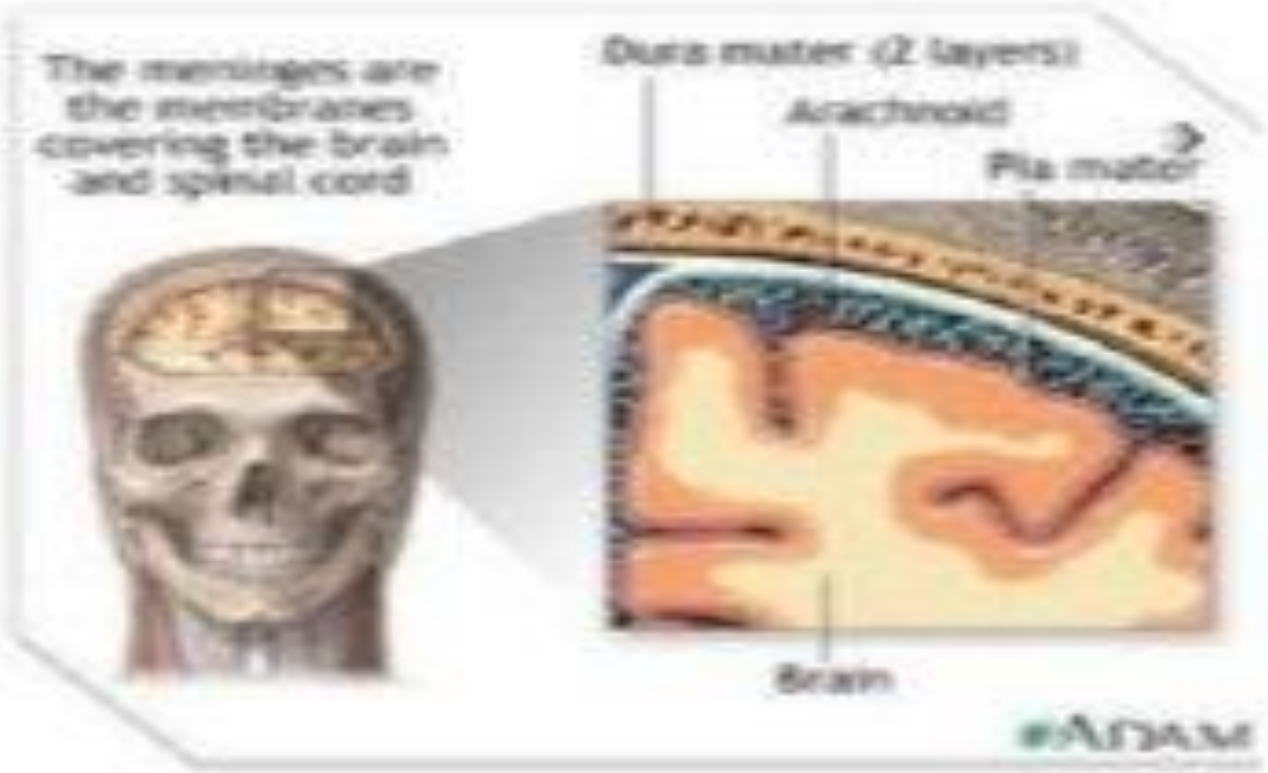
BRAIN MENINGES &

The Meninges

- The brain and spinal cord are enclosed by three membranous coverings or meninges

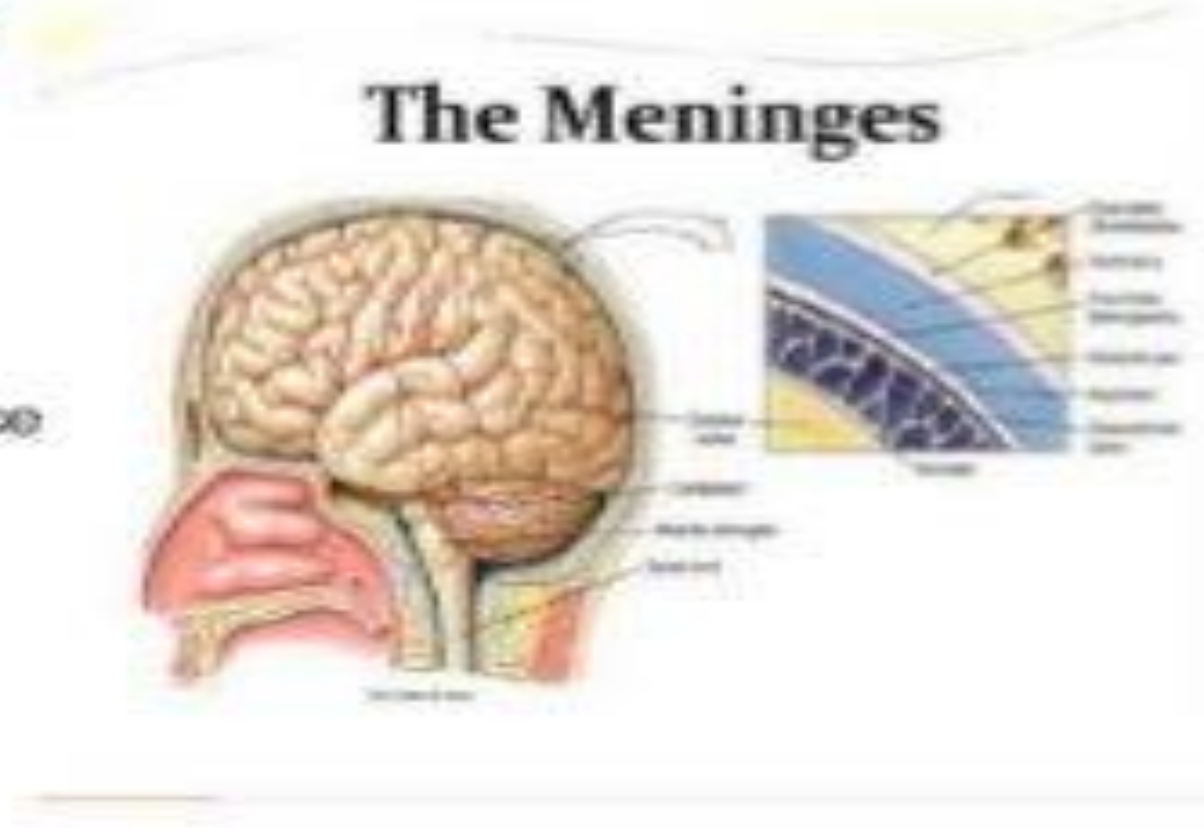
- These are
  - The Dura mater
  - The Arachnoid mater
  - The Pia mater

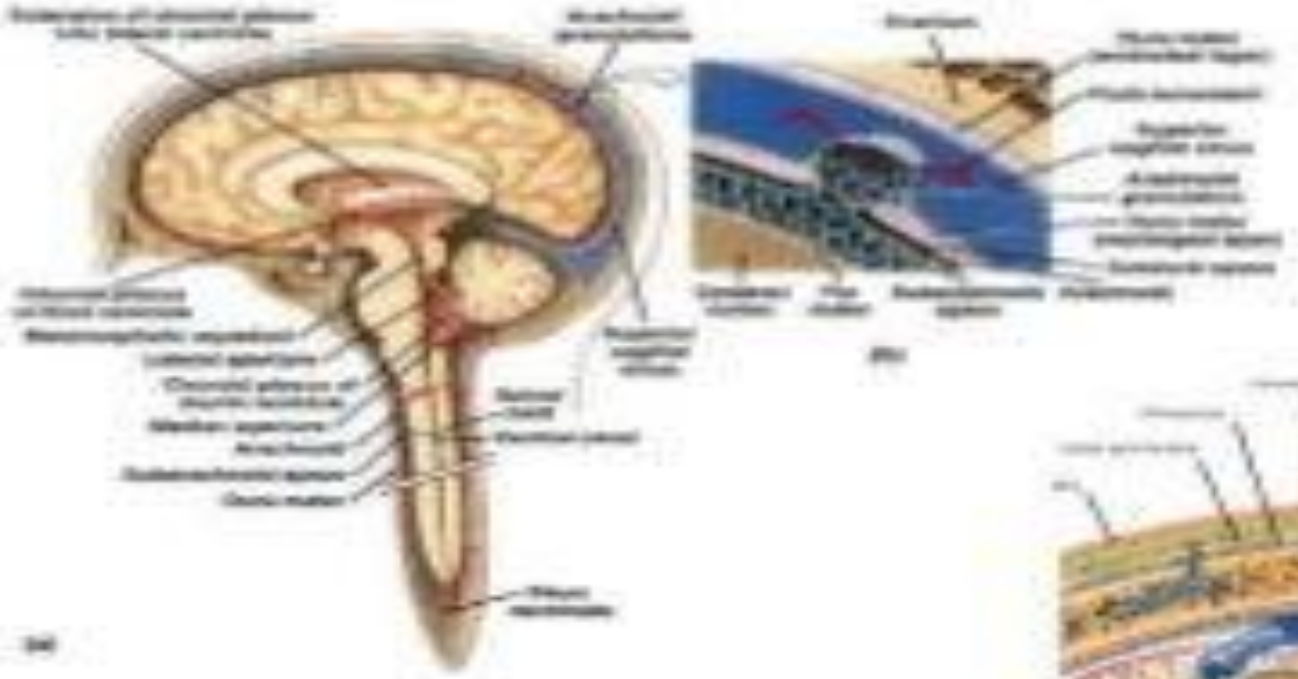


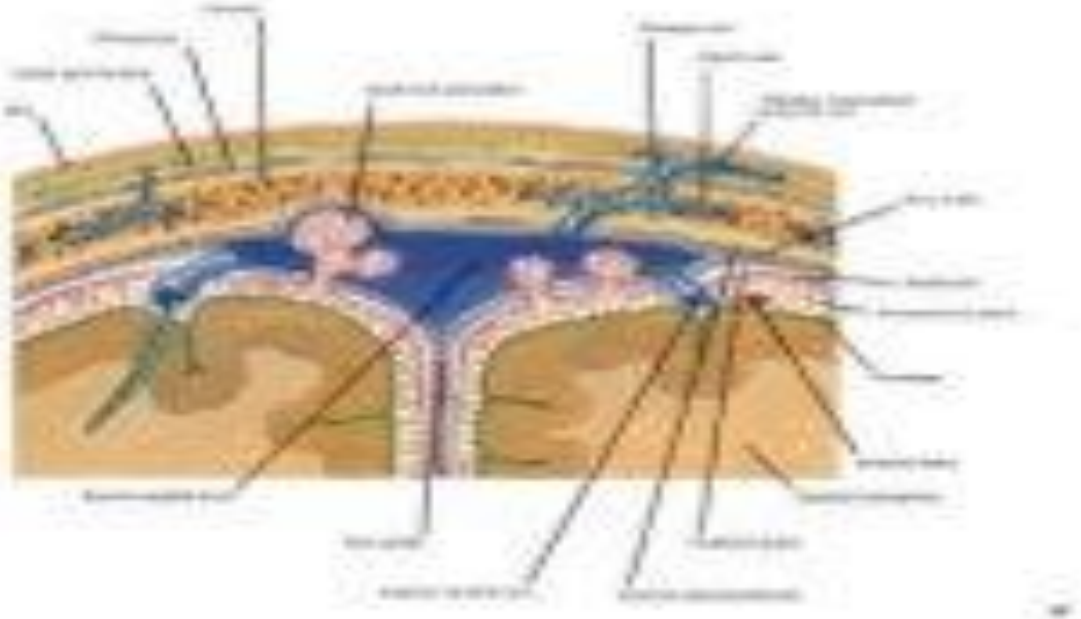
Spaces Between the meninges

1)Sub dural space

2)Sub arachnoid space





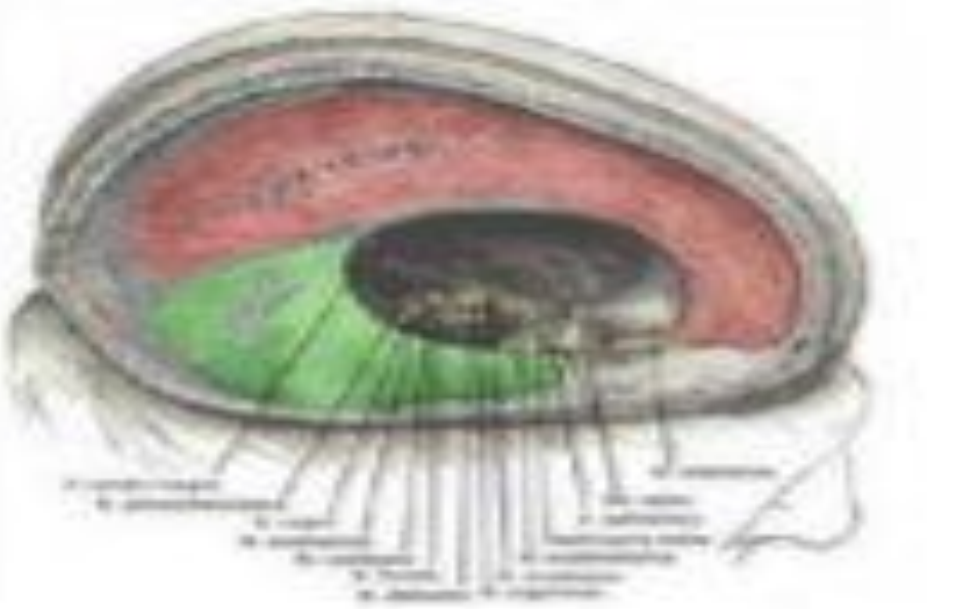


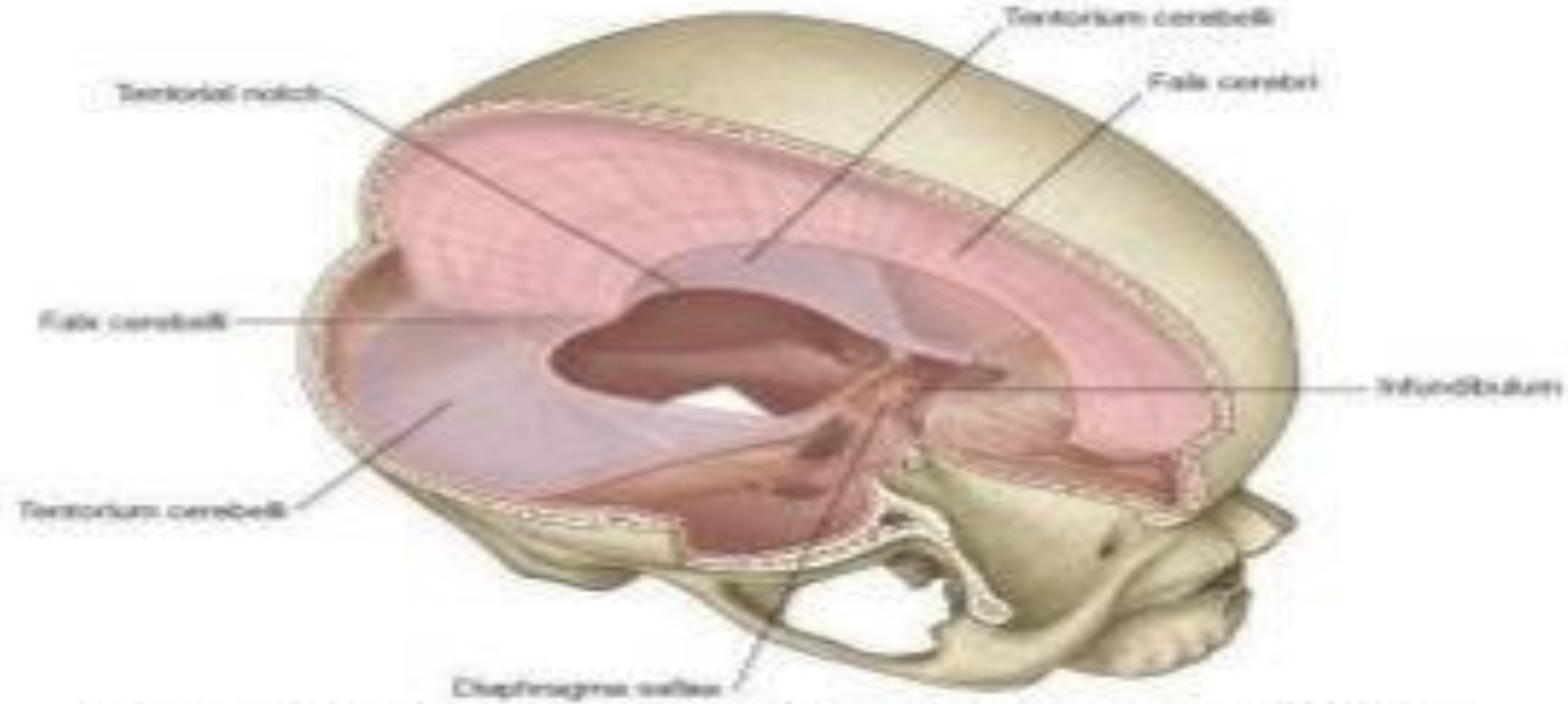
Dural septa

Meningeal layer sends inward four septa which devide the cranial cavity

The dura mater

- Falx cerebri
- Falx cerebelli
- Tentorium cerebelli
- Diaphragma sella



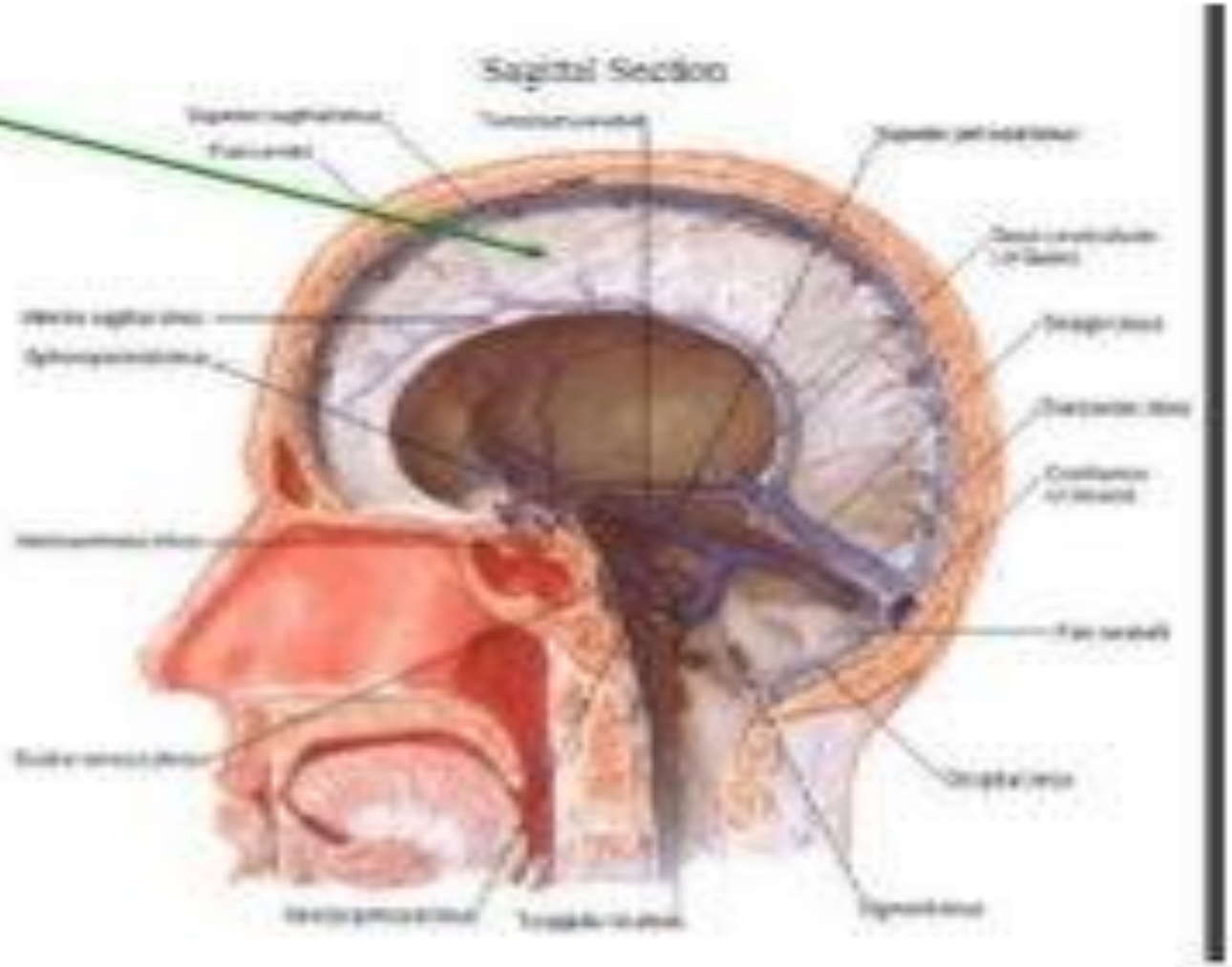


Falx cerebri

It is a sickle-shaped fold of dura mater that lies in the midline between the two cerebral hemispheres.

Its narrow end in front is attached to the internal frontal crest and the crista galli.

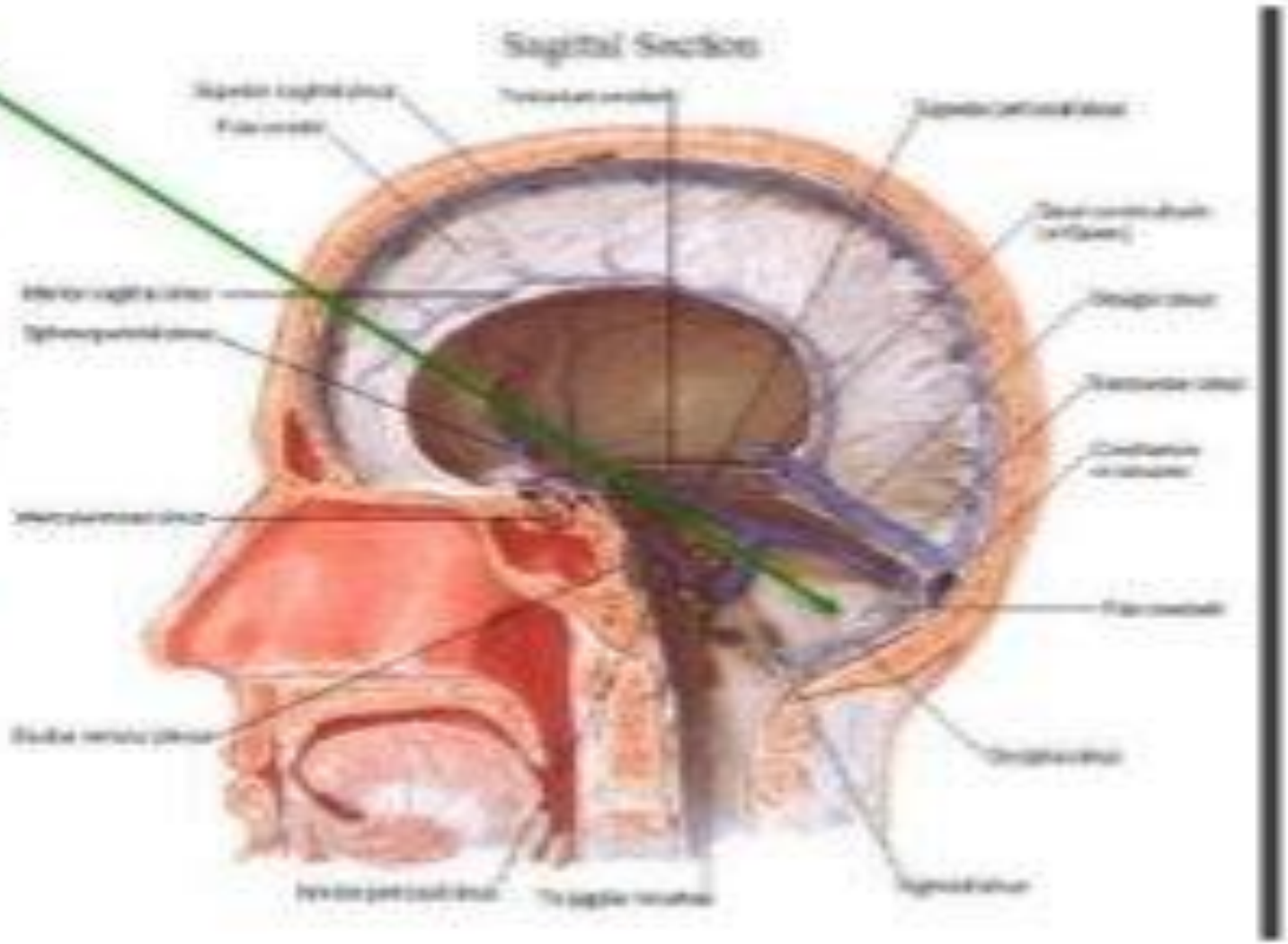
Its broad posterior part blends in the midline with the upper surface of the tentorium cerebelli.



Falx cerebelli

- The falx cerebelli is a small, *sickle*-shaped fold of dura mater that is attached to *the internal occipital crest* and projects forward between the two cerebellar hemispheres.

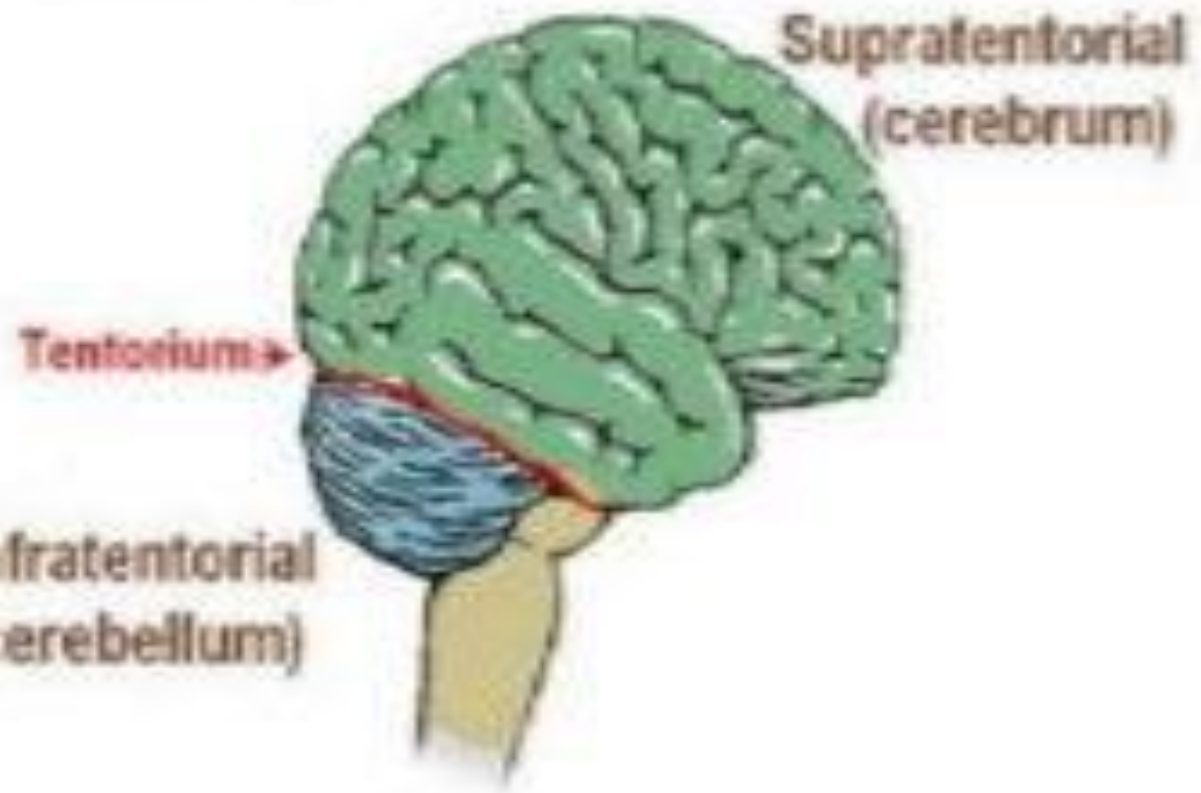
- Its posterior fixed margin contains *the occipital sinus*



The Tentorium Cerebelli

- The tentorium cerebelli is a crescent-shaped fold of dura mater that roofs over the posterior cranial fossa.

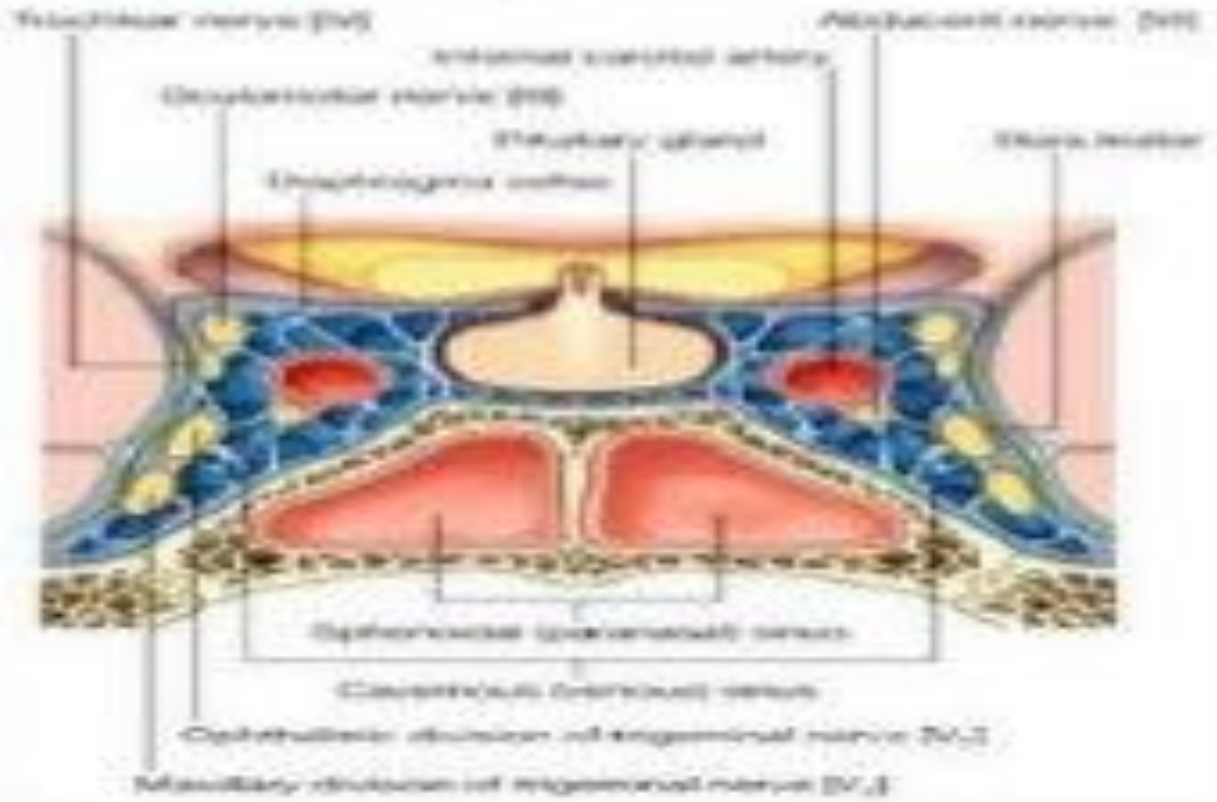
- It covers the upper surface of the cerebellum and supports the occipital lobes of the cerebral hemispheres.



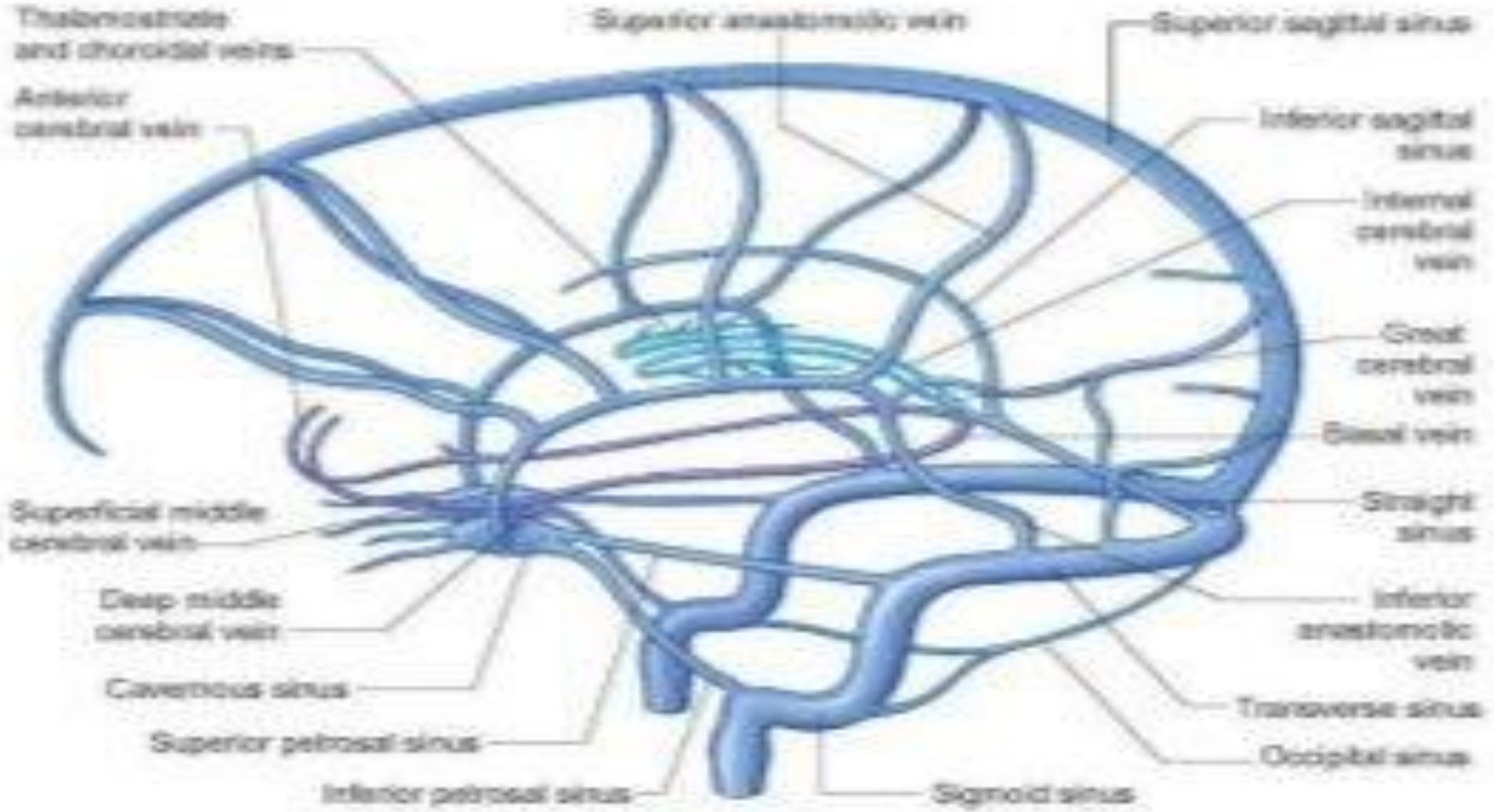
The Diaphragma Sellae

The diaphragma sellae is a small *circular* fold of dura mater that forms the roof for *the sella turcica*.

A small opening in its center allows passage of the stalk of *the pituitary gland*



Dural venous sinuses

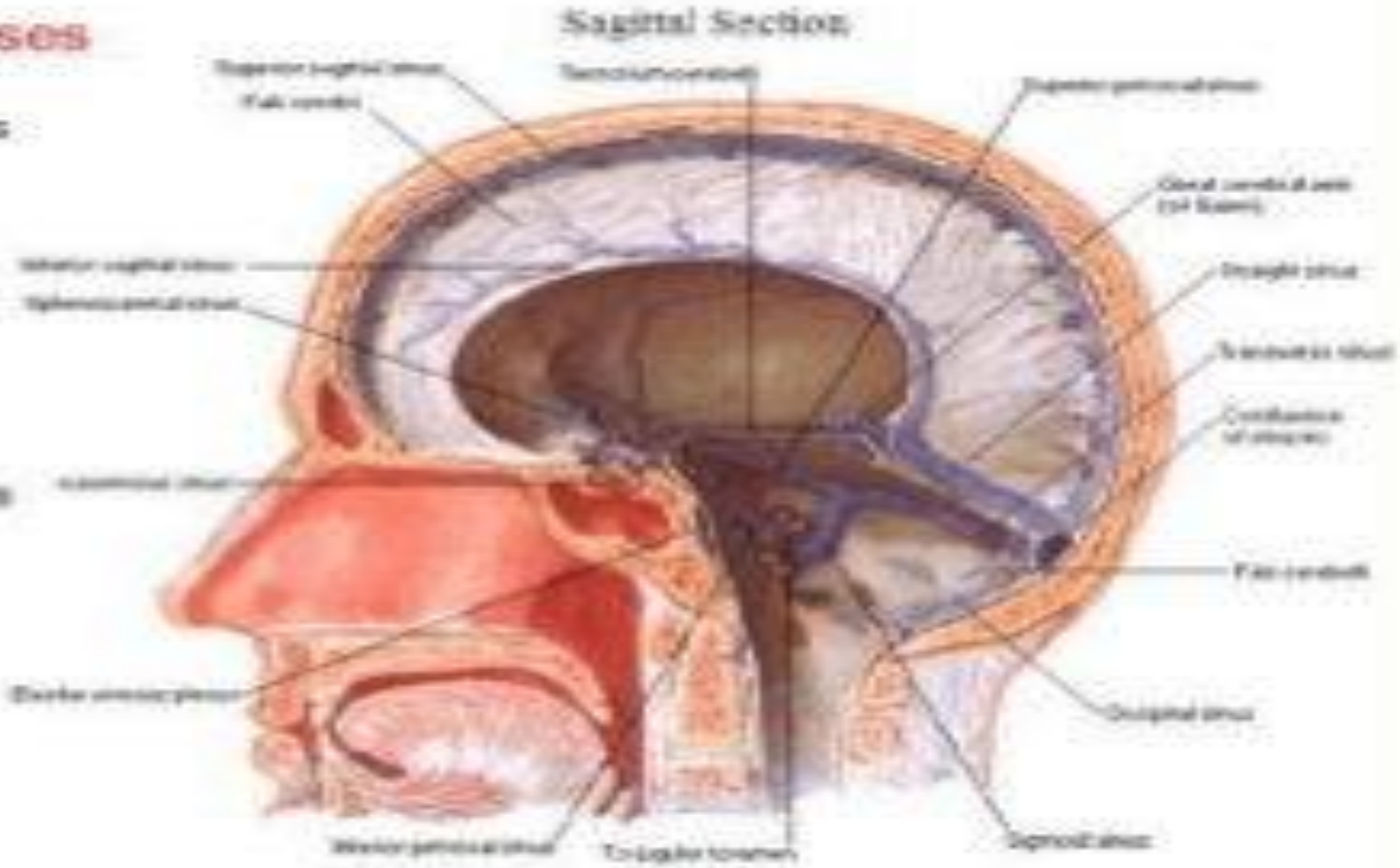

Thalamostriate and choroidal veins
Anterior cerebral vein
Superficial middle cerebral vein
Deep middle cerebral vein
Cavernous sinus
Superior petrosal sinus
Inferior petrosal sinus
Superior anastomotic vein
Superior sagittal sinus
Inferior sagittal sinus
Internal cerebral vein
Great cerebral vein
Basal vein
Straight sinus
Inferior anastomotic vein
Transverse sinus
Occipital sinus
Sigmoid sinus

Characteristic feature of dural venous sinuses

- Lined by endothelium, no muscular coat & valveless.
- Collect blood from brain, meninges, orbit, internal ear & diploe.
- Connected to valveless emissary veins to maintain the internal & external venous pressure.
- Projection of arachnoid granulation into it for CSF absorption.

Dural venous sinuses

1) Superior sagittal sinus
2) Inferior sagittal sinus
3) Straight sinus
4) Transverse sinus
5) Sigmoid sinus
6) Occipital sinus
7) Superior petrosal sinus
8) Inferior petrosal sinus
9) Cavernous sinus



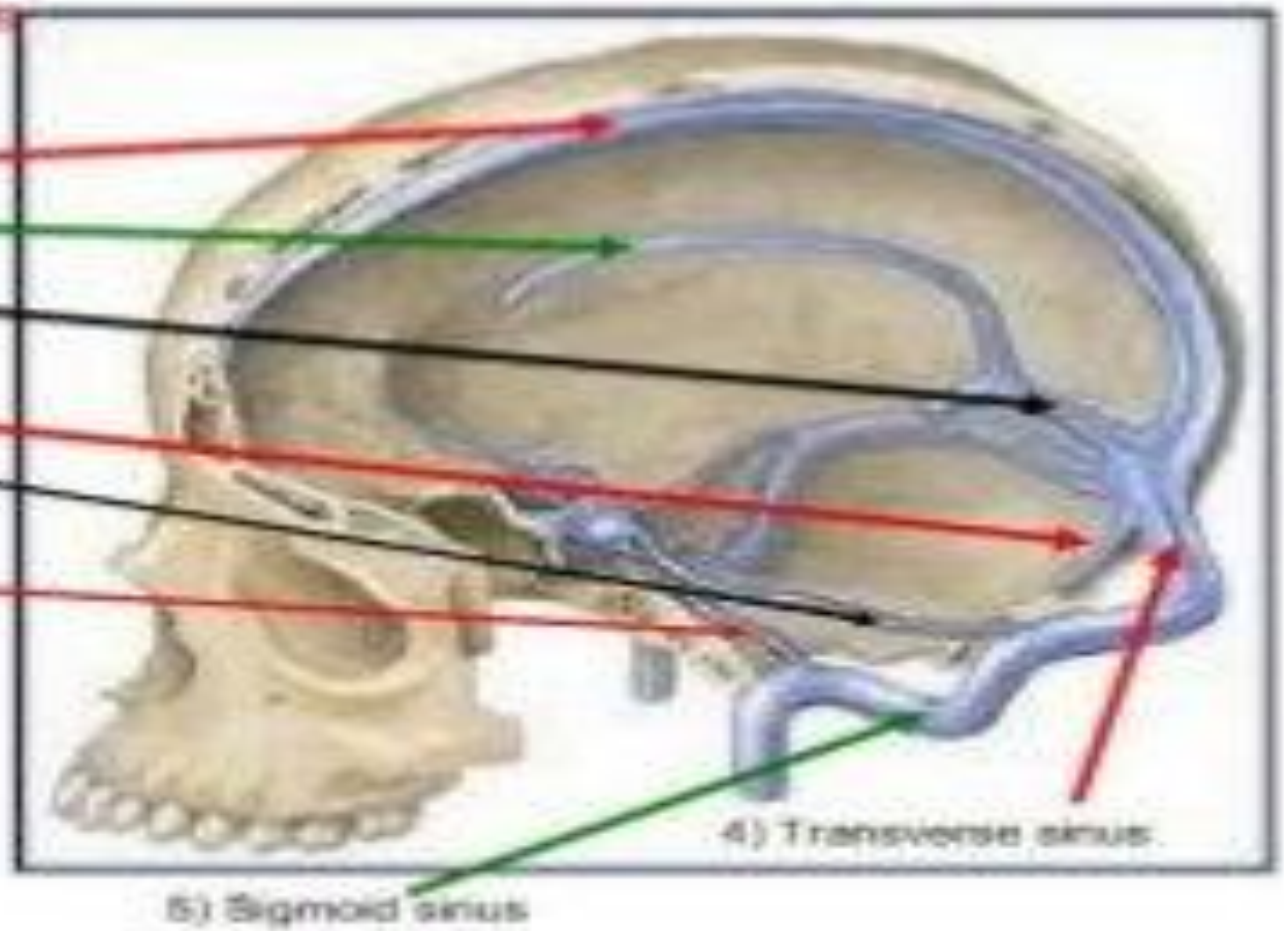
Dural venous sinuses

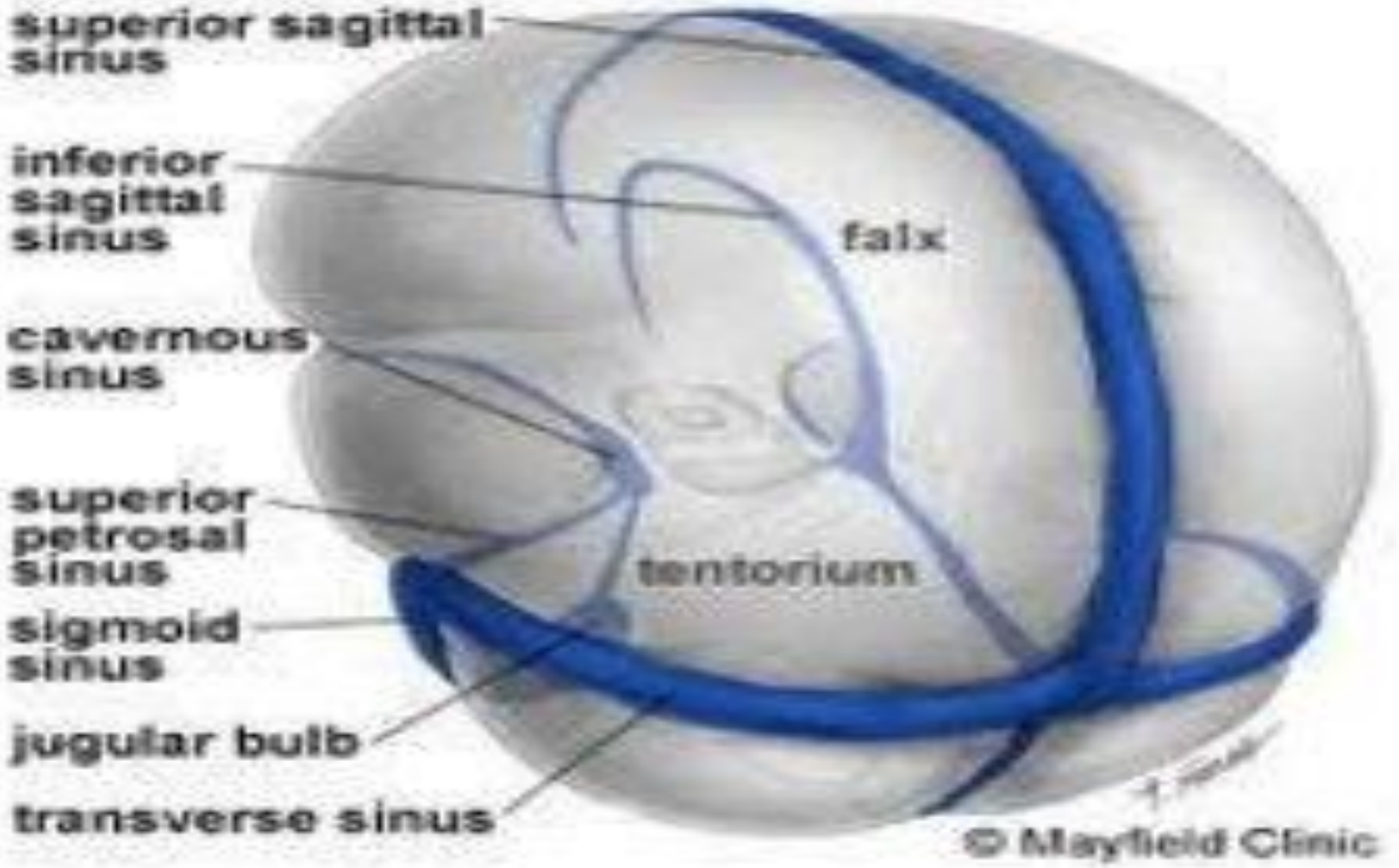
1)Superior sagittal sinus
2) Inferior sagittal sinus
3) Straight sinus

6) Occipital sinus
7) Superior petrosal sinus

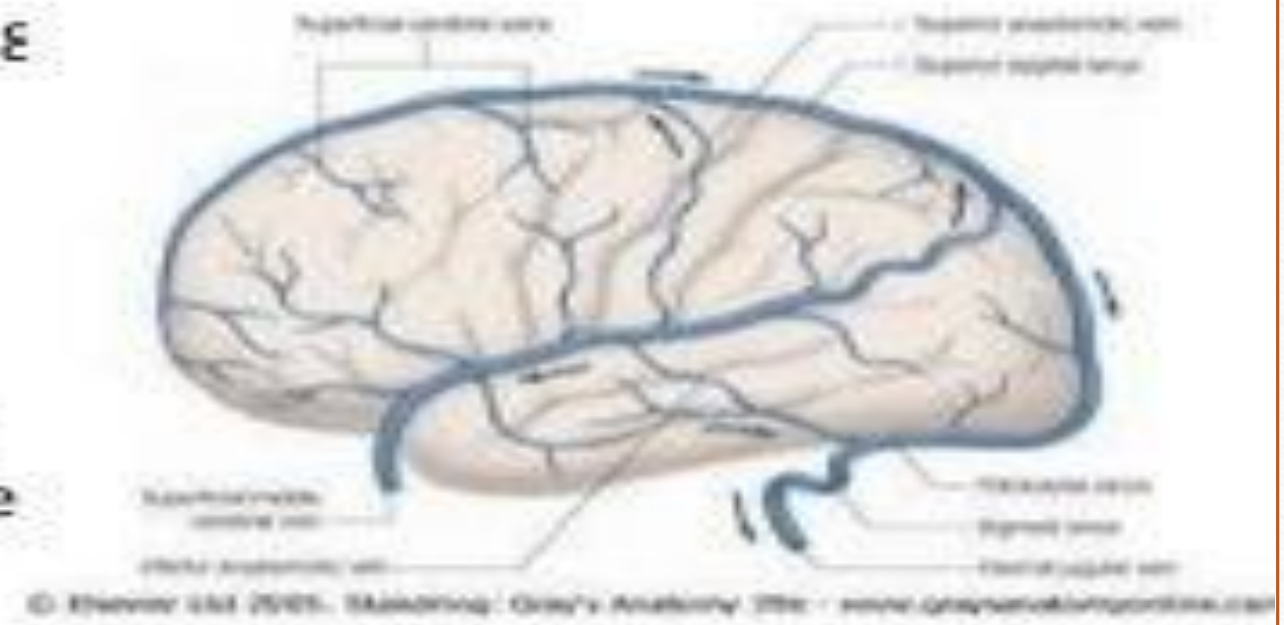
8) Inferior petrosal sinus

9) Cavernous sinus




superior sagittal sinus
inferior sagittal sinus
falx
cavernous sinus
superior petrosal sinus
tentorium
sigmoid sinus
jugular bulb
transverse sinus
© Mayfield Clinic

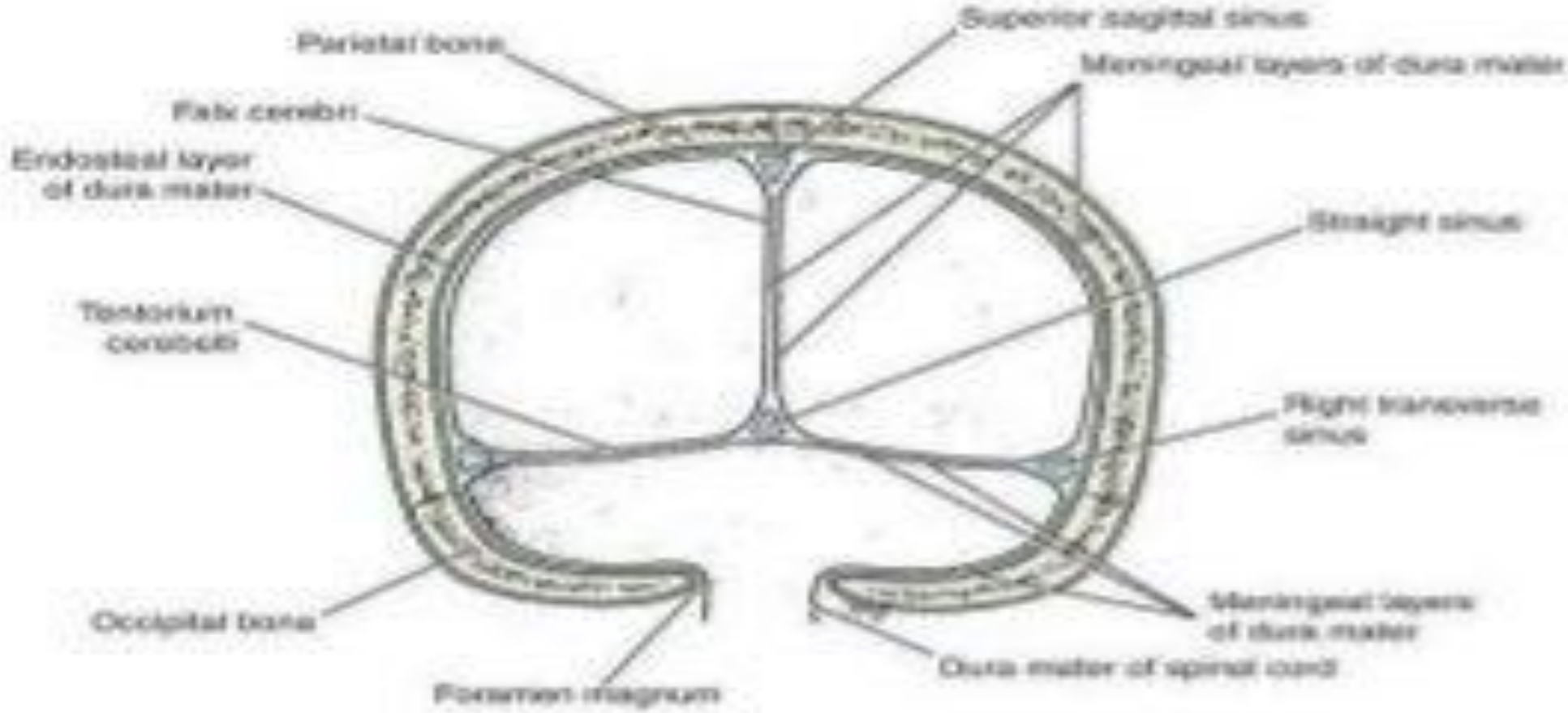
- Tributaries :
- Superior cerbral vein- ε 12
- Emissary vein
- Communications :
- Veins of scalp
- Vein from nasal cavity through patent forame caecum
- Cavernous sinus



Clinical significance

- Infection from scalp, nasal cavity & diploic tissue → septic thrombosis → ↓ CSF absorption → ↑ ICT

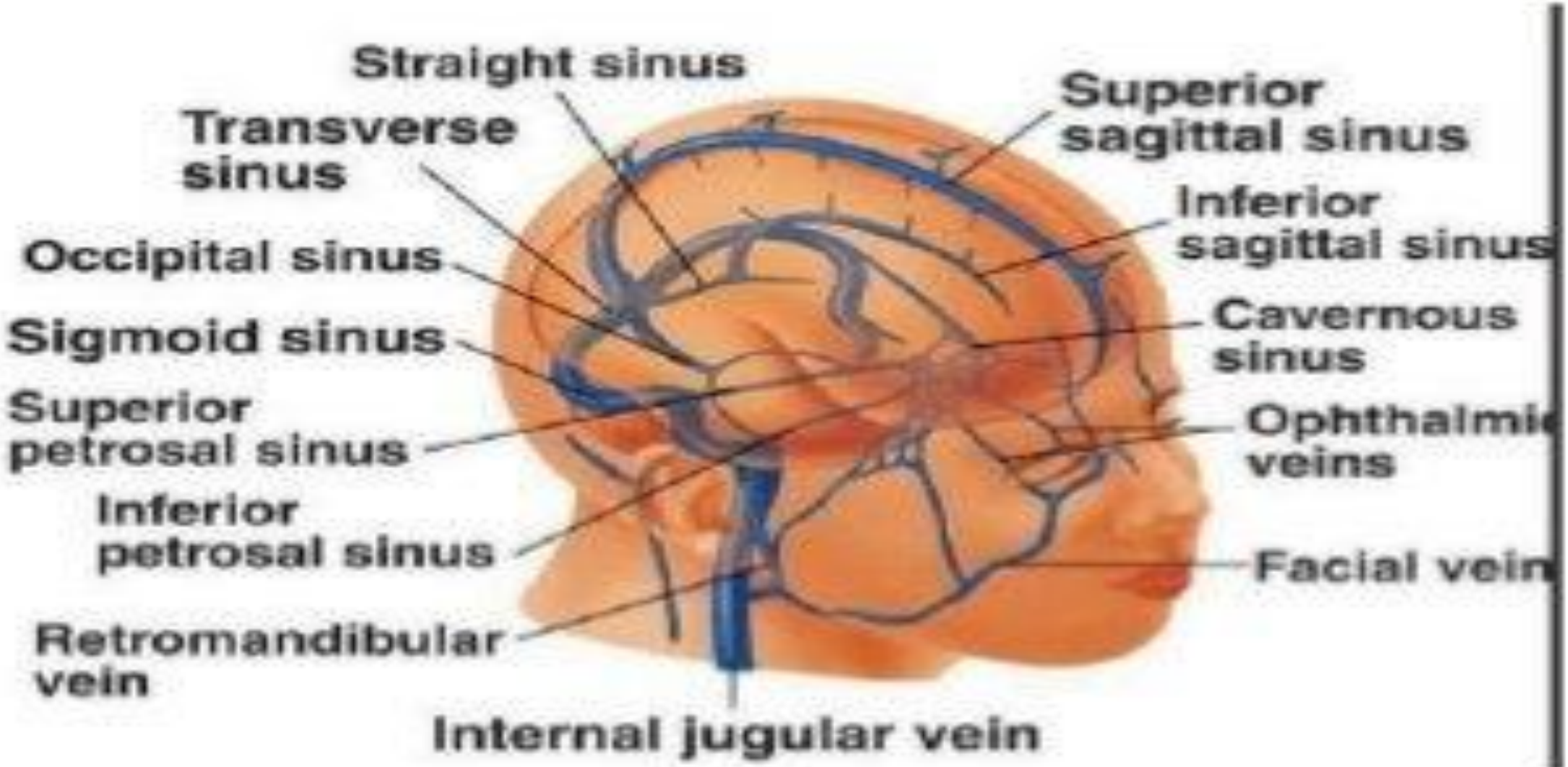
Straight sinus



Straight sinus

- Location : junction of falx cerebri & tentorium cerebelli
- Terminate into left transvese sinus & connected to confluence
- Tributaries :

1. Inferior sagittal sinus
2. Few superior cerebellar veins
3. Great cerebral vein (vein of Galen)


Straight sinus
Transverse sinus
Occipital sinus
Sigmoid sinus
Superior petrosal sinus
Inferior petrosal sinus
Retromandibular vein
Internal jugular vein
Superior sagittal sinus
Inferior sagittal sinus
Cavernous sinus
Ophthalmic veins
Facial vein

Paired sinuses

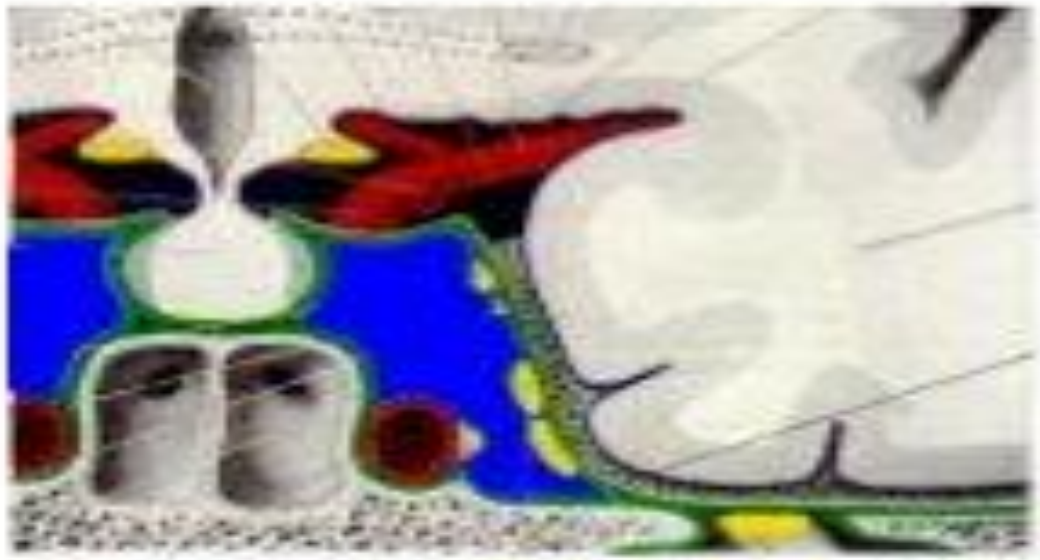
- Transverse sinuses
- Posterior attached margin of tentorium cerebelli
- Continues below as sigmoid sinus
- Tributaries :

1. Superior petrosal
2. Inferior cerebral & cerebellar veins

- Sigmoid sinuses
- Exit skull through posterior compartment of jugular foramen
- Continues with superior bulb of internal jugular vein
- Tributaries:

1. Mastoid & condylar emissary veins
2. Cerebellar vein
3. Labyrinthine vein

Cavernous sinus

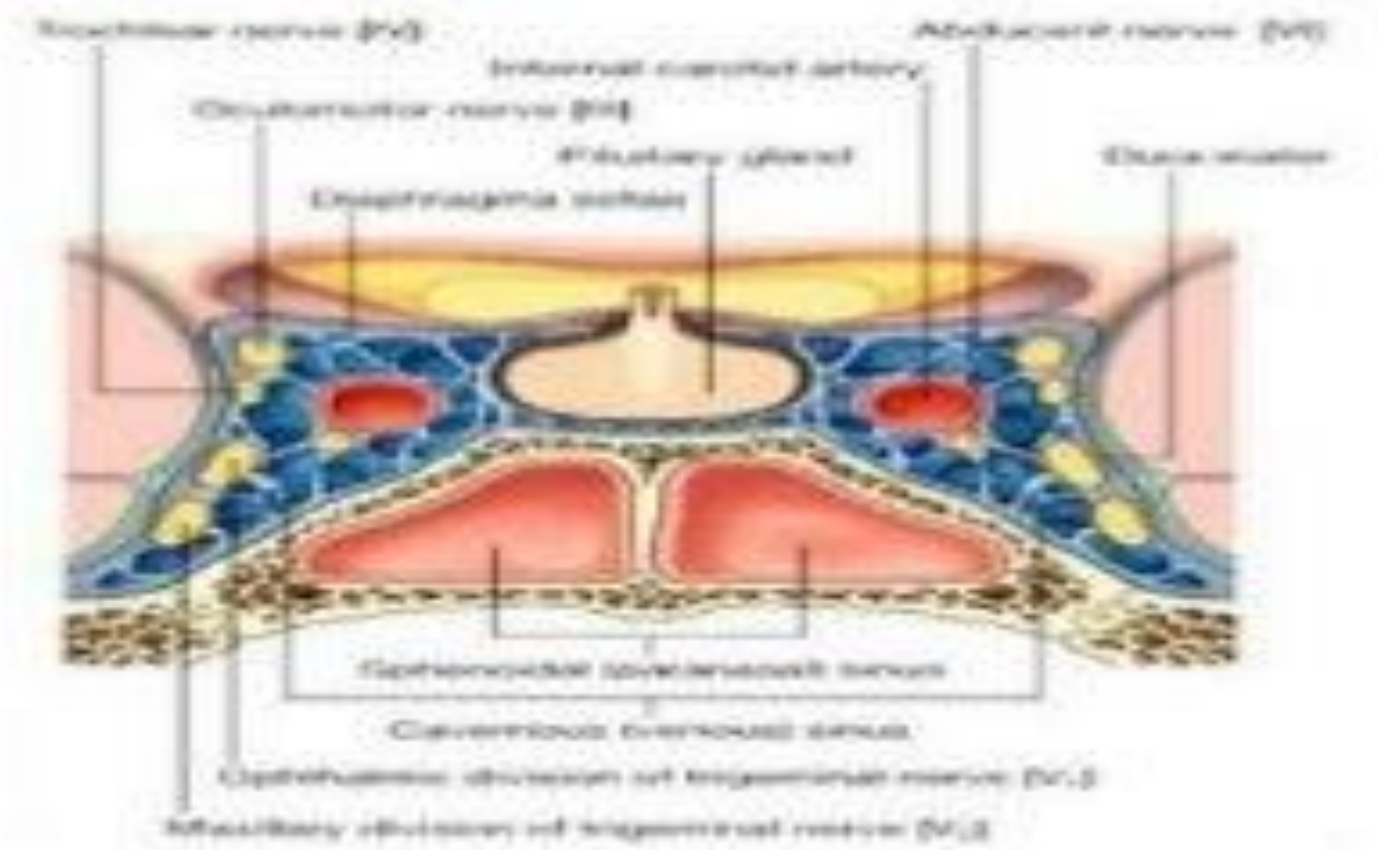


- Formation : cephalic part of primary head vein
- 2x 1 cm
- Roof & lateral wall : meningeal layer
- Floor & medial wall : endosteal layer
- RELATIONS

Contents of cavernous sinus

* Cranial nerves
  - III
  - IV
  - V_1
  - V_2
  - VI

Internal carotid artery



Communications of cavernous sinus

Anteriorly	Superior ophthalmic vein
	Inferior ophthalmic vein
Posteriorly	Superior petrosal sinus
	inferior petrosal sinus
Inferiorly	Pterygoid venous plexus

Two cavernous sinuses communicate with each other through

Anterior intercavernous sinus

Posterior intercavernous sinus

Tributaries of cavernous sinus

1) Superior ophthalmic vein
2) Inferior ophthalmic vein
3) Inferior cerebral vein
4) Sphenoparital sinus
5) Central vein of retina

- The brain and spinal cord are covered by the meninges, which are three layers or membranes of connective tissue that not only protect the brain and spinal cord, but also form a framework for vessels and venous sinuses.

- These three layers, from superficial to deep, are the dura mater, arachnoid mater, and pia mater.

- The dura mater is a tough, thick, fibrous external meningeal layer.
- Deep to the dura mater is the arachnoid mater.
- The dura and arachnoid mater are separated from each other by a potential space called the subdural space.

- Deep to the arachnoid mater is the pia mater.
- The pia mater is a delicate vascular layer that is intimately adhered to the brain, covering the gyri and extending along the different sulci and fissures.

Together, the arachnoid and pia mater are collectively known as the leptomeninges. Between the arachnoid mater and the pia mater is the subarachnoid space, also known as the leptomeningeal space, which is a true space between the arachnoid and pia mater which contains cerebrospinal fluid or CSF for short, as well as major vessels and cranial nerves.

- the dura mater, which is the thickest, outermost meningeal layer. The dura mater itself is further divided into two layers.
- The first, more superficial layer is called the endosteal layer, or periosteal layer of the dura mater.
- It is located on the interior surface of the skull bones and ends at the foramen magnum.

- The endosteal layer does not continue with the dura mater of the spinal cord, but instead becomes continuous with the periosteum on the external aspect of the skull bones. Between the endosteal layer of the dura mater and the skull bones, there lies a potential space called the extradural, or epidural space, which is not a natural space, but may become a pathological space during bleeding.
- The second, deeper layer of the dura mater is the inner meningeal layer, which is continuous with the dura mater of the spinal cord and ends at the level of the S2 vertebra. For the most part, these two dural layers are fused together and cannot be separated, but there are two main exceptions to this.

- One, there are locations where spaces are created between the layers to house the Dural venous sinuses. Secondly, the inner meningeal layer of the dura mater reflects away from the endosteal layer at certain regions to create Dural infoldings, or reflections, which divide the cranial cavity into compartments.
- These dural infoldings, or reflections, consist of the
- falx cerebri, falx cerebelli,
- tentorium cerebelli, and
- diaphragma sellae
- . The largest dural infolding is the falx cerebri, which lies in the longitudinal fissure and separates the two cerebral hemispheres from each other.
- It attaches anteriorly to the frontal crest of the frontal bone and the crista galli of the ethmoid bone. It contains the superior sagittal sinus in its fixed superior margin and attaches posteriorly to the internal occipital protuberance, where it also blends with the upper surface of the tentorium cerebelli.

Speaking of the tentorium cerebelli, this crescent shaped reflection is the second largest dural infolding, with a fixed margin posterolaterally and a free margin more anteriorly. The fixed margin is attached at three sites; bilaterally at the posterior clinoid processes, to the superior parts of the petrous portion of the temporal bone, and to the grooves of the transverse sinus on the inner surface of the occipital bone.
In contrast, the anterior part of the tentorium cerebelli is connected to the clinoid process of the sphenoid bone at its most rostral end. Otherwise, its margins are free, forming a U-shaped space.
This space between the free margins of the tentorium cerebelli is called the tentorial notch, and it allows for passage of the brainstem. The tentorium cerebelli spans a transverse plane over the cerebellum, which forms a roof over the posterior cranial fossa.

This effectively separates the cerebellum from the cerebrum, and divides the cranial vault into an infratentorial compartment below the tentorium cerebelli and a supratentorial compartment above. As you can see, the falx cerebri blends with the tentorium cerebelli posteriorly, helping to maintain its position.
Now, inferior to the tentorium cerebelli, we will find the falx cerebelli. This small dural infolding attaches to the internal occipital crest and contains the occipital sinus in its fixed posterior margin. It extends in the sagittal plane and partially separates the cerebellum into two cerebellar hemispheres.

The diaphragma sellae is the last and smallest dural infolding. It is a flat layer between the clinoid processes that forms an incomplete roof over the hypophyseal fossa of the sella turcica, which is a part of the sphenoid bone and contains the pituitary gland. The diaphragma sellae has a circular opening in the middle, which allows the passage of the pituitary stalk, or infundibulum, to connect the hypothalamus above to the pituitary gland below.

Now, as we said before, the two layers of the dura mater, for the most part, are strictly fused together. However, there are areas between the endosteal and meningeal layers that form spaces to accommodate the dural venous sinuses.

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These dural venous sinuses contain venous blood from the cerebral veins and also cerebrospinal fluid from the subarachnoid space. The cerebrospinal fluid enters the sinuses through structures called arachnoid granulations, which protrude through the meningeal dura mater into the dural venous sinuses. The contents of the dural venous sinuses ultimately drain into the internal jugular vein.

The dural venous sinuses can be either paired or unpaired. Paired sinuses include the transverse sinus, cavernous sinus, superior petrosal sinus, inferior petrosal sinus, sphenoparietal sinus, and sigmoid sinus. On the other hand, unpaired sinuses include the superior sagittal sinus, inferior sagittal sinus, straight sinus, occipital sinus, and intercavernous sinus.

The superior sagittal sinus is the largest dural venous sinus and, throughout its course, it receives venous blood from the superior cerebral veins. As the name suggests, it runs in the sagittal plane, along the border of the falx cerebri. The superior sagittal sinus extends from the foramen cecum of the frontal bone, rostrally, to the internal occipital protuberance, caudally, where it drains into the confluence of sinuses

Keep in mind that the confluence of sinuses is also the point where the straight and occipital sinuses merge with the superior sagittal sinus. It then deviates to one side, usually the right, to connect with the transverse sinus.
The left transverse sinus and right transverse sinus begin at the internal occipital protuberance, from the confluence of sinuses, and pass laterally to run in the lateral border of the tentorium cerebelli.

While doing so, these sinuses create impressions in the occipital and parietal bones. The transverse sinuses also receive blood from the superior petrosal sinuses. The two transverse sinuses eventually continue as the right and left sigmoid sinuses on each side.
The right and left sigmoid sinuses follow an S shaped course in the posterior cranial fossa. During their course, they turn anteriorly and continue inferiorly as the internal jugular veins, which travel through the jugular foramen.

Deeper to the superior sagittal sinus lies the smaller, unpaired inferior sagittal sinus, which runs along the inferior free border of the falx cerebri. Similar to the superior sagittal, it has a rostral to caudal extent. During its course, it receives venous blood from small veins draining the medial surface of the cerebral hemispheres and ultimately drains into the straight sinus.

The straight sinus is formed by the merger of the inferior sagittal sinus and the great cerebral vein. The straight sinus runs posteroinferiorly along the attachment between the falx cerebri and tentorium cerebelli to eventually meet the superior sagittal and occipital sinuses at the confluence of sinuses.
Speaking of the occipital sinus, this sinus is located on the interior aspect of the occipital bone, along the caudal attached border of the falx cerebelli. It ends posterosuperiorly at the confluence of sinuses.

Up next, we have the cavernous sinuses, which are located within the middle cranial fossa on either side of the sella turcica of the sphenoid bone. The cavernous sinus extends from the superior orbital fissure to the apex of the petrous part of the temporal bone. The left and right cavernous sinuses are connected to each other via intercavernous sinuses, which are quite variable, but usually consist of anterior and posterior parts.

The cavernous sinuses then diverge into the superior petrosal sinus and inferior petrosal sinus. The superior petrosal sinus drains into the transverse sinus at the site where it continues as the sigmoid sinus, and the inferior petrosal sinus drains into the sigmoid sinus at its transition to becoming the internal jugular vein.