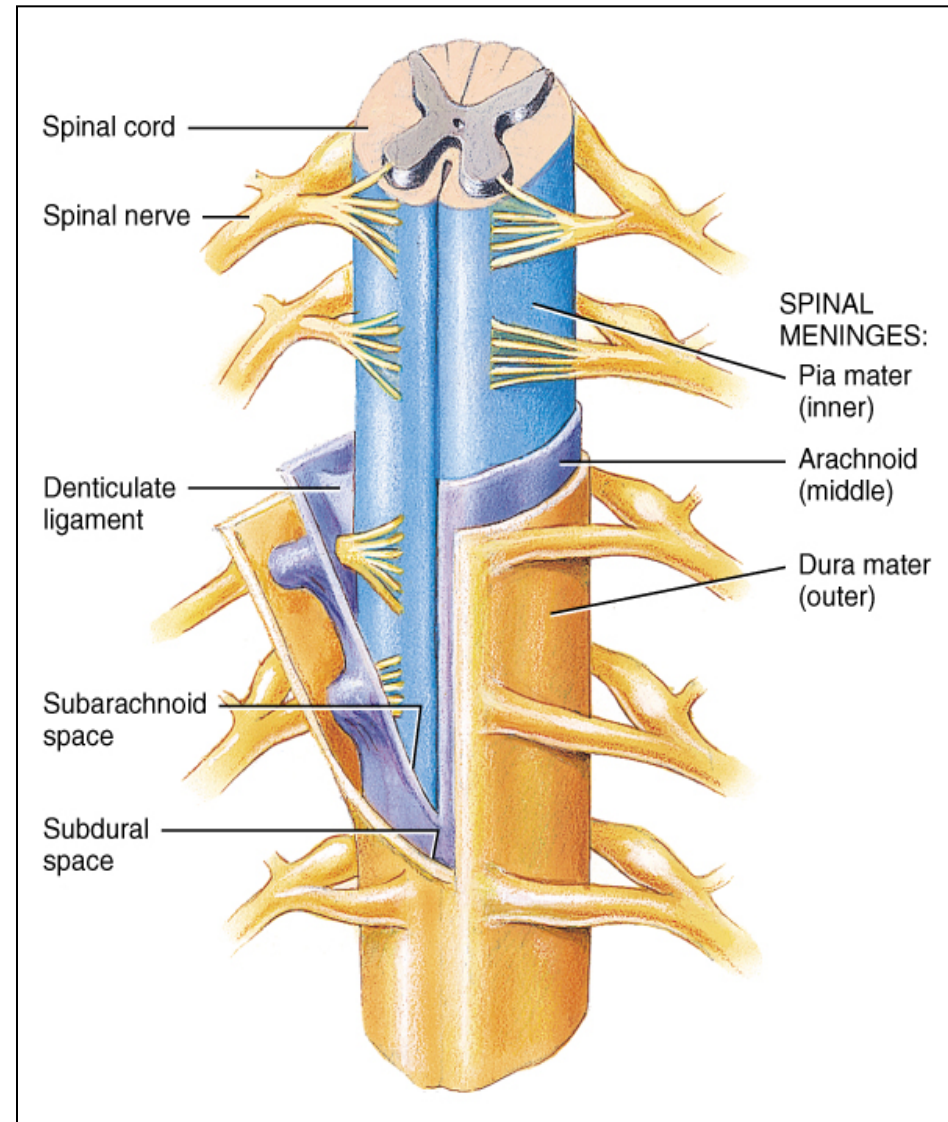
2. The **interpeduncular cistern**, which is located at the base of the brain, where the arachnoid spans the space between the two cerebral peduncles of midbrain.

- **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 **dura matter**; **The outer covering**; is a thick, tough fibrous membrane.
  - It envelops 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 **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**.

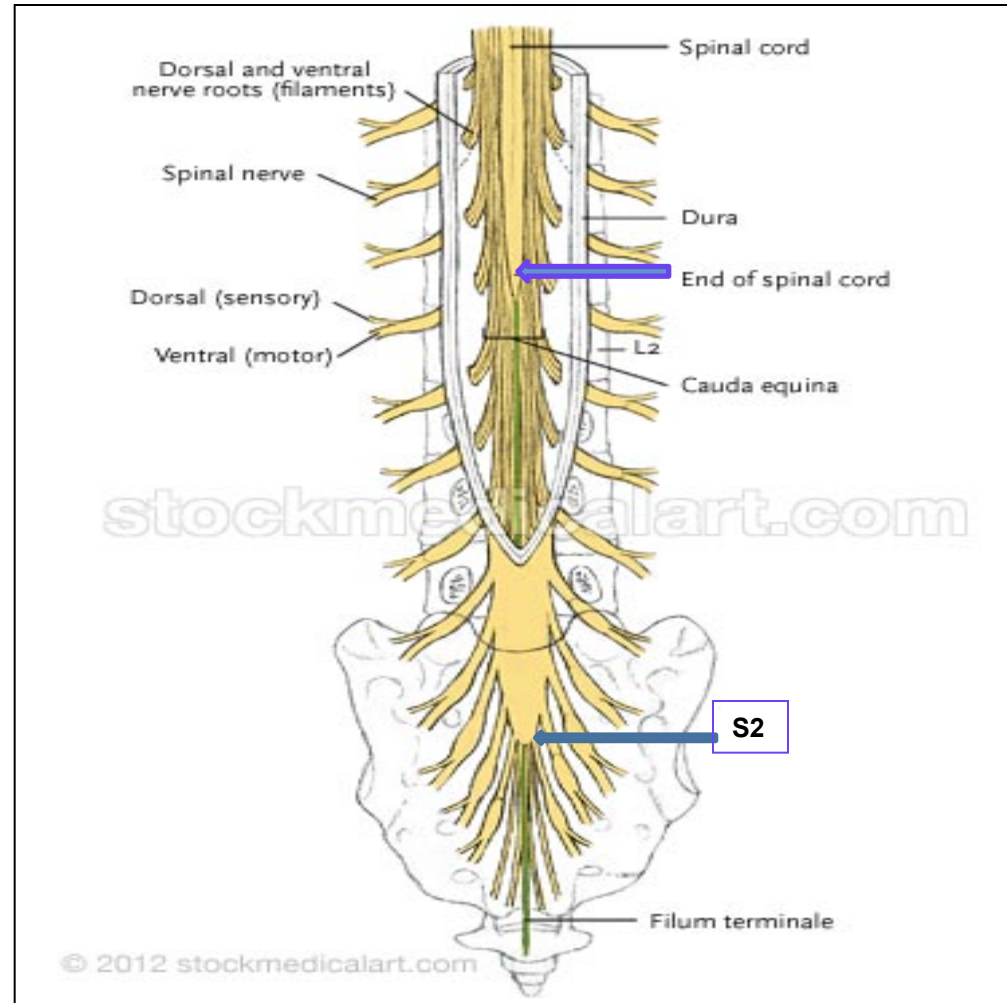


# Spinal meninges

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

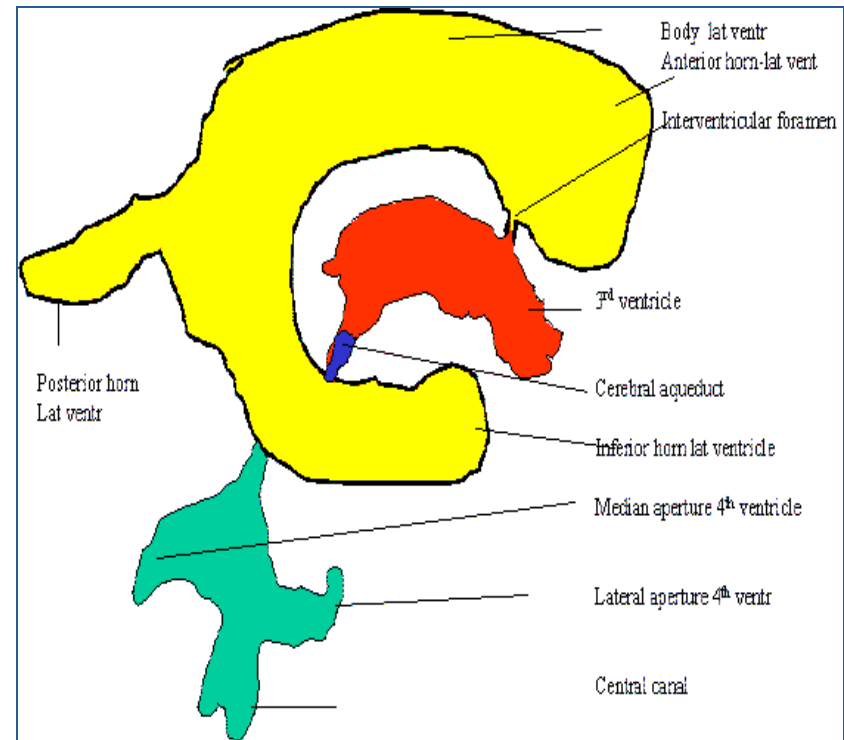
❑ The **dura and arachnoid** and, **subarachnoid space**, continue caudally to **S2**.

❑ 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**.



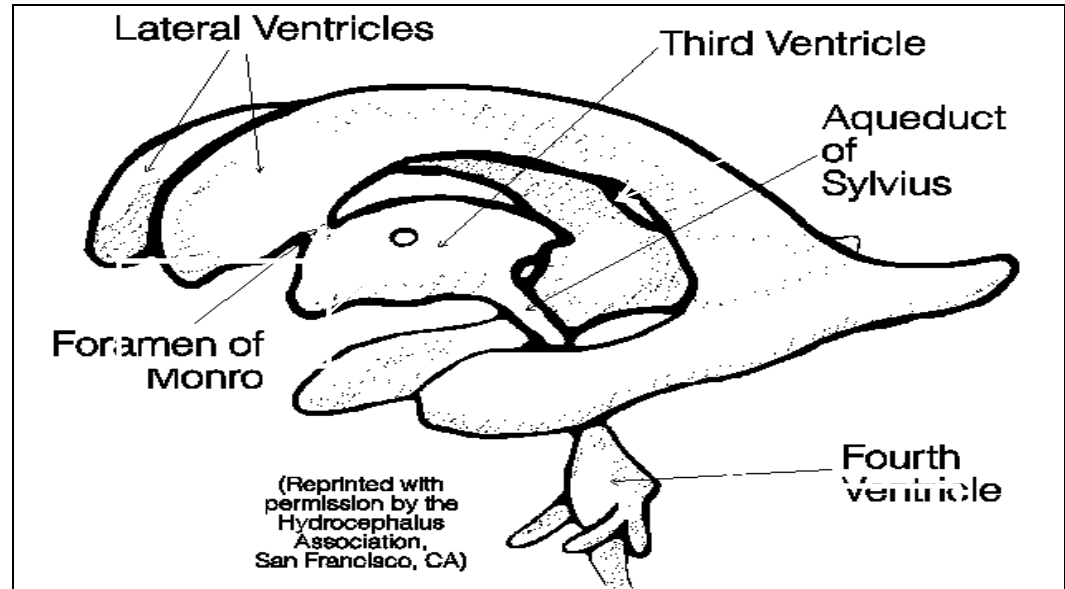
# VENTRICULAR SYSTEM

- ❑ **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 **fourth ventricle**.
- ❑ On each side of the **fourth ventricle** laterally, **lateral recess** extend to open into lateral aperture (**foramen of Luscka**), central defect in its roof (**foramen**



# VENTRICULAR SYSTEM

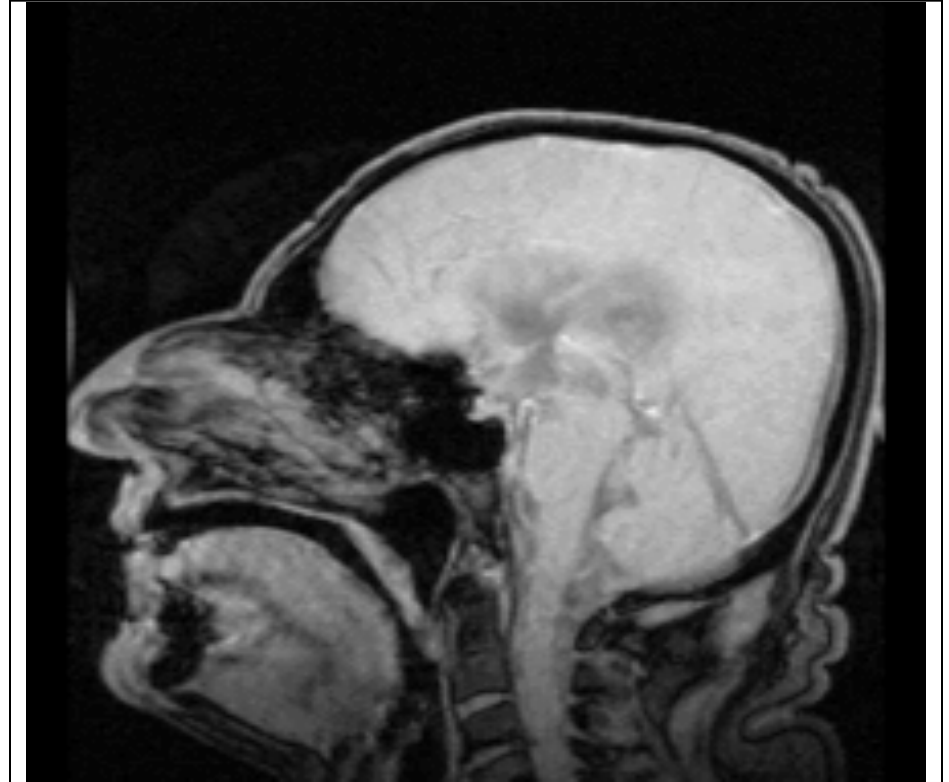
- ❑ The **forth ventricle** is continuous up with the **cerebral aqueduct**, that opens in the **third ventricle**.
- ❑ The **third ventricle** is continuous with the **lateral ventricle** through the **interventricular foramen (foramen of Monro)**.





# CEREBROSPINAL FLUID

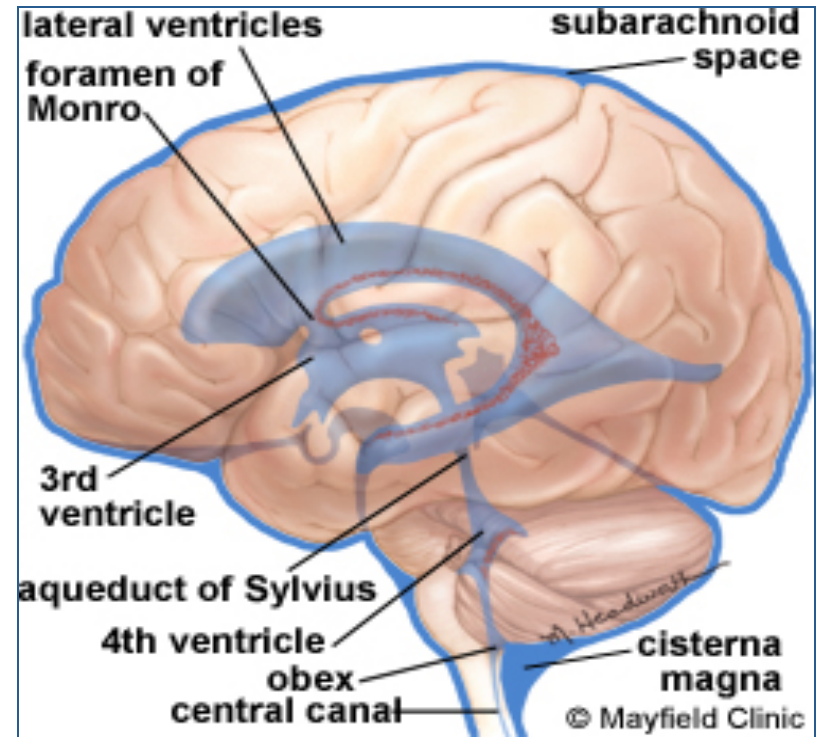
- ❑ Present in the **ventricular system**, together with the cranial and spinal **subarachnoid spaces**.
- ❑ It is **colourless clear fluid** containing little protein and few cells.
- ❑ It is about **150** ml.
- ❑ It acts as a **cushion** for the brain from sudden movements of the head.



MRI showing pulsation of CSF

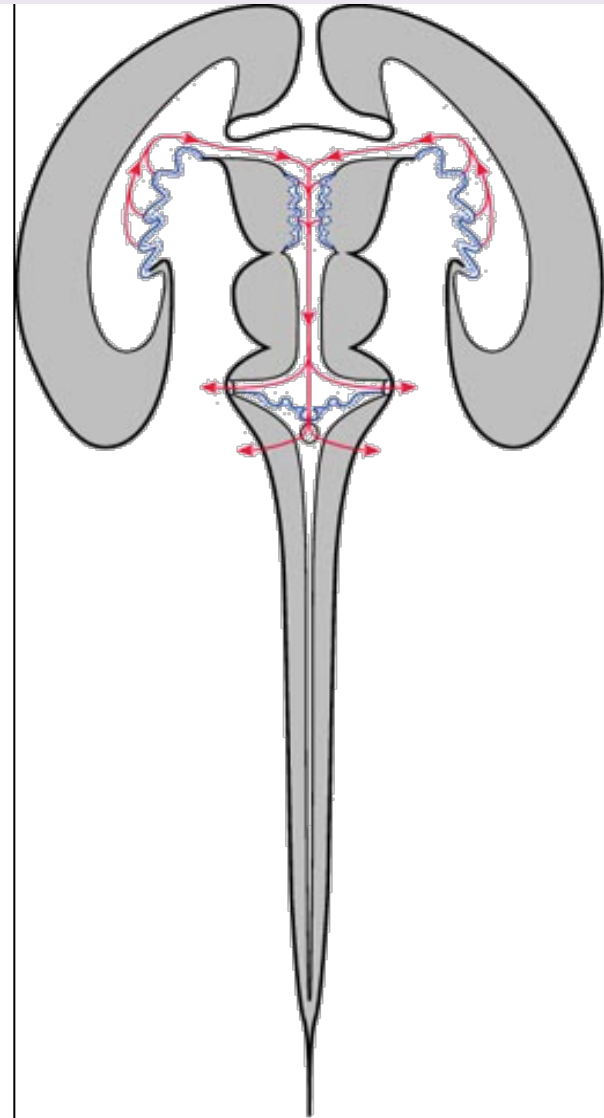
# CEREBROSPINAL FLUID

- ❑ 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 **3<sup>rd</sup> ventricle** and, by way of the **cerebral aqueduct**, into the **4<sup>th</sup> ventricle**.



# CEREBROSPINAL FLUID

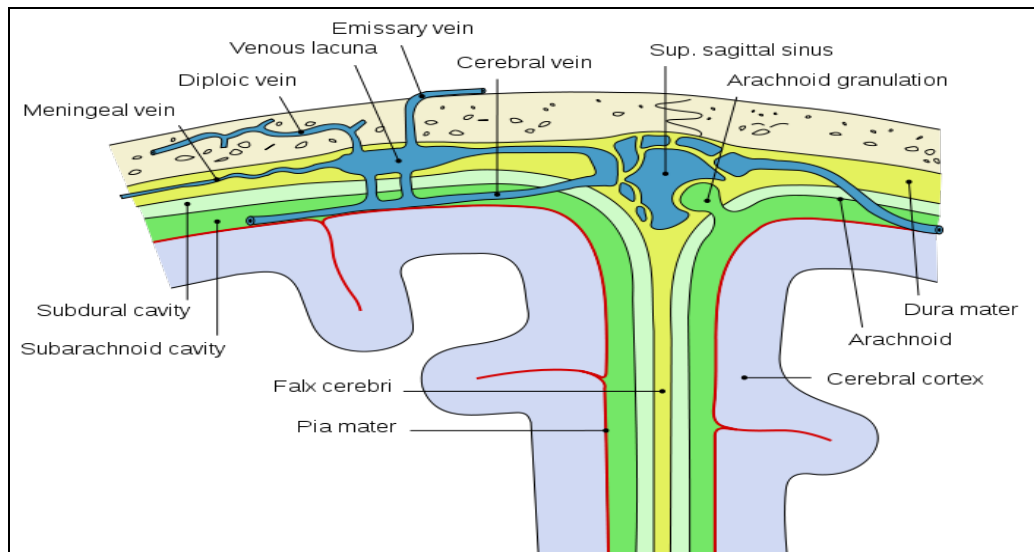
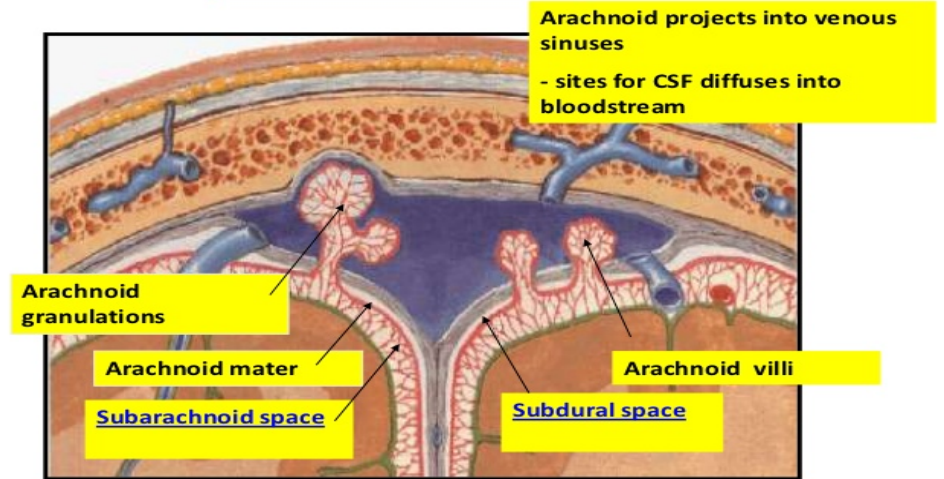
□ It leaves the ventricular system through the three **apertures of the 4<sup>th</sup> ventricle** (median foramen of Magindi & 2 lateral foraminae of Leushka), to enters the **subarachnoid space.**



# 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.**

## Arachnoid mater





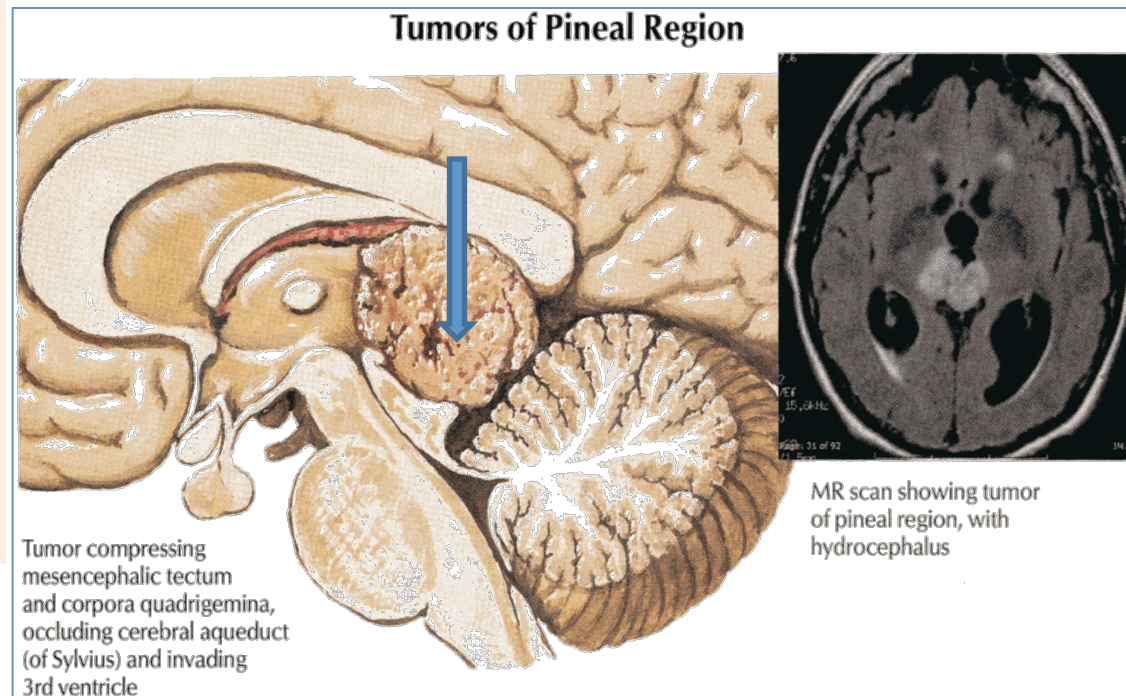
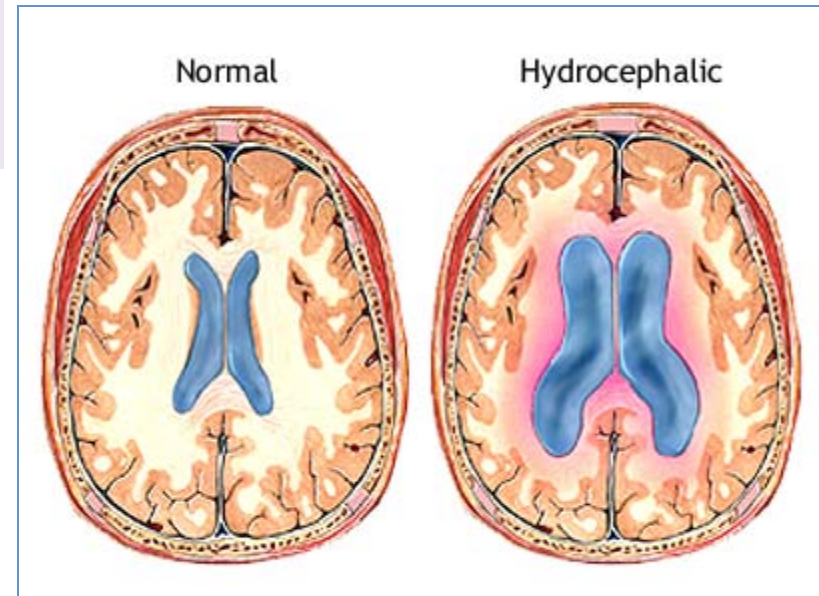
# CEREBROSPINAL FLUID

## 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

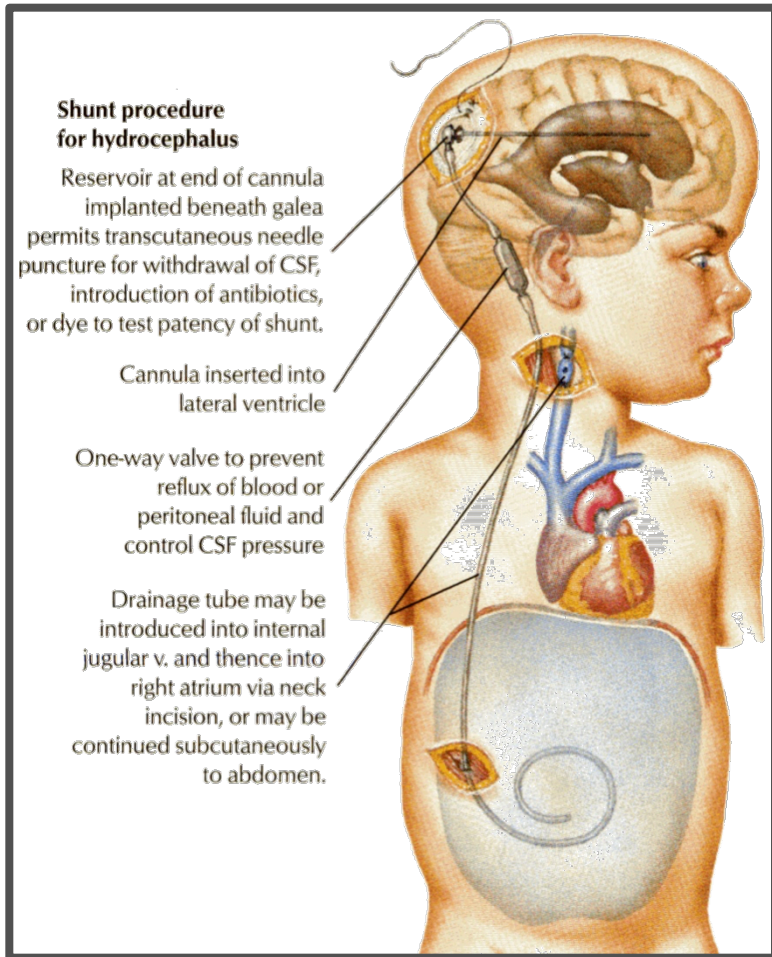




# CEREBROSPINAL FLUID

## 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 ,3<sup>rd</sup> & 4<sup>th</sup> 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 2<sup>nd</sup> sacral vertebra.
- Obstruction of the flow of CSF as in **tumors of the brain** leads to **hydrocephalus**.