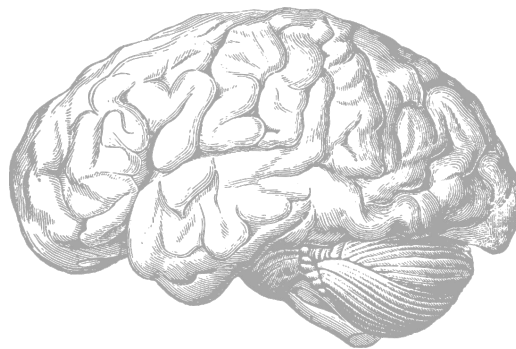




Anatomy of the Meninges, CNS Cavities, and CSF Circulation

CNS Block









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Objectives

-  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:

1

The outermost layer is the **Dura mater**.

2

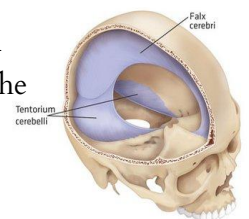
The middle layer is the **Arachnoid mater**.

3

The innermost layer is the **Pia mater**.

Dura mater

Description	The cranial dura is a two layered tough, fibrous thick membrane that surrounds the brain.	
Layers	Periosteal layer.	Attached to the skull .
	meningeal layer.	folded forming dural folds: <ol style="list-style-type: none"> 1. falx cerebri. 2. tentorium cerebelli.
Dura Mater Folds	<p>Dura mater folds: Two large reflection of dura extend into the cranial cavity:</p> <ol style="list-style-type: none"> 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: <ul style="list-style-type: none"> ▶ An attached border adherent to the skull . ▶ A free border lies above the corpus callosum. 2. The tentorium cerebelli, it is a horizontal shelf of dura, It lies between the posterior part of the cerebral hemispheres and the cerebellum. In the middle line it is continuous above with the falx cerebri. <p>It has:</p> <ul style="list-style-type: none"> ▶ A free border that encircles the midbrain. 	
Dural Nerve Supply	<ul style="list-style-type: none"> ▶ Branches of trigeminal, vagus, and first three cervical nerves and branches from the sympathetic system. ▶ The dura is sensitive to stretching (sense of headache). <p style="text-align: center;">Referral pain</p> <ul style="list-style-type: none"> ▶ Cranial nerves 5 and 10: referral pain to the head from above the tentorium cerebelli. ▶ Spinal nerves C1-C3: referral pain the back of the head and neck from below tentorium. 	
Arterial Supply	<ol style="list-style-type: none"> 1. Branches from internal carotid, mainly maxillary, ascending pharyngeal, occipital, & vertebral arteries. 2. Clinically the most important is the middle meningeal artery (MMA is a branch of the maxillary artery), which is commonly injured in head injuries. 	



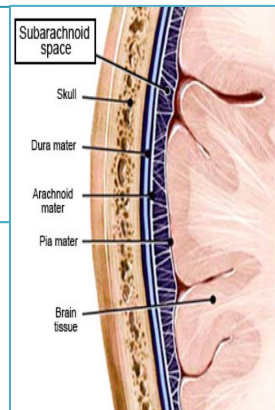
Arachnoid and Pia mater

Arachnoid mater

It is a soft, translucent membrane loosely envelops the brain. It is **separated from the dura** by a narrow subdural space.

Pia mater (Tender mother)

It is the innermost, thin, delicate & **highly vascular** membrane that is closely adherent to the gyri and fitted into the sulci.



Subarachnoid space

Definition

Between the pia and arachnoid mater lies the subarachnoid space which **contains**: fibrous trabeculae, main blood vessels & CSF.

Subarachnoid Space is varied in depth forming subarachnoid cisterns:

1

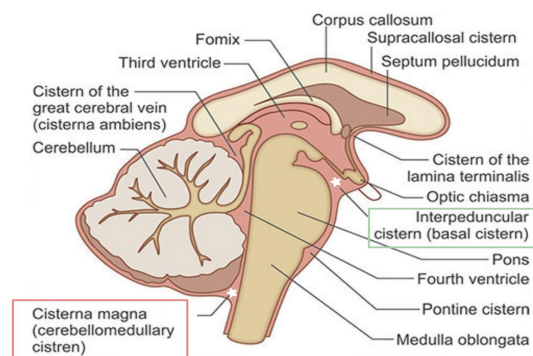
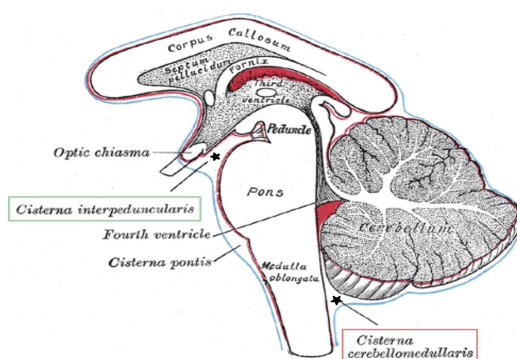
The cisterna magna or cerebellomedullary cistern

- ▶ 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 2 lateral apertures and median aperture.
- ▶ **Can be tapped by CSF (suboccipital tap).**

2

The interpeduncular cistern

- ▶ Located at the base of the brain, where the arachnoid spans between the two cerebral peduncles of midbrain.
- ▶ **Contains** the optic chiasma & circulus arteriosus of Wills.



Spinal meninges

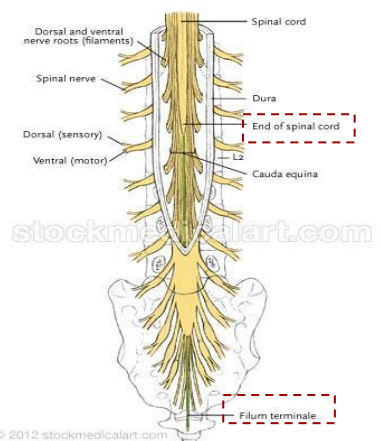
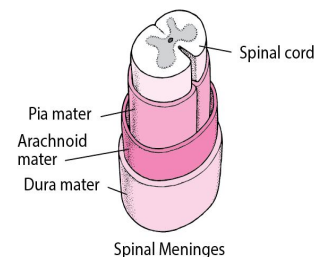
The spinal cord is invested by three meningeal layers:

<p>Dura Mater</p>	<p>The outer covering; is a thick, tough fibrous membrane. It envelops the cord loosely. It is separated from arachnoid mater by the subdural space, and from the bony wall of the vertebral canal by the epidural space. ▶ Epidural space: Contains loose areolar tissue, venous, plexuses and lymphatics. may be injected with a local anaesthetic to produce a paravertebral nerve block.</p>
<p>Arachnoid Mater</p>	<p>translucent membrane lies between the pia and dura, Between arachnoid and pia lies the subarachnoid space contains CSF.</p>
<p>Pia Mater</p>	<p>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. (Very IMPORTANT) Dr: Which mater has the denticulate ligament?</p>



Dr's note: The differences between meninges of the brain and the spinal cord:

- 1- The Dura mater of the spinal cord has only **one layer**
- 2- Denticulate ligament is **only** found in the **spinal cord**

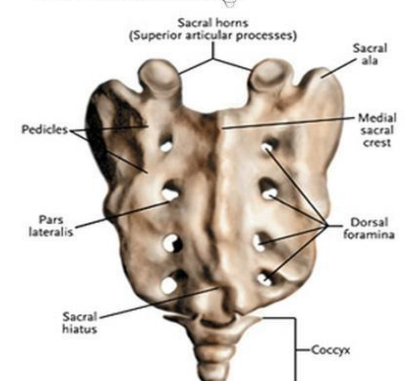


Terminations

MCQ

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

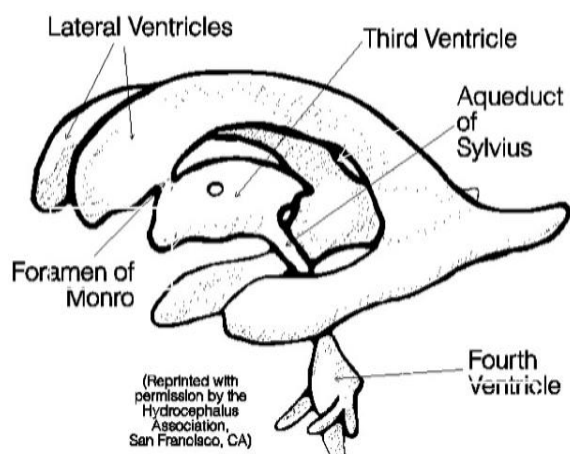
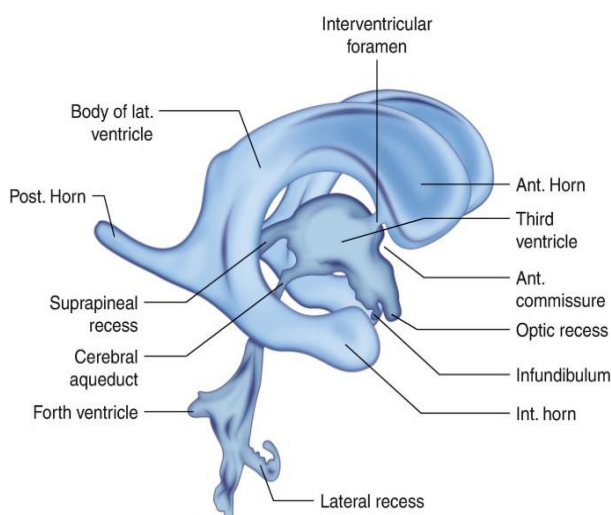
The ventricular system is Interconnecting channels within the CNS.

In the spinal cord; represented by the **central canal**, While 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**).

The **fourth 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).



Dr's note: you should know the names in the picture

Cerebrospinal fluid

It's present in the ventricular system together with the cranial & spinal subarachnoid spaces.

1

Colourless clear fluid containing : little protein and few cells.

2

It is about **150 ml.**

3

It acts as a **cushion** for the brain from sudden movements of the head.

4

It is produced by the **choroid plexus**, which is located in the **lateral, third & fourth ventricles.**

Flow of CSF

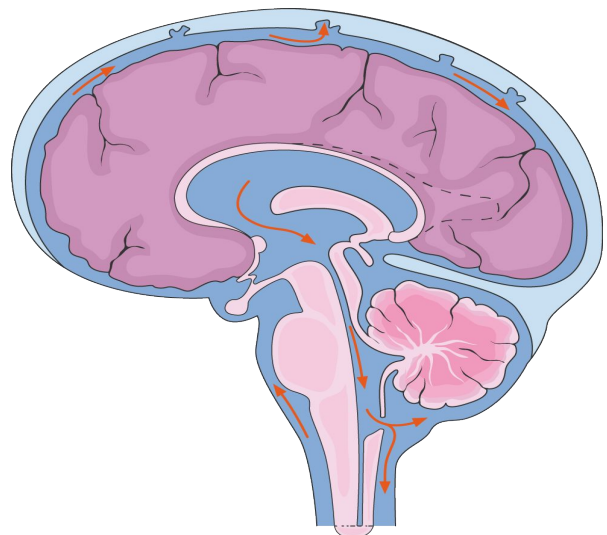
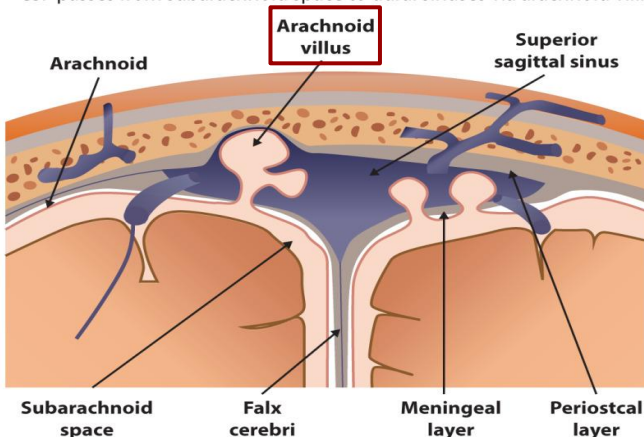
From **lateral ventricle** it flows through the **interventricular foramen** into the **3rd ventricle** and by way of the **cerebral aqueduct**, into the **4th ventricle.**

It leaves the **ventricular system** through the three **apertures of the 4th ventricle** (median foramen of Magendie & 2 lateral foramina of Luschka), to enter the **subarachnoid space.**

-Reabsorbed finally into the **venous system** along 1- **arachnoid villi** (small microscopic herniation of arachnoid mater).
2- **arachnoid granulation** (Macroscopic multilobulated structures) that project into the **dural venous sinuses**, mainly **superior sagittal sinus.**

CSF Circulation

- CSF is produced from blood and is returned to the blood
- CSF passes from subarachnoid space to dural sinuses via arachnoid villi



Cerebrospinal Fluid (Clinical point)

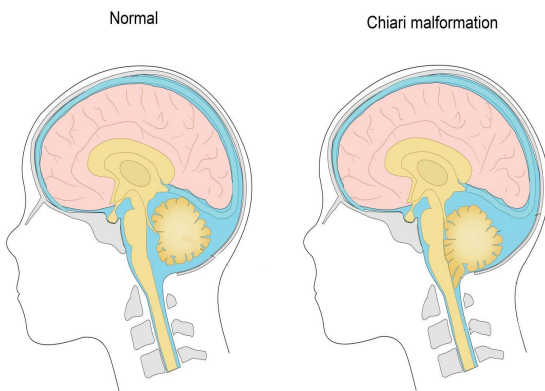
Hydrocephalus

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

Hydrocephalus Causes

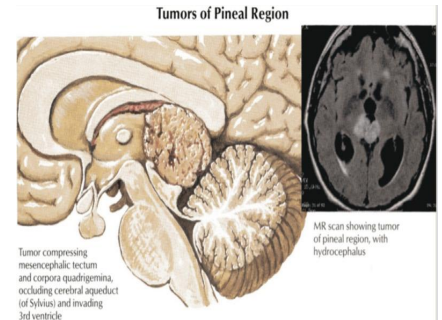
Congenital (Arnold-Chiari malformation)

Acquired



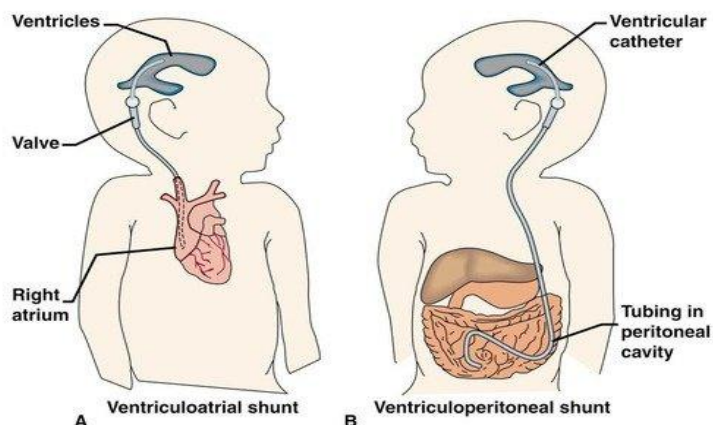
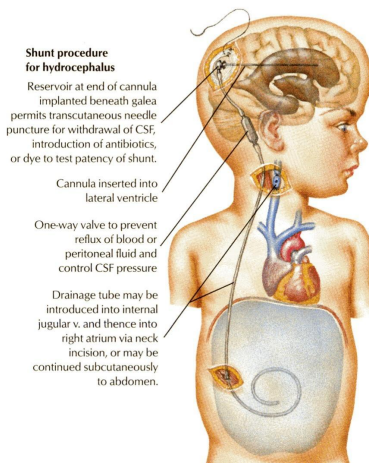
Obstruction of the **interventricular foramina (foramen of monro)** secondary to tumors, hemorrhages or infections such as meningitis.

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



Ventricular Decompression

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



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.



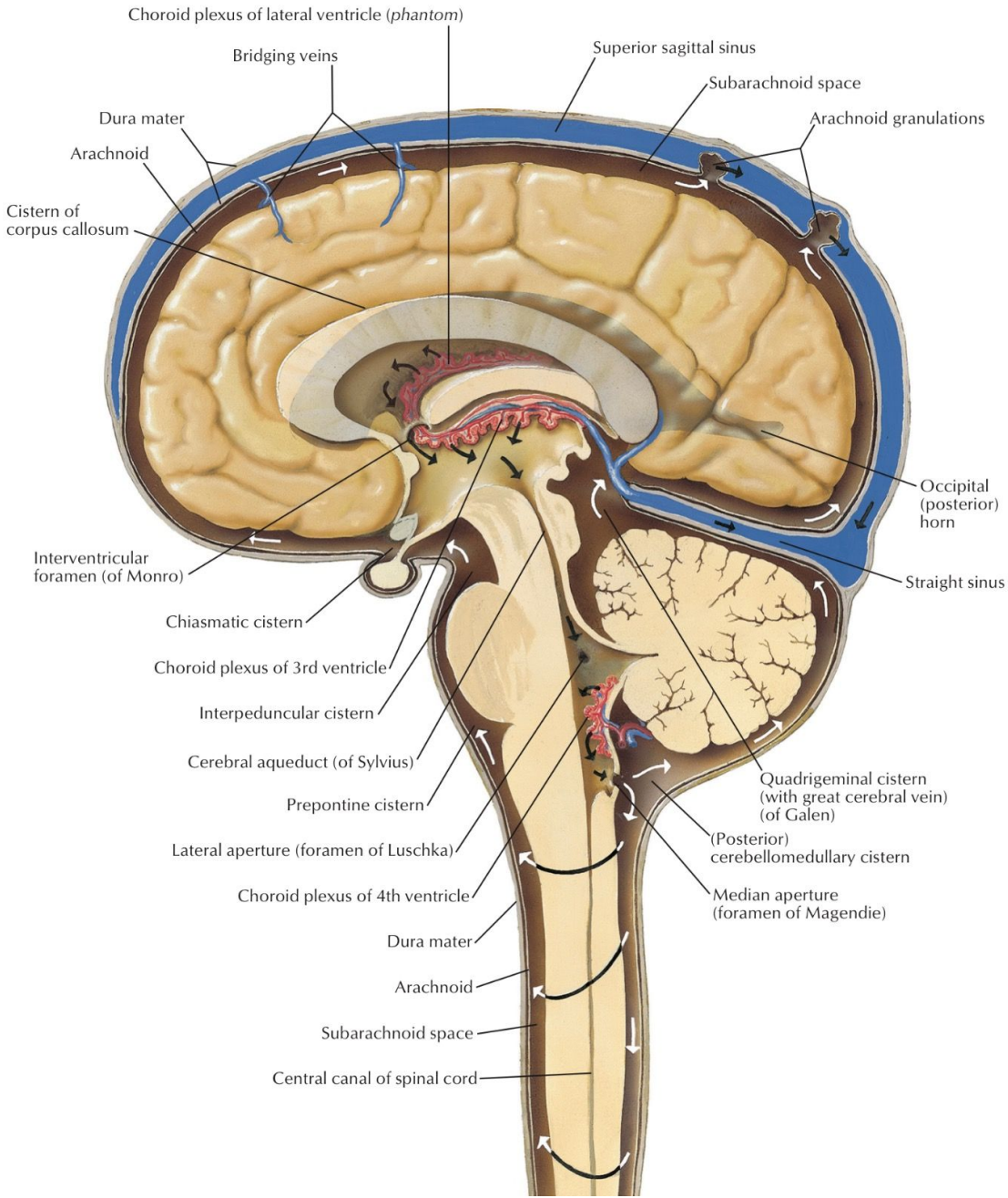
CSF is drained into the dural venous sinuses principally superior saggital sinus.



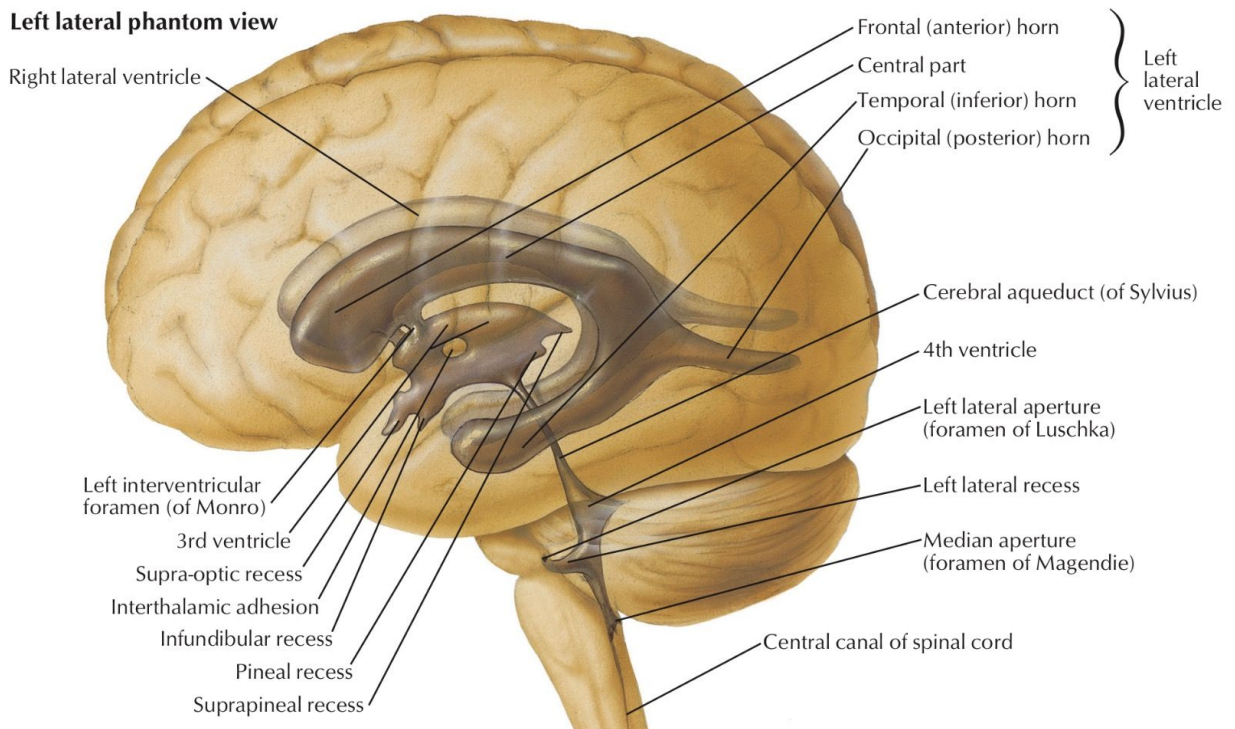
The subarachnoid space in the spinal cord terminates at the 2nd sacral vertebra.



Obstruction of the flow of CSF as in tumors of the brain leads to hydrocephalus.



Left lateral phantom view



MCQs

Q1. Which one of the following is the final drainage site of the CSF?

- | | | | |
|--------------------|-----------------------|-------------------|----------------------------|
| A. Arachnoid villi | B. Subarachnoid space | C. Subdural space | D. Superior sagittal sinus |
|--------------------|-----------------------|-------------------|----------------------------|

Q2. Which one of the following opens into the subarachnoid space?

- | | | | |
|----------------------|-----------------------------|-------------------------------|------------------|
| A. Cerebral aqueduct | B. Interventricular foramen | C. Median foramen of Magendie | D. Central canal |
|----------------------|-----------------------------|-------------------------------|------------------|

Q3. Where is the exact location of tentorium cerebelli?

- | | | | |
|---|--|---|------------------------------------|
| A. Between the two cerebral hemispheres | B. Between the cerebellum and cerebrum | C. Between the two cerebellar hemispheres | D. Between the cerebellum and pons |
|---|--|---|------------------------------------|

Q4. Which one of the following is a characteristic of the arachnoid mater?

- | | | | |
|--------------------------------------|--------------------|----------------------|--------------------------------|
| A. Firmly attached to the dura mater | B. Highly vascular | C. Soft and delicate | D. Loosely envelopes the brain |
|--------------------------------------|--------------------|----------------------|--------------------------------|

Q5. Which one of the following ventricles opens into the subarachnoid space?

- | | | | |
|---------------------|--------------------|----------------------|----------------------|
| A. Fourth ventricle | B. Third ventricle | C. Lateral ventricle | D. Cerebral aqueduct |
|---------------------|--------------------|----------------------|----------------------|

Q6. Which one of the following levels is where the subarachnoid space ends?

- | | | | |
|-------|-------|-------|-------|
| A. S2 | B. S1 | C. L2 | D. L1 |
|-------|-------|-------|-------|

A1. D A2. C A3. B A4. D A5. A A6. A

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