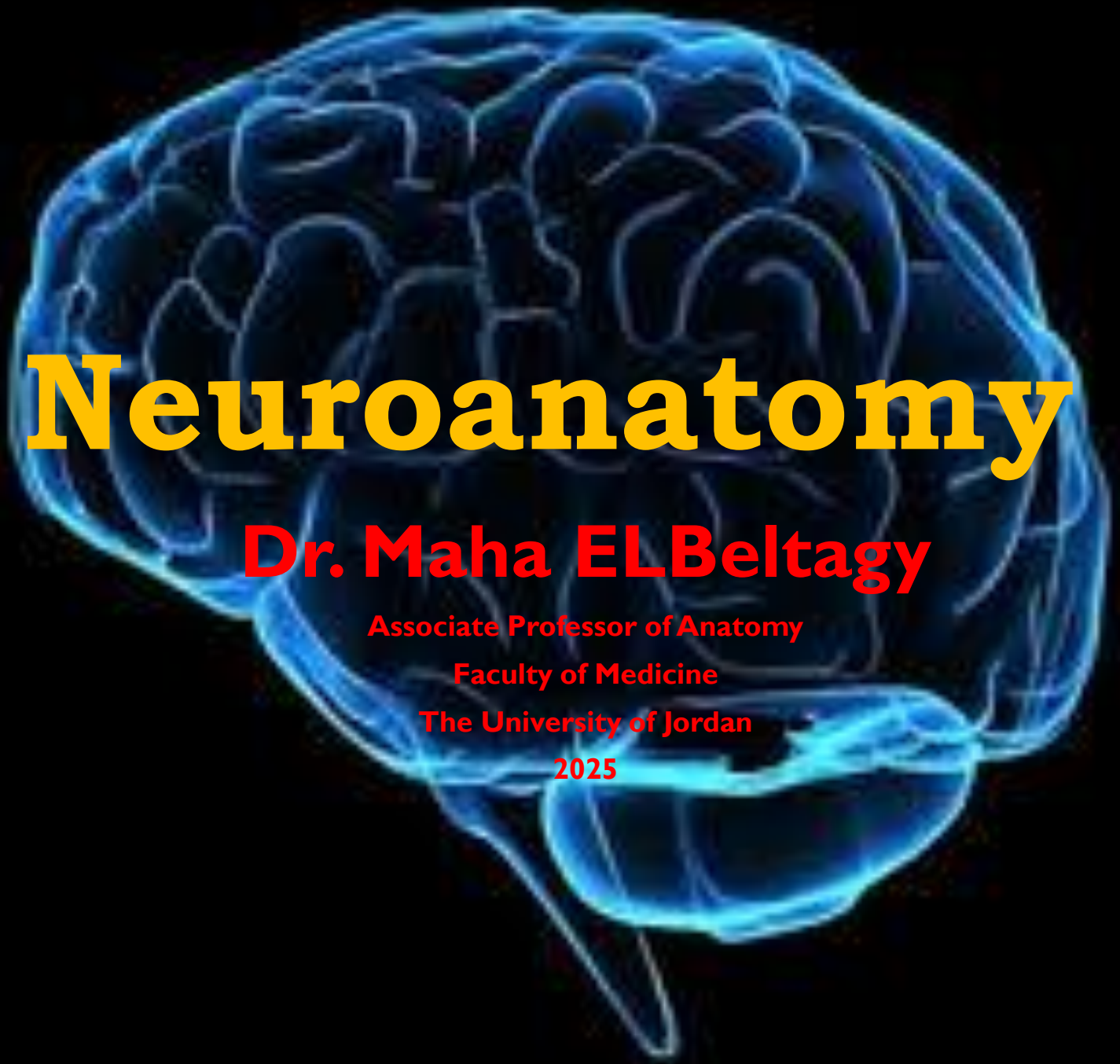

Neuroanatomy

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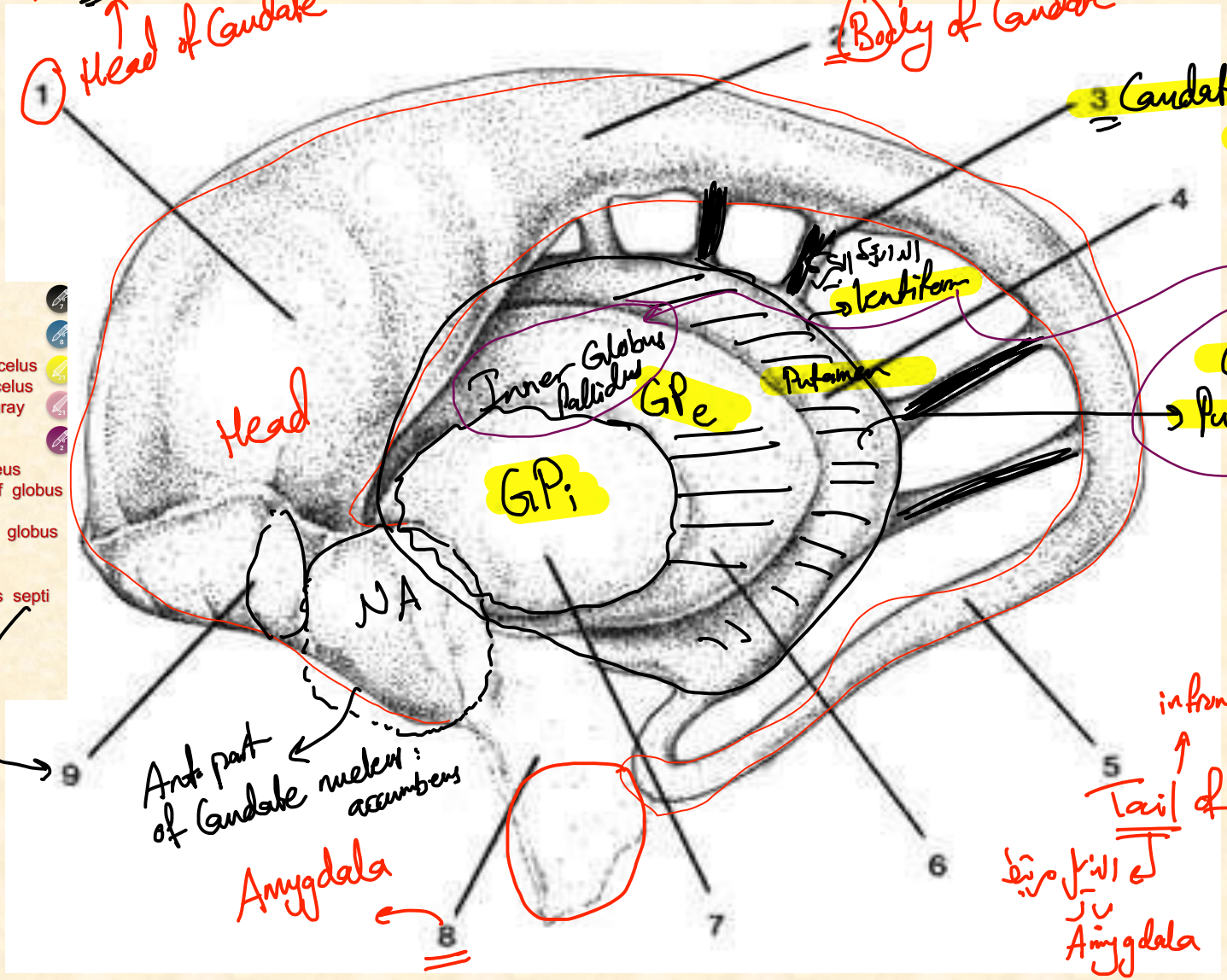
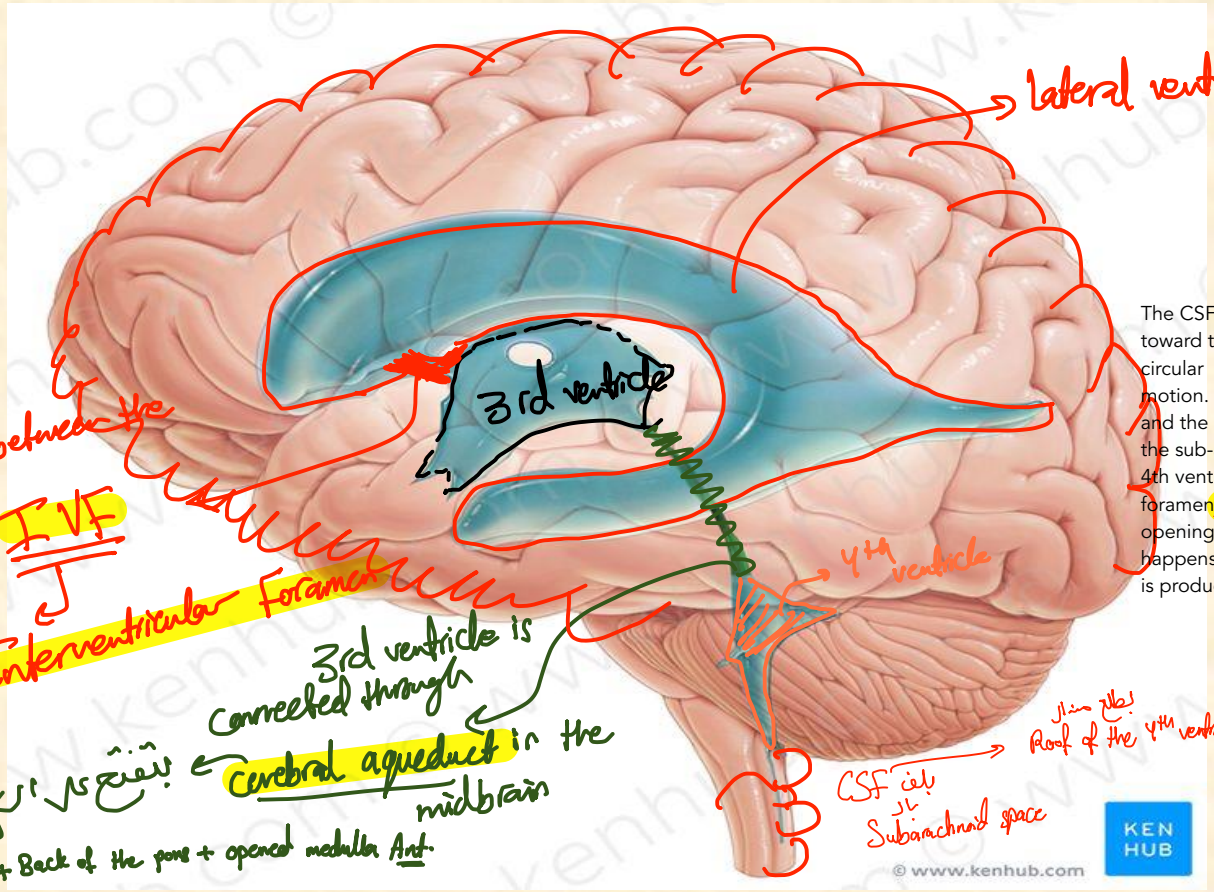
Faculty of Medicine

The University of Jordan

2025


1. head of caudate nucelus
2. body ofcaudate nucelus
3. caudatolenticular gray bridge
4. putamen
5. tail of caudate nucleus
6. external segment of globus pallidus
7. internal segment of globus pallidus
8. amygdaloid body
9. nucleus accumbens septi
in frontal lobe
Head of Caudate
Parietal lobe
Body of Caudate
Caudatolentiform Bridges
Lentiform
Outer
Putamen
Inner Globus Pallidus
GPe
GPi
Putamen
Head
NA
Contain Reward Syst.
Ant part of Caudate nucleus accumbens
Amygdala
in front of occipital lobe
Tail of Caudate
Amygdala

Ventricular System, The Cerebrospinal Fluid, and the Blood Brain Barrier



The CSF, runs from the 4th ventricle downward toward the central canal of the spinal cord in a circular
motion. Actually, the CSF circulates around the brain and the spinal cord, this movement happens inside the sub-arachnoid space. When the CSF leaves the 4th ventricle's roof through 3 foramina; in the middle foramen Magendie, while in the lateral there are 2 openings called foramina of Luschka. This loop happens twice to three times a day in which the CSF is produced and reabsorbed.

The lateral ventricle

It is Y-shaped cavity in the cerebral hemisphere with the following parts:

1) **A central part (body):** Extends from the interventricular foramen to the splenium of corpus callosum.

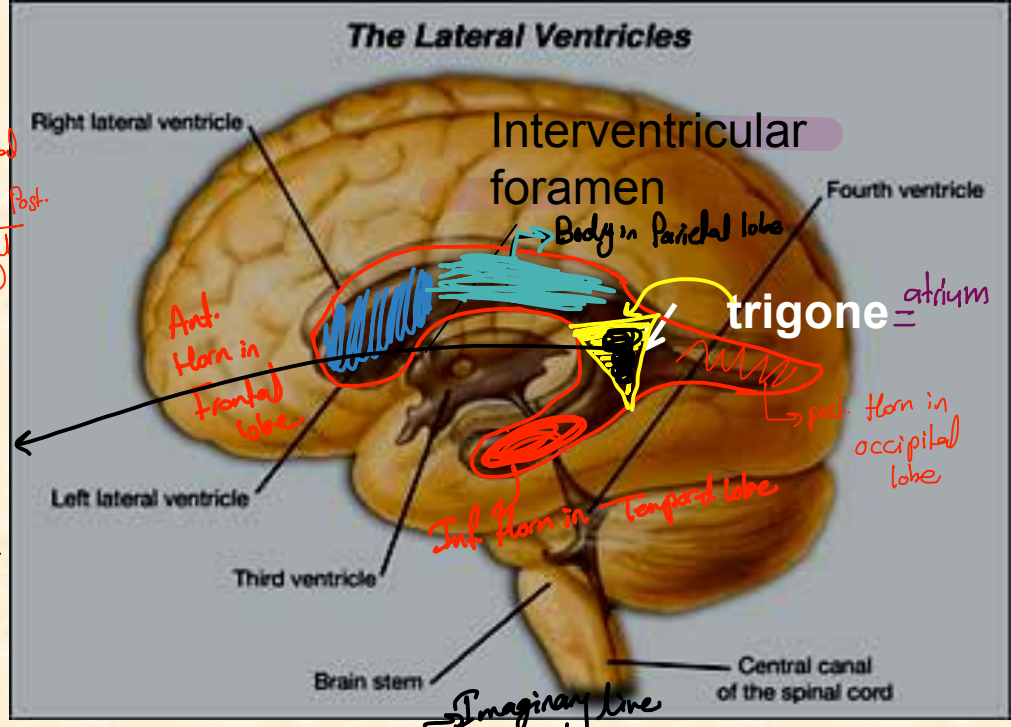
2) **3 horns:**

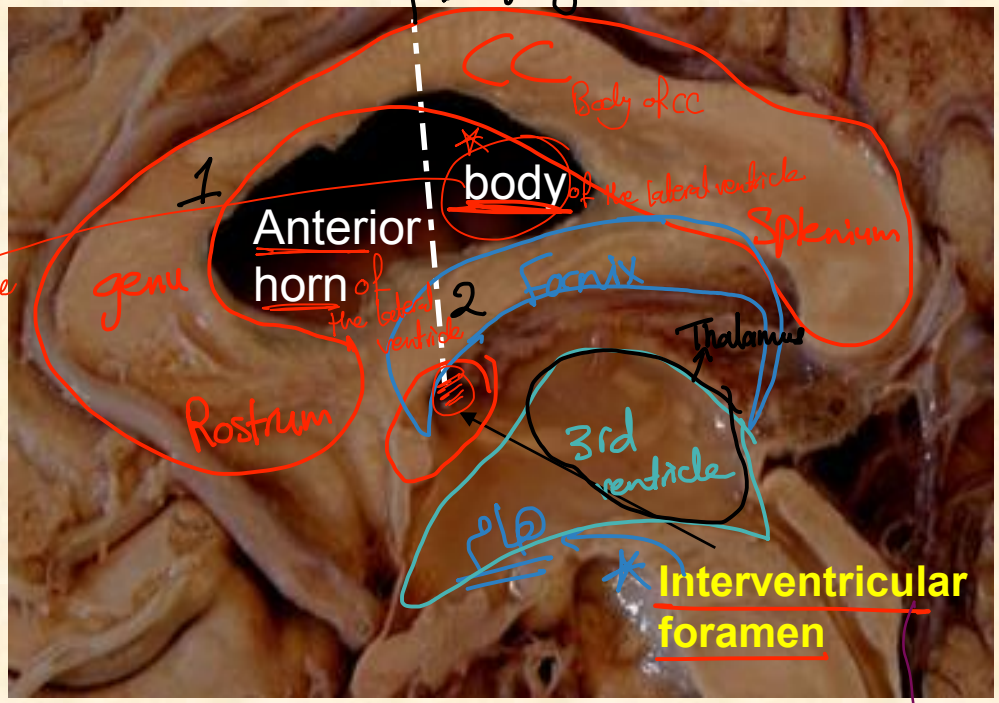
- **Anterior horn:** Lies in the **frontal** lobe in front of the interventricular foramen.
- **Posterior horn** : Lies in the **occipital** lobe.
- **Inferior horn** : Lies in the **temporal** lobe.

It is connected to the **3rd ventricle** by **interventricular foramen (of Monro).**

Trigone (atrium): the part of the body at the junction of inferior and posterior horns

Contains the glomus (choroid plexus tuft) calcified in adult (x-ray&CT).





Anterior horn inside the frontal lobe, posterior horn inside the occipital lobe, Inferior horn inside the temporal lobe, the body inside the parietal lobe and the trigon (triangular in shape) which is shaped because of these parts' intersection.
After the age of 40, mainly the trigon will be covered by a white lesion in the MRI or the ICT, this is because of the classification that happens normally (not pathological) in this part inside all the ventricles, since each one has a choroid plexus (capillaries) that produces the CSF.
These choroid plexuses are derived from the blood vessels that supply the brain (e.g: Anterior choroidal not a specific section vessel comes from the internal carotid artery, posterior choroidal vessel comes from the posterior cerebral artery).
A barrier separates the CSF (Brain CSF Barrier) that is secreted by theses vessels from the blood there.

Figure (5) represents a sagittal section. 1.Corpus callosum 2. The fornix, below the fornix we can see a v.imp foramen (might be an exam question) called the interventricular foramen, it is a connection between the lateral ventricle and the 3d ventricle (the CSF comes from it then goes to the 3d ventricle). A past paper question was about this information: the interventricular foramen lies between the anterior end of the thalamus and the anterior column of the fornix
An imaginary line should be drawn from the interventricular foramen toward the corpus callosum to identify the structures there. In front to it we have the anterior horn, behind we can see the body of the lateral ventricle. The rest parts can't be seen here in the sagittal section. Actually, the whole cavity can't be seen here till we remove the cover which is the septum pellucidum.

1- anterior horn
2- central part
3-posterior horn
4-temporal horn
5-choriod plexus
6-choriod glomerulus
1
7-Calcar avis
8-Collateral trigon
9-Caudate nucleus
10-sulcus terminalis
11- Thalamus
12- Transverse temporal gyrus
13-Insula
14-Interventricular foramen

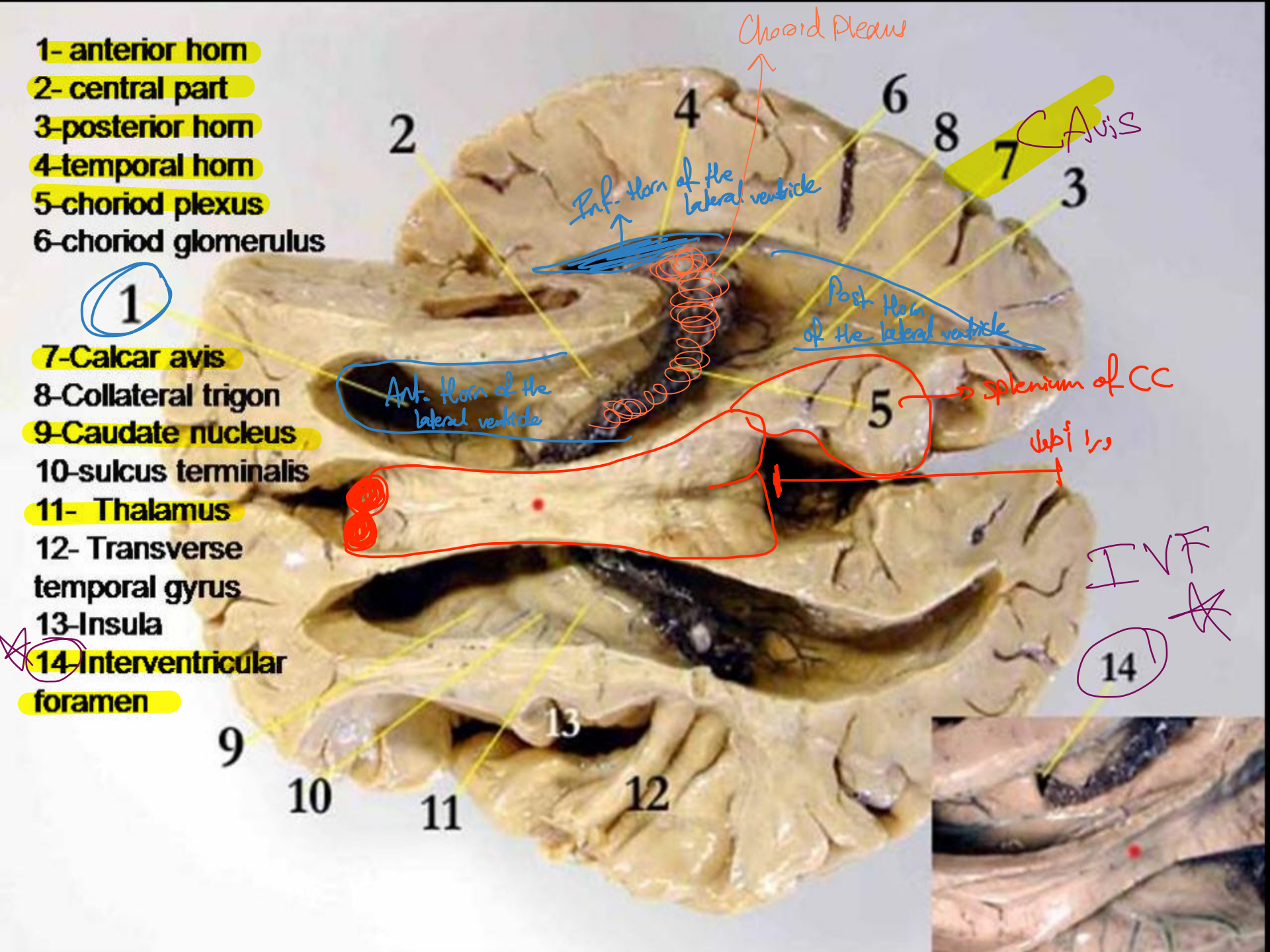
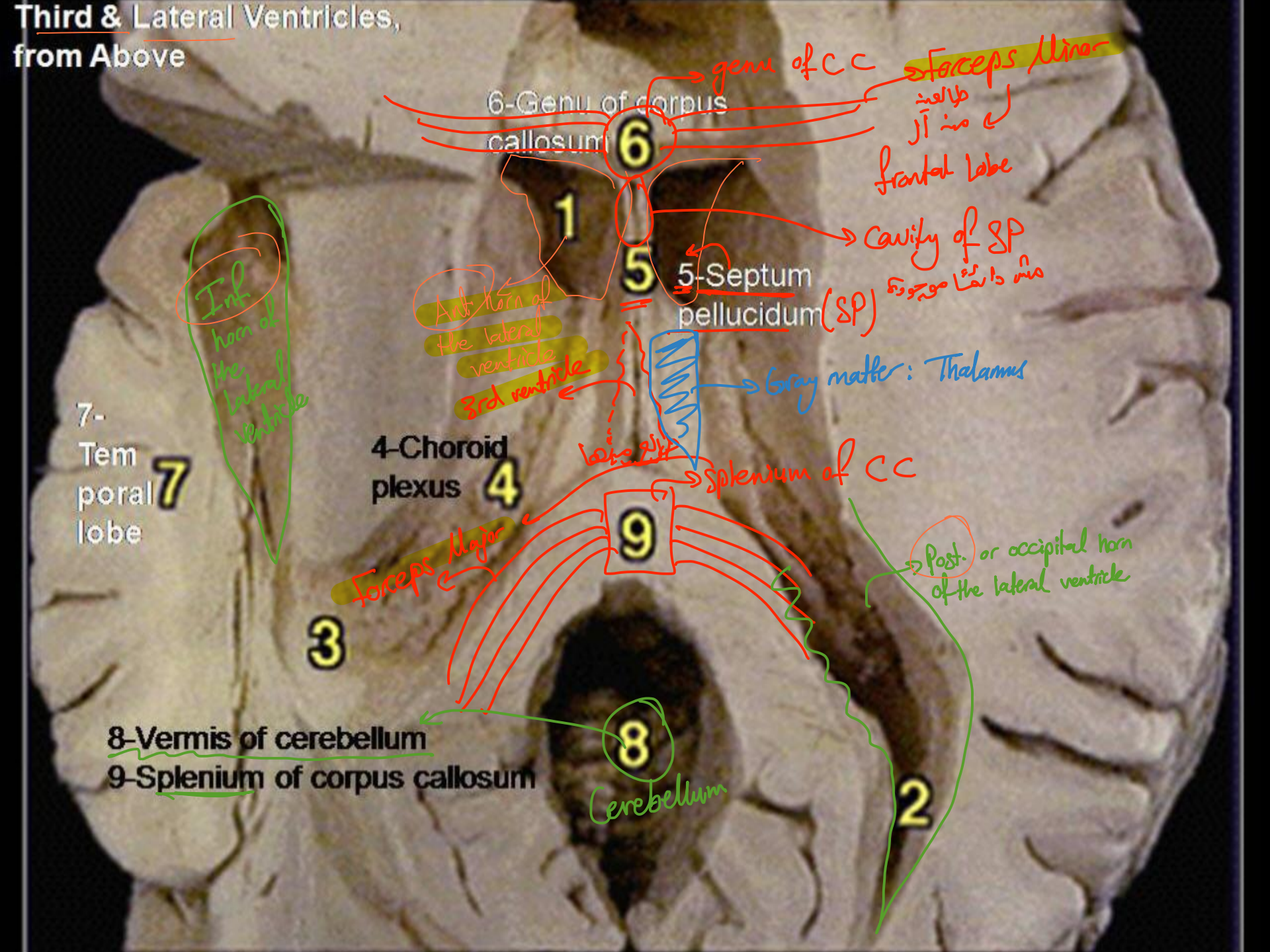
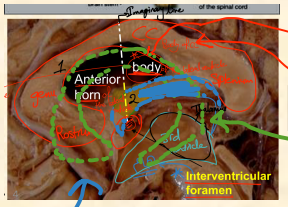


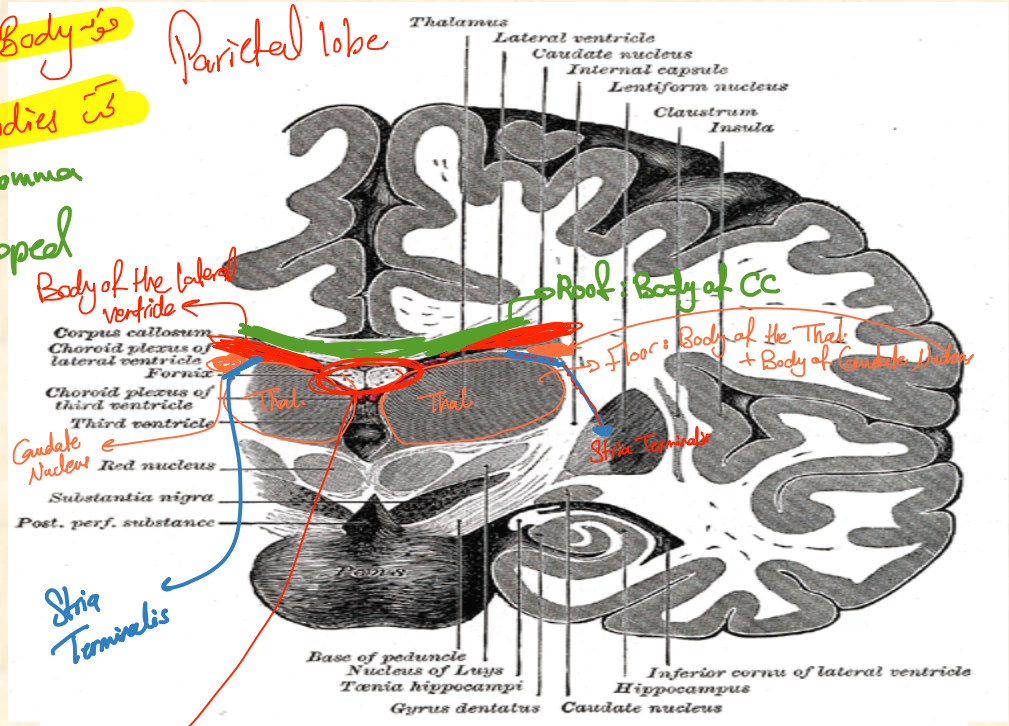
Figure (6) represents a horizontal section. As we said before,
by measuring the distance behind the splenium
which is longer than the distance in front to the genu
we will be able to differentiate between the anterior short part
from the posterior long part.
The cavity that is labeled as (1) represents the
anterior horn of the lateral ventricle, while the one that is
behind represents the posterior horn of the lateral
ventricle, lastly the blue one represents the inferior horn of
the lateral ventricle that is located in the temporal lobe.
We can see the choroid plexus (in orange), these fibers are covered by 2 layers of pia matter.
Fibers that connect different parts of the cerebral hemisphere (occipital, parietal and temporal
lobes) are called tabetum of the corpus callosum.

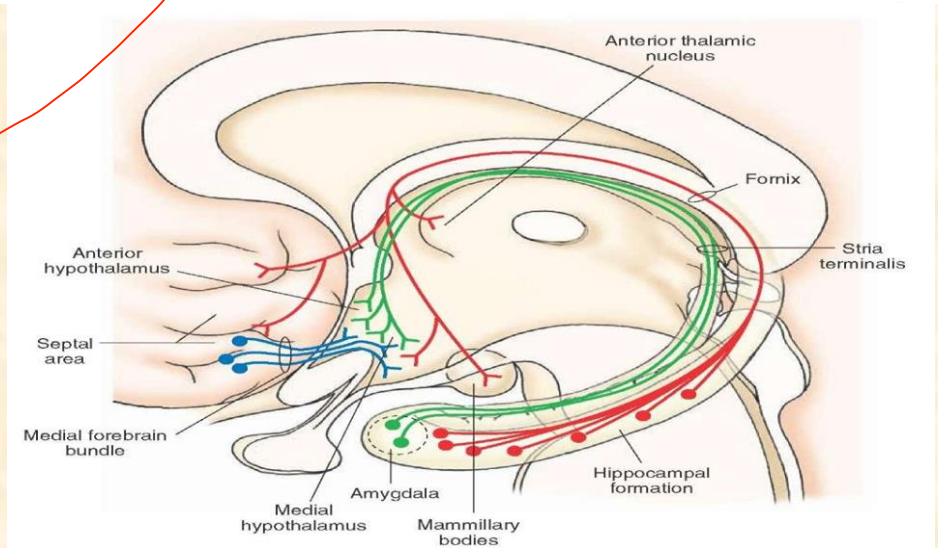

Third & Lateral Ventricles, from Above
6-Genu of corpus callosum
6
genu of CC
Forceps Minor
طالعة من الـ frontal lobe
1
5
5-Septum pellucidum (SP)
cavity of SP
موجودة داخل الـ SP
Ant. horn of the lateral ventricle
3rd ventricle
Gray matter: Thalamus
Inf. horn of the lateral ventricle
7-
Tem
poral
lobe
7
4-Choroid plexus
4
Splenium of CC
9
Forceps Major
Post. or occipital horn of the lateral ventricle
3
8-Vermis of cerebellum
9-Splenium of corpus callosum
8
Cerebellum
2



Relations of Body of the lateral ventricle

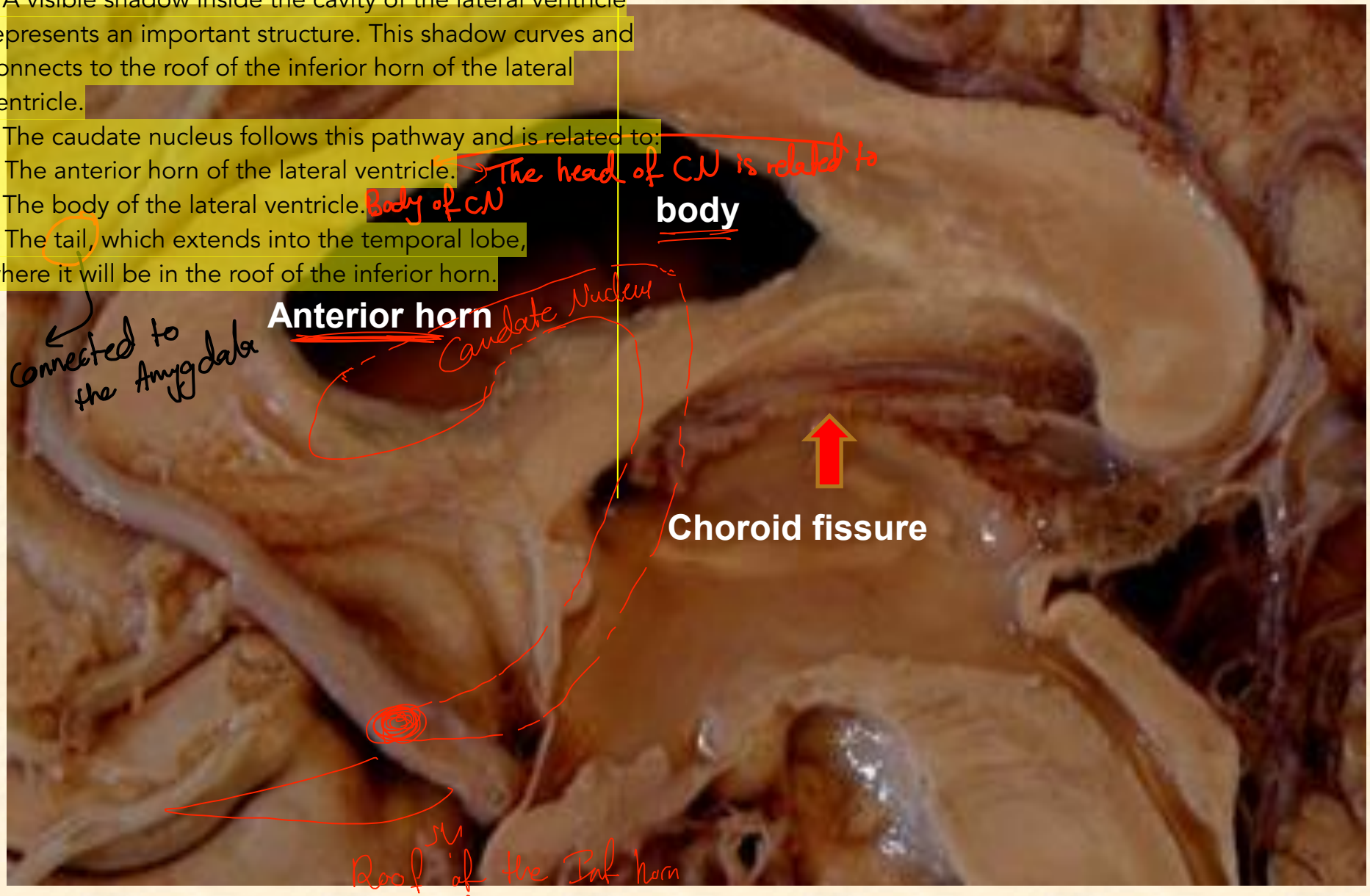
- **Roof** : body of the Corpus callosum
- **Floor**: body of Caudate Nucleus and body of the thalamus.
- Stria terminalis between thalamus and caudate. (connects between amygdala and venteral nucleus of the hypothalmus)
- **Medial wall:**
  1. Septum Pellucidum
  2. Body of the fornix (choroid fissure between fornix and thalamus (choroid plexus)





Relations of lateral ventricle

- A visible shadow inside the cavity of the lateral ventricle represents an important structure. This shadow curves and connects to the roof of the inferior horn of the lateral ventricle.
- The caudate nucleus follows this pathway and is related to:
  - The anterior horn of the lateral ventricle.
- The body of the lateral ventricle.
  - The tail, which extends into the temporal lobe, where it will be in the roof of the inferior horn.



Relations of Anterior horn of the lateral ventricle

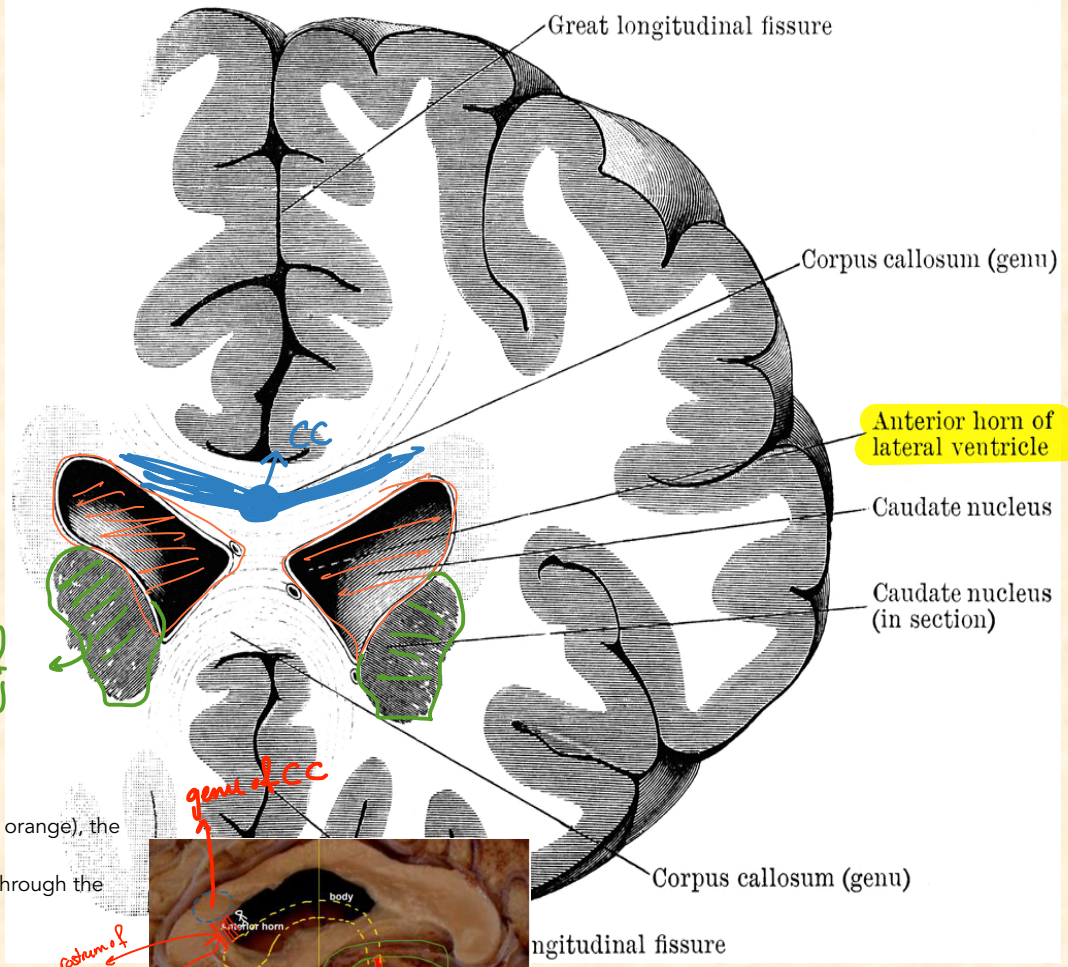
Roof : genu of the Corpus callosum

Floor: Head of Caudate Nucleus

Medial wall: Rostrum of corpus callosum

Septum Pellucidum

Anterior column of the fornix



- To examine its coronal section of anterior horn (in orange), the cut must pass through the frontal lobe.
- If targeting the body, the coronal section passes through the parietal lobe.

Boundaries in the Coronal Section:

- Roof: The corpus callosum, specifically its genu (since the cut is anterior). (in blue)

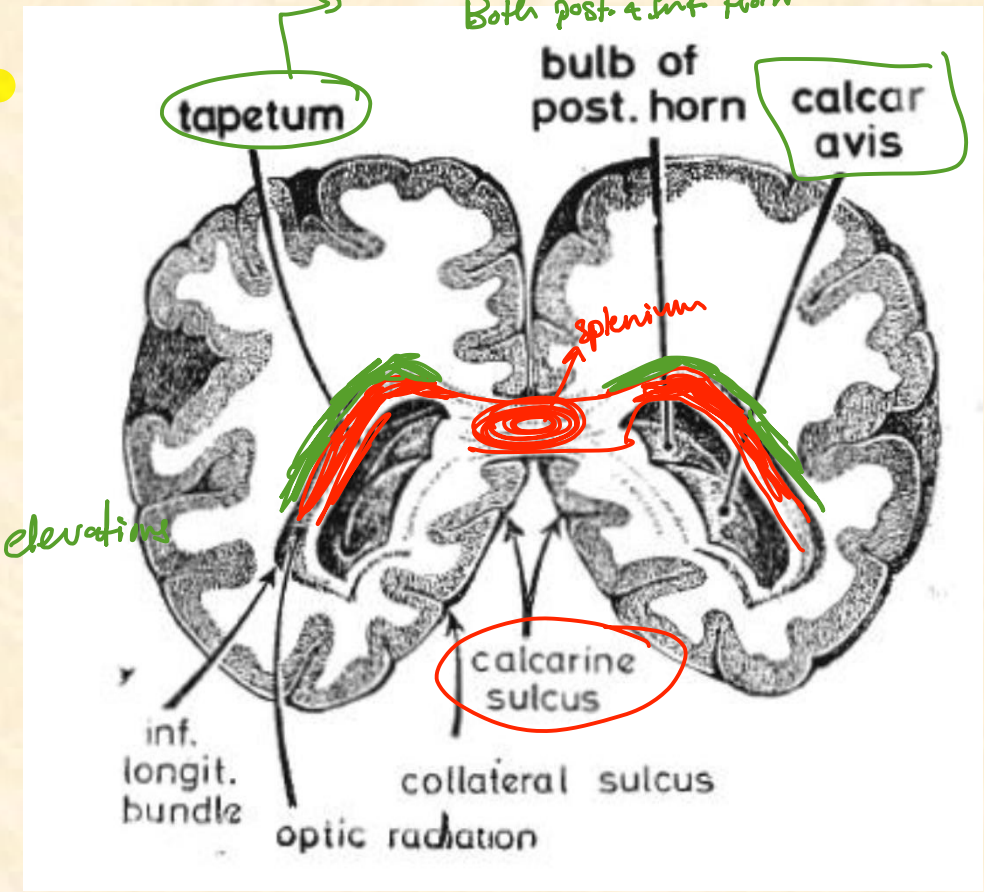
Floor: The head of the caudate nucleus (in green), which also forms the floor of the anterior horn of the lateral ventricle.

- Medial Wall: Septum pellucidum (in red), rostrum of the corpus callosum, and anterior column of the fornix.

Understanding these relations makes it easier to visualize the lateral ventricle's anatomical positioning.

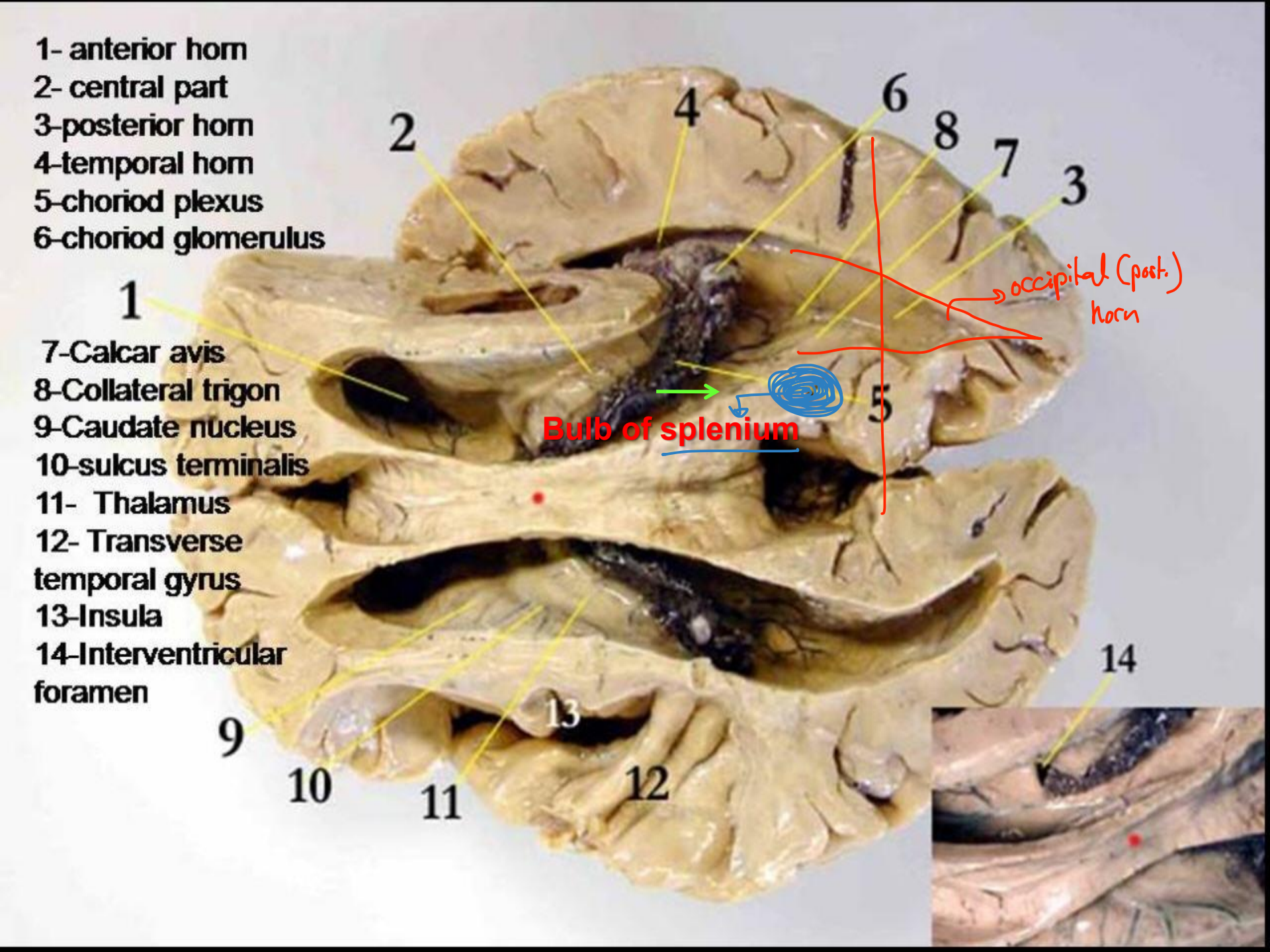
Relations of Posterior horn of the lateral ventricle

- **Roof and lateral wall**
  - Tapetum of the corpus callosum
  - Optic radiation lying against the tapetum in the lateral wall.
- **Medial wall** --- two convexities:
  - Upper (bulb of the posterior horn)
    - Splenium of the corpus callosum (bulb)
  - Lower (Calcar avis)
    - Calcarine sulcus.
    - If Calcar avis is well developed, it obliterates the posterior horn.



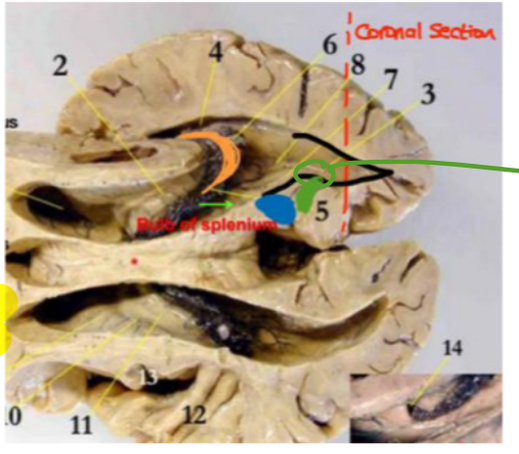
1- anterior horn
2- central part
3-posterior horn
4-temporal horn
5-choriod plexus
6-choriod glomerulus

7-Calcar avis
8-Collateral trigon
9-Caudate nucleus
10-sulcus terminalis
11- Thalamus
12- Transverse temporal gyrus
13-Insula
14-Interventricular foramen



4.8 Relations Of The Occipital Horn:

Figure (12)



The **occipital horn** is located within the **occipital lobe**.
To better understand its relations, let's examine a coronal section.
The **medial wall** (in black in figure 13) is of particular importance in the posterior horn, along with the **floor.**

Structures forming the medial wall include: **1. Bulb of the Corpus Callosum,** the splenium (in blue) of the corpus callosum extends into the medial wall, creating a noticeable elevation known as the bulb of the splenium.

2. Calcarine Fissure (in green). Adjacent to the bulb is the calcarine fissure, which is closely associated with visual area 17. This fissure plays a crucial role in separating parts of the primary visual cortex.

- **Above the fissure**: The cuneus
- **Below the fissure**: The lingual gyrus This anatomical arrangement has functional significance.

For instance, a lesion in the cuneus results in **contralateral inferior quadrant anopia**, meaning vision loss in the lower quarter of the opposite visual field. * as you remember from prev. lecs * The calcarine also pushes inward into the substance of the medial wall of the lateral ventricle, particularly in the posterior portion making (Calcar avis).

(Calcar avis) This term refers to the elevation near the calcarine fissure.

The calcarine fissure and its related elevation are situated on the **medial wall** of the lateral ventricle, specifically in the **occipital region**. * might be an exam question*

Tapetum

- **Splenium of the Corpus Callosum**

o The splenium of the corpus callosum is located at the midline and is responsible for arching over to connect the hemispheres of the brain.

- **Forceps Major**

o The fibers emerging from the splenium form the fornix major (in red). , which connects with other fibers called the " tapetum " (in green).
o The tapetum contributes to the roof and lateral walls of the lateral ventricle, particularly in the posterior and inferior walls.

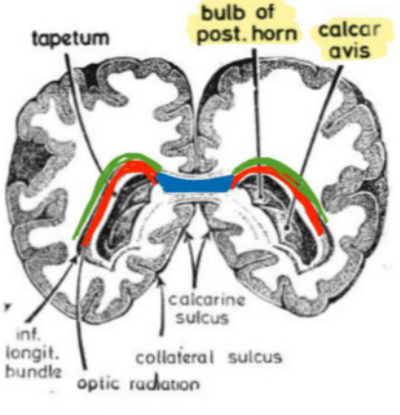
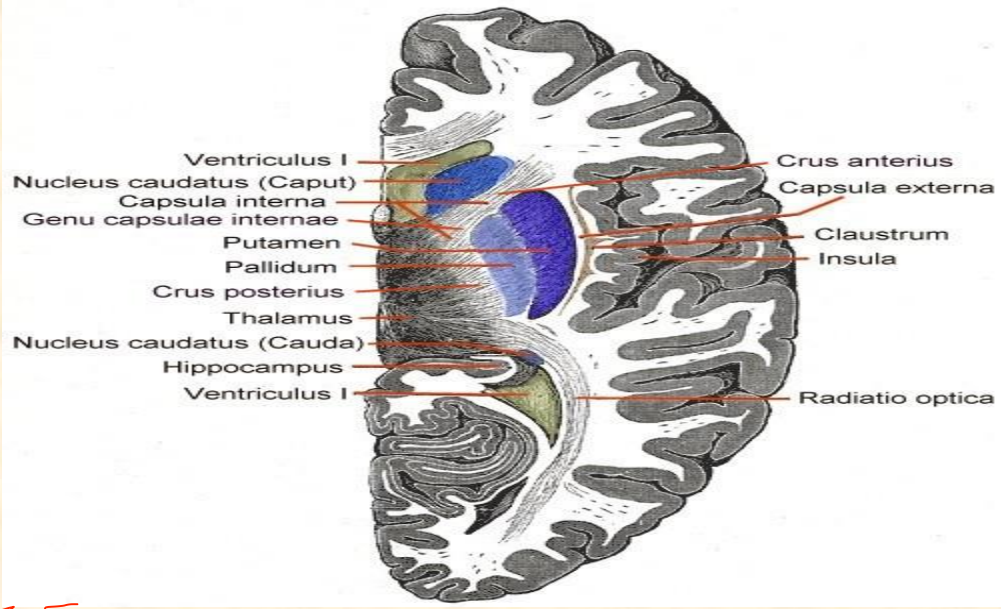


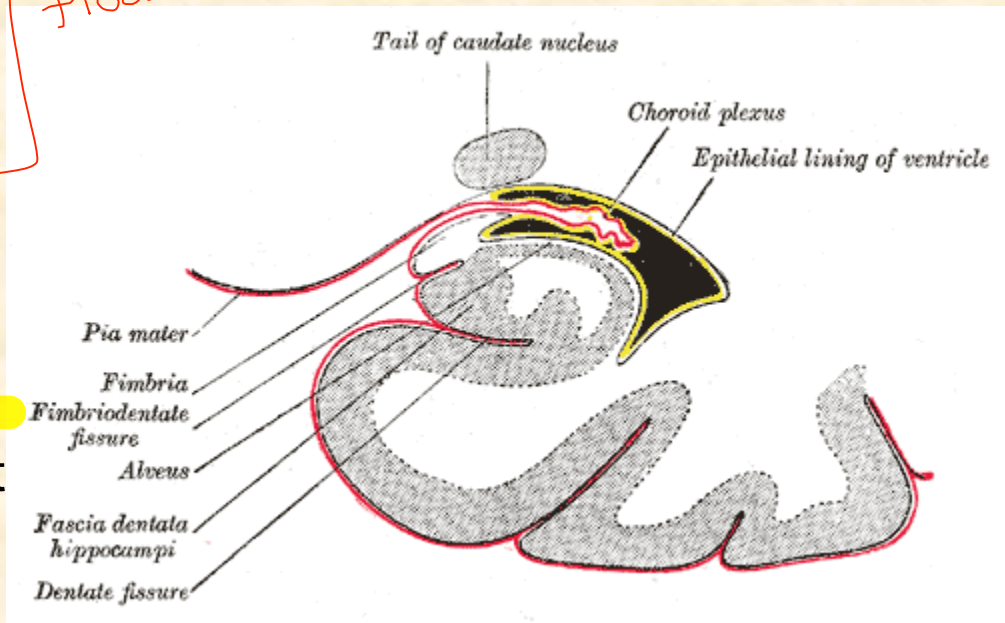
Figure (13)

Relations of Inferior horn of the lateral ventricle

- **Roof**
  - tail of the caudate nucleus,
  - amygdaloid body
- **Lateral wall**
  - Tapetum of corpus callosum and optic radiation
- **Floor**
  - medially
    - hippocampus
  - laterally
    - collateral eminence (by collateral fissure)

Lower part of choroid plexus enter this horn from the temporal part of the choroid fissure





4.9 Temporal Lobe and Inferior Horn:

- **Structures in the Roof :**
  - o The caudate nucleus plays a role in the roof of the inferior horn of the lateral ventricle. Specifically, **the tail of the caudate nucleus** is located here.
  - o **The amygdala** is another important structure related to the caudate tail and is found near the roof of the inferior horn.

- **Structures in the Floor:**

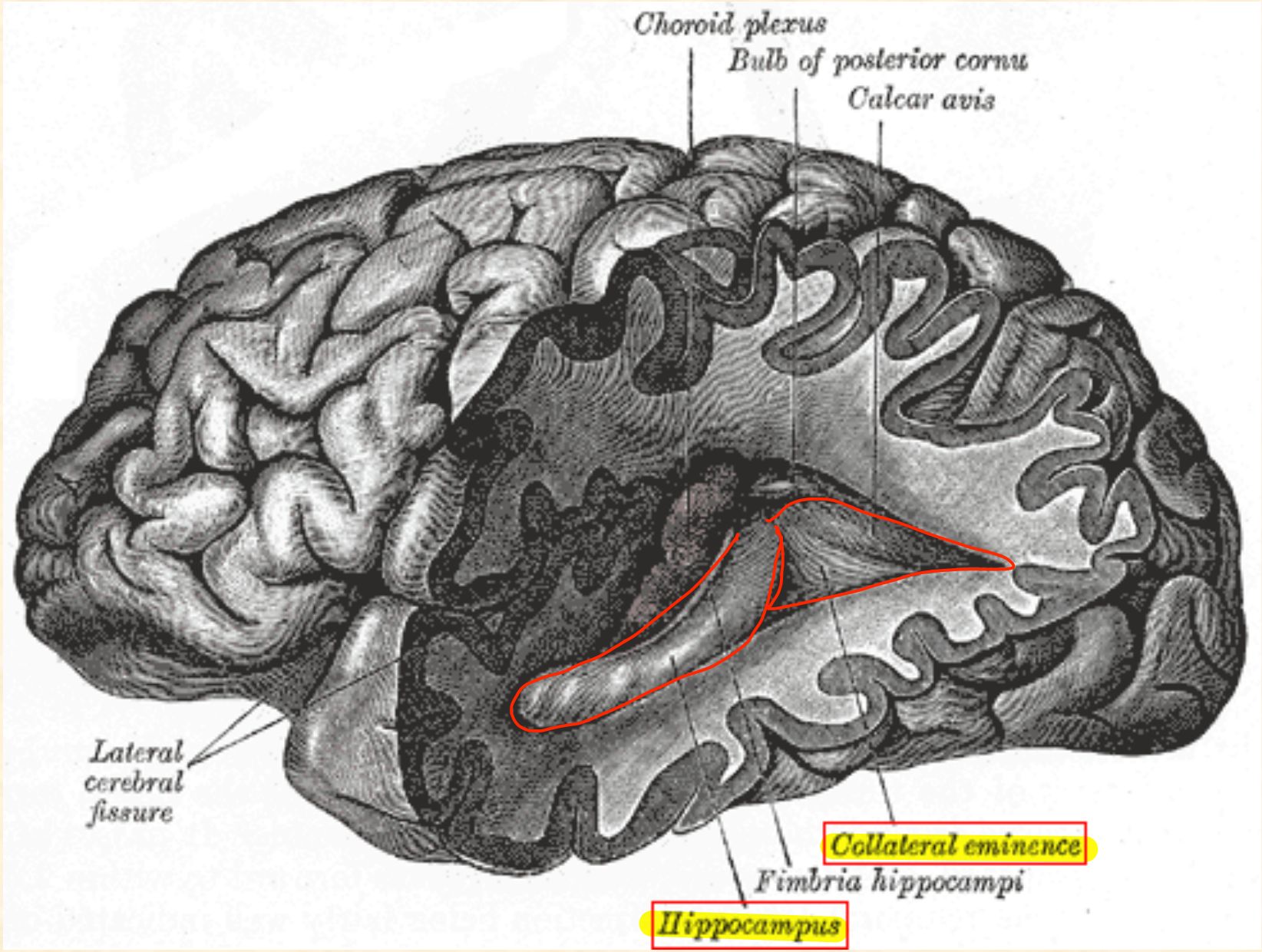
o The inferior horn lies within the **temporal lobe** and contains several structures, including:

- **Hippocampus**: Positioned in the floor of the inferior horn.
- **Collateral Eminence**: Adjacent to the hippocampus, this structure is notable for its proximity to the collateral sulcus.

Before continuing, let's remember Temporal Lobe Structures:

- Tentorial Surface : The tentorial surface of the temporal lobe is divided into three distinct gyri:
  1. Medial Gyrus: Known as the parahippocampal gyrus.
  2. Lateral Gyrus: Divided into medial occipitotemporal and lateral occipitotemporal.

- **Lateral wall:** Tapetum of corpus callosum


Choroid plexus
Bulb of posterior cornu
Calcar avis
Lateral cerebral fissure
Collateral eminence
Fimbria hippocampi
Hippocampus

Choroid plexus of Lateral Ventricle

Choroid plexus projects into the ventricles on its **medial aspect**.

Composed of **pia matter** covered with ependymal lining of the ventricle.

Choroid plexus is made of **tela choroidea** (two layers of pia matter).

Lies between **fornix** superiorly and **thalamus** inferiorly.

Situated in **the inferior horn** of the lateral ventricle.

Projects into the **choroid fissure**

Formed by posterior choroid branch of PCA (body) and anterior choroid branch of ICA (inferior horn)

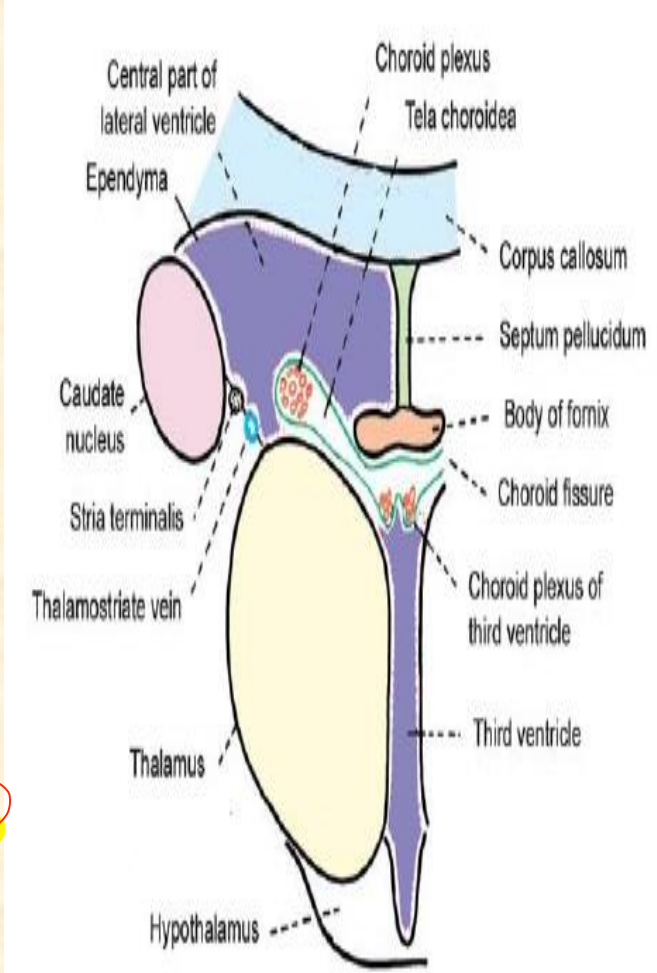


Fig. 20.2. Boundaries of the central part of the lateral ventricle and of the third ventricle. Note the relationship of the tela choroidea and the choroid plexuses to these ventricles.

4.10 The Choroid Plexus:

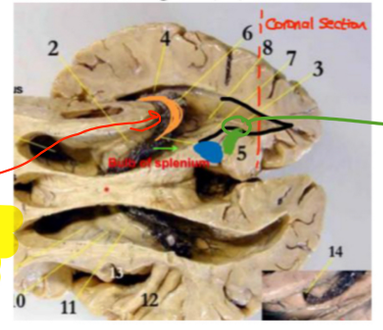
• **Definition:**

o The choroid plexus consists of capillary tufts and is responsible for the production of cerebrospinal fluid "CSF" within the ventricles.

• **Location:**

o In the lateral ventricle, the choroid plexus is primarily located in the **body** and **inferior horn** and **trigone.** refer to figure (12) the orange structure. .. it Projects into the choroid fissure

Figure (12)



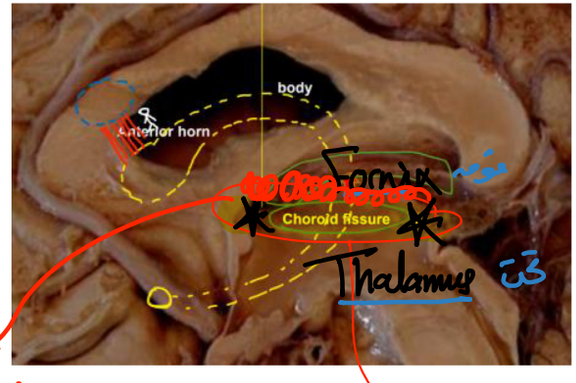
• **Arterial Supply:**

o The choroid plexus is supplied by the anterior choroidal artery to inf. horn (from the internal carotid artery) and the posterior choroidal artery to body (from the posterior cerebral artery).

The Choroid Fissure: * might come in lab questions*

o It marks the boundary between the thalamus (below) and the fornix (above). refer to figure (10) the green structure.

Function: The choroid fissure accumulates and directs the flow of CSF into the lateral ventricle

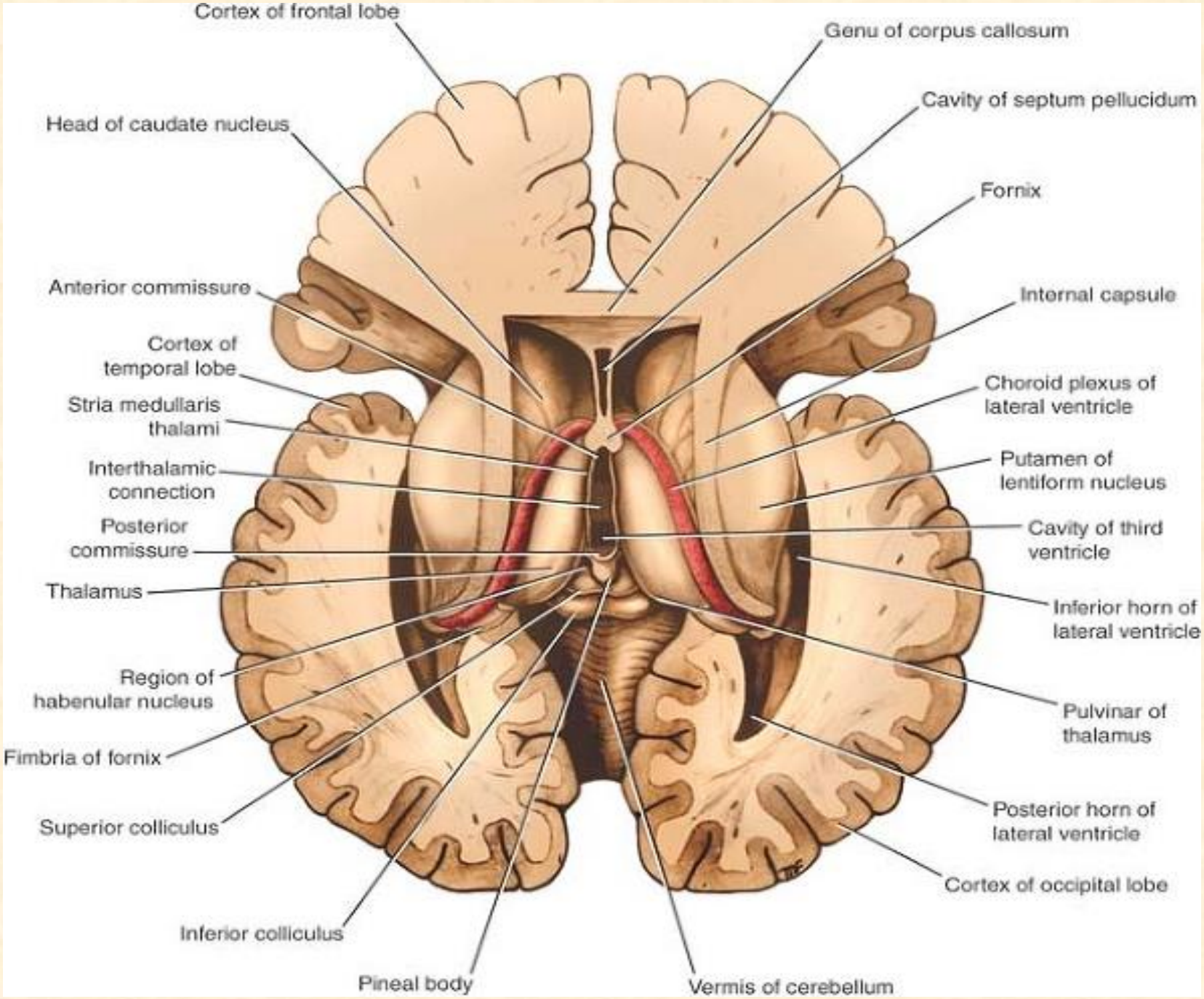


CSF Flow and Ventricular System:

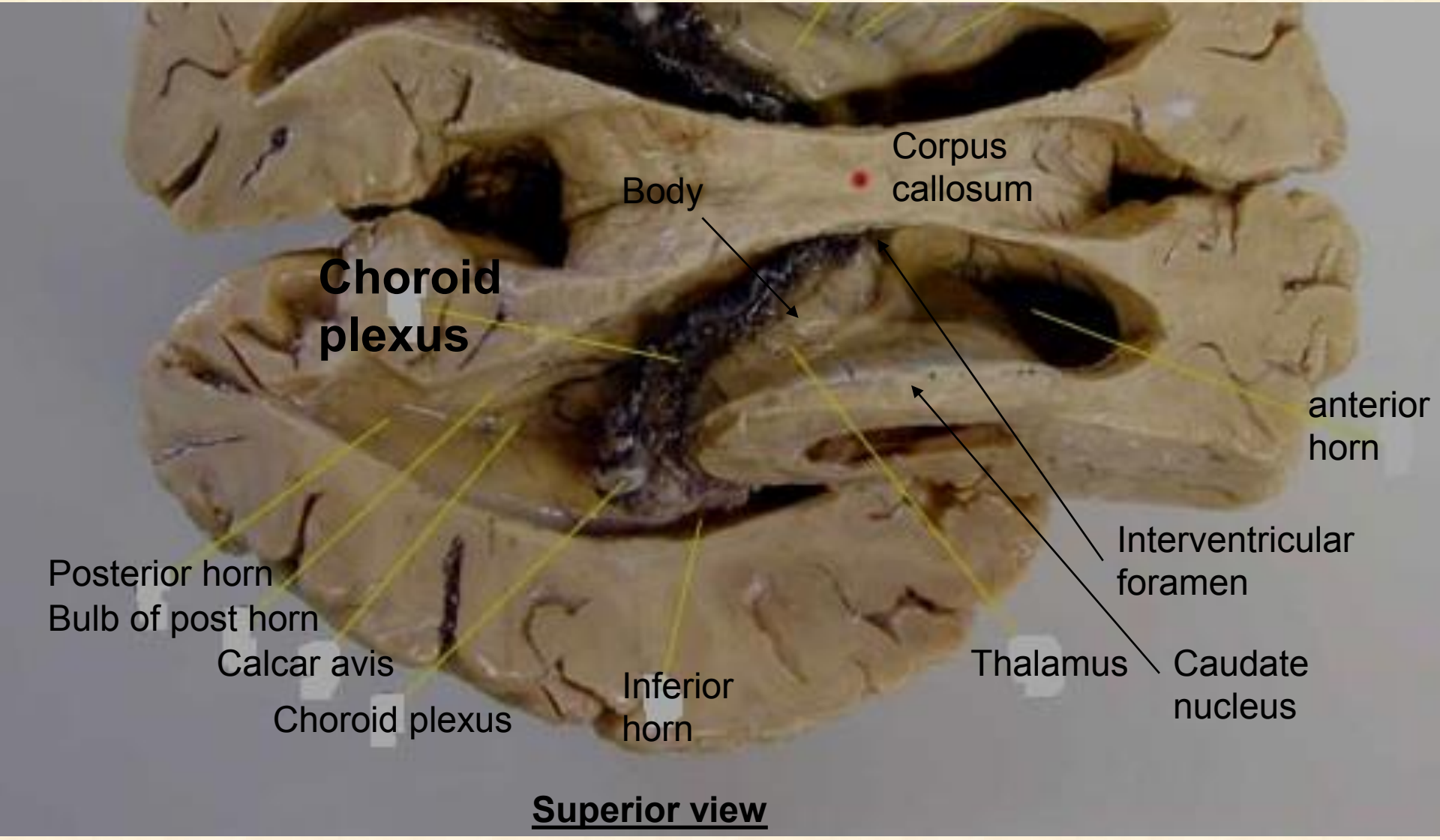
• CSF Movement: CSF produced by the choroid plexus flows into the third ventricle and then into the lateral ventricle, continuing to circulate throughout the ventricular system.

Let's review all relations :))

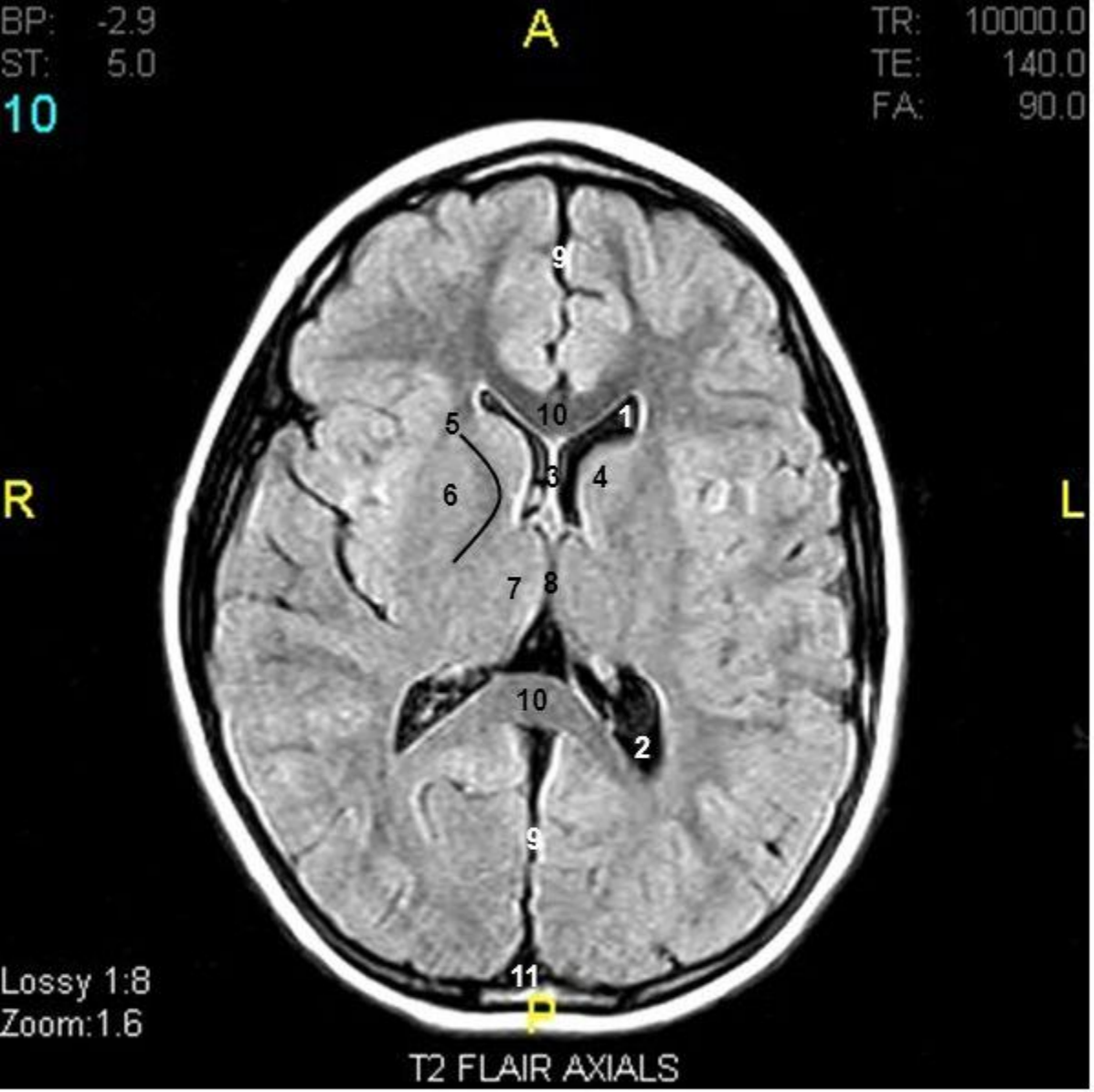
Part	Roof	Floor	Medial Wall	Lateral Wall
Body	Body of the corpus callosum	- Body of the caudate nucleus - Body of the thalamus - Stria terminalis (groove between)	- Septum pellucidum - Body of the fornix	-
Anterior Horn	Genu of the corpus callosum	Head of the caudate nucleus	- Septum pellucidum - Rostrum of corpus callosum - Anterior column of the fornix	-
Posterior Horn	Tapetum of the corpus callosum *note: Roof and lateral wall are mentioned together so they have same relation	-	- Bulb of the posterior horn (splenium of corpus callosum) - Calcar avis (from calcarine sulcus)	-Tapetum of corpus callosum - Optic radiation *dr didn't mention it though written in slides*
Inferior Horn	- Tail of the caudate nucleus - Amygdala	- Hippocampus (medially) - Collateral eminence (laterally)	-	-Tapetum of corpus callosum - Optic radiation


Cortex of frontal lobe
Genu of corpus callosum
Cavity of septum pellucidum
Head of caudate nucleus
Fornix
Anterior commissure
Internal capsule
Cortex of temporal lobe
Choroid plexus of lateral ventricle
Stria medullaris thalami
Putamen of lentiform nucleus
Interthalamic connection
Posterior commissure
Cavity of third ventricle
Thalamus
Inferior horn of lateral ventricle
Region of habenular nucleus
Pulvinar of thalamus
Fimbria of fornix
Posterior horn of lateral ventricle
Superior colliculus
Cortex of occipital lobe
Inferior colliculus
Pineal body
Vermis of cerebellum

The lateral ventricle



Superior view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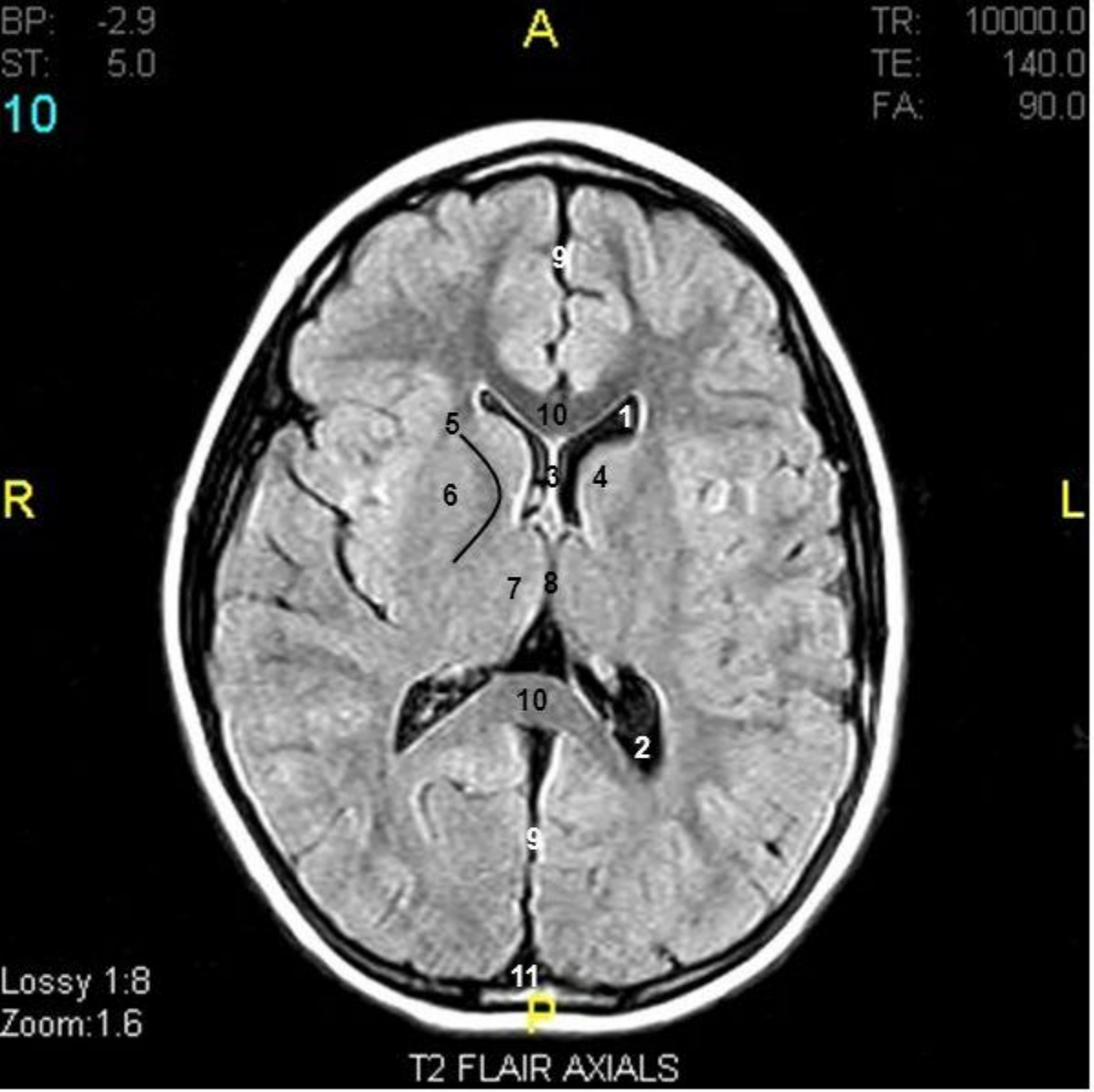
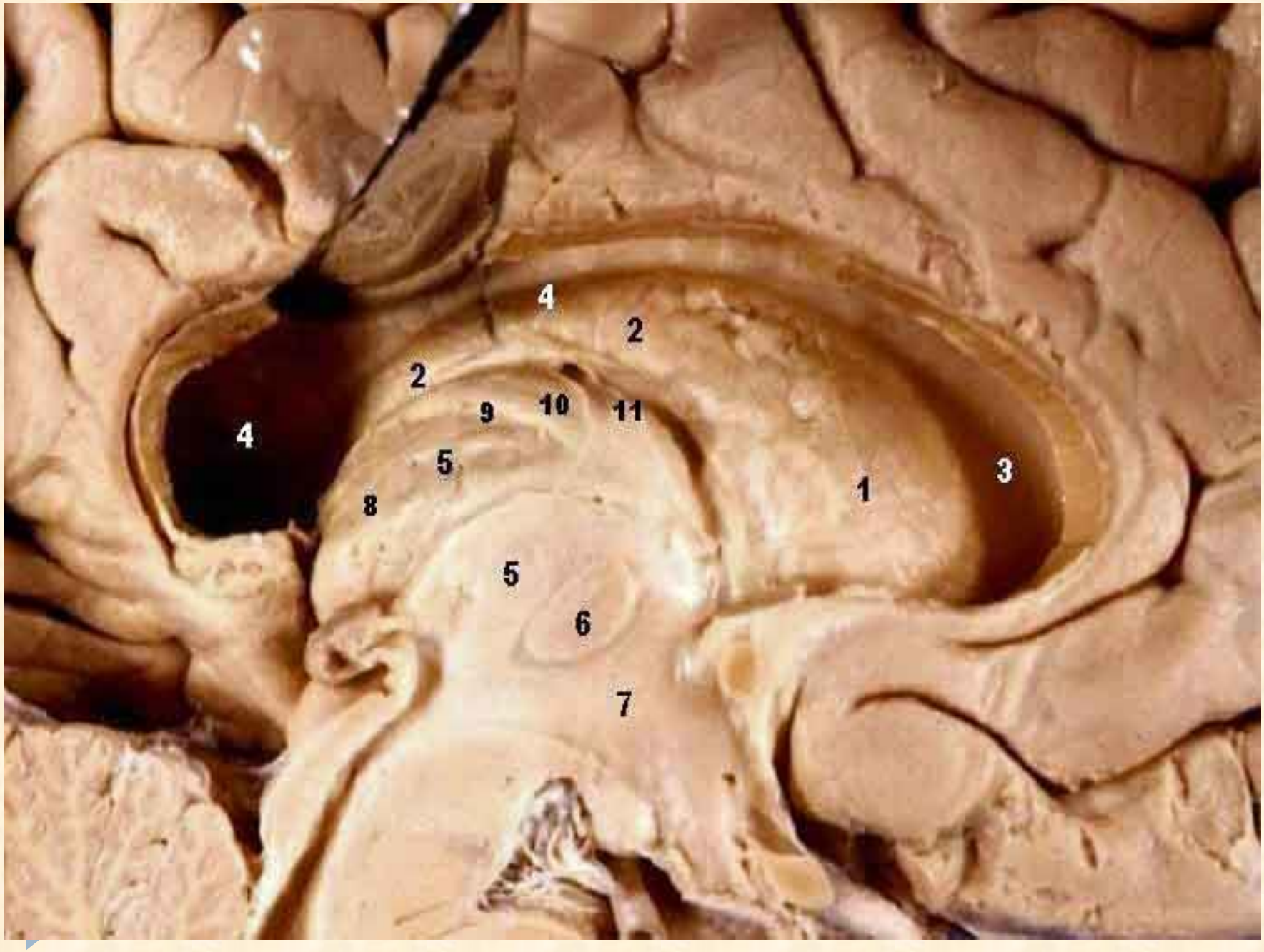


Key to MRI:

1. anterior horn of lateral ventricle
2. posterior horn of lateral ventricle
3. septum pellucidum
4. head of caudate nucleus
5. internal capsule
6. lentiform nucleus
7. thalamus
8. 3rd ventricle
9. longitudinal fissure
10. corpus callosum
11. superior sagittal sinus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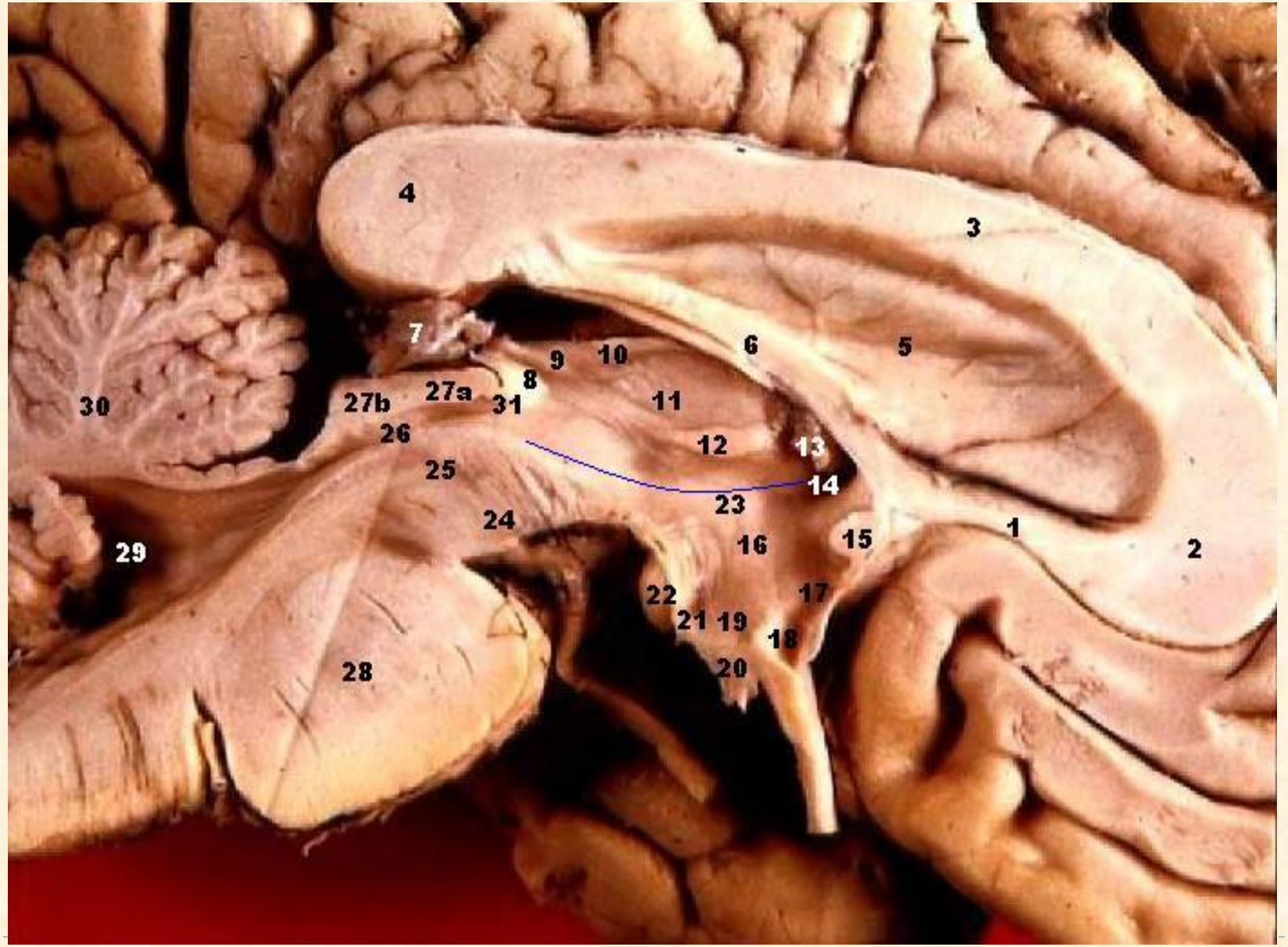
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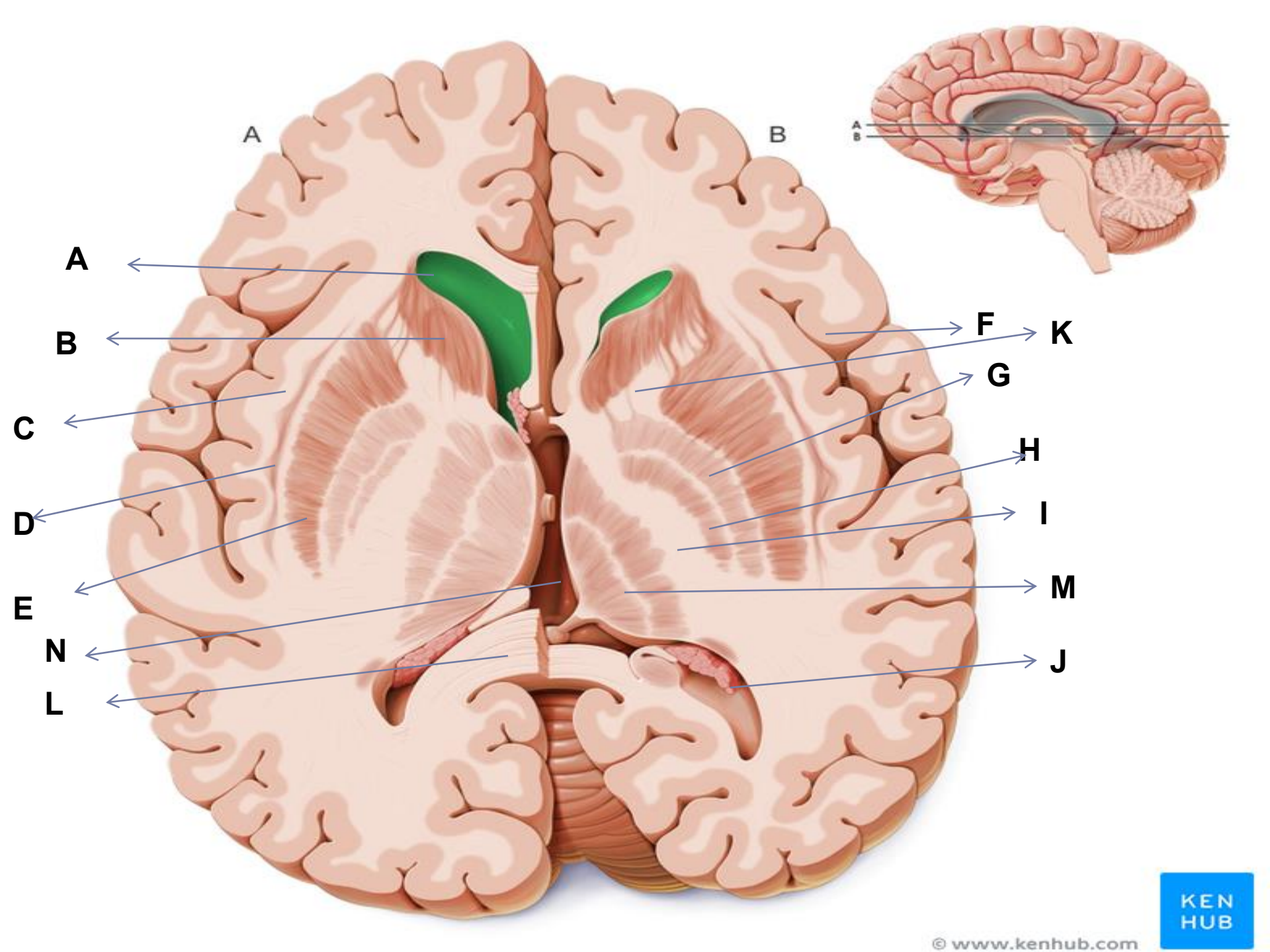
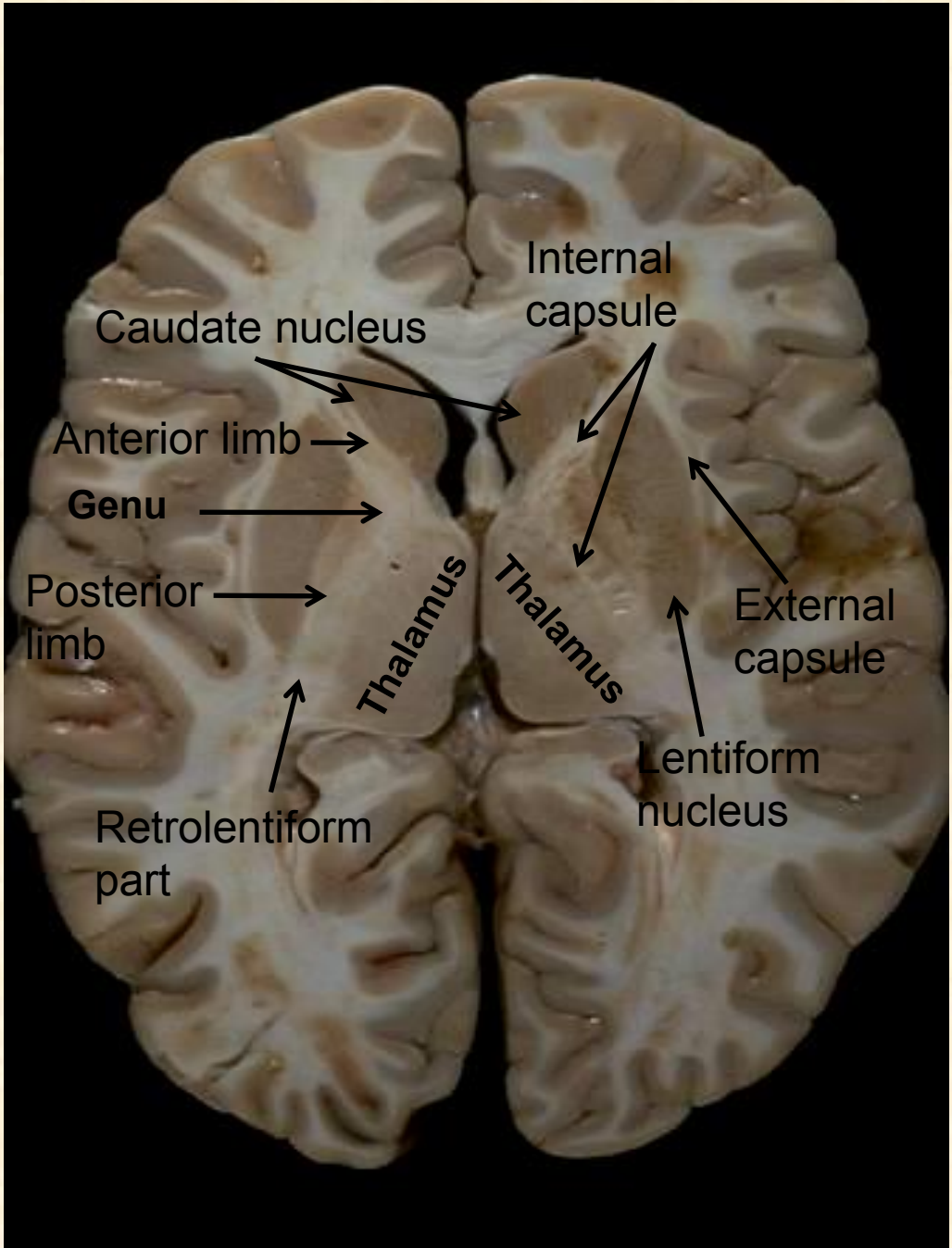


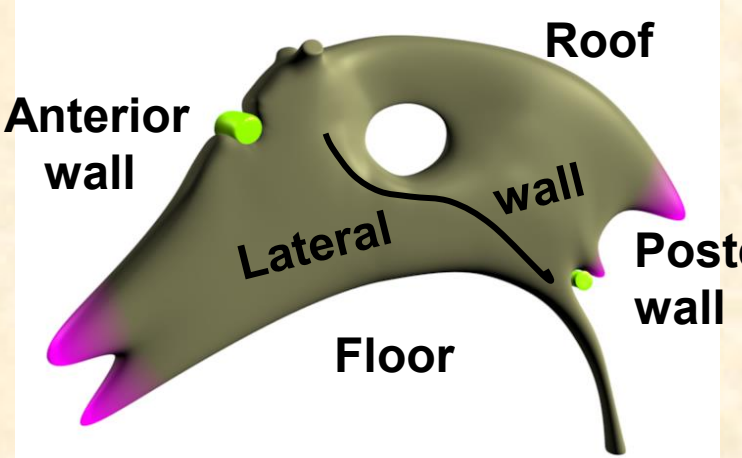

Internal capsule
Caudate nucleus
Anterior limb
Genu
Posterior limb
Thalamus
Thalamus
External capsule
Lentiform nucleus
Retrolentiform part

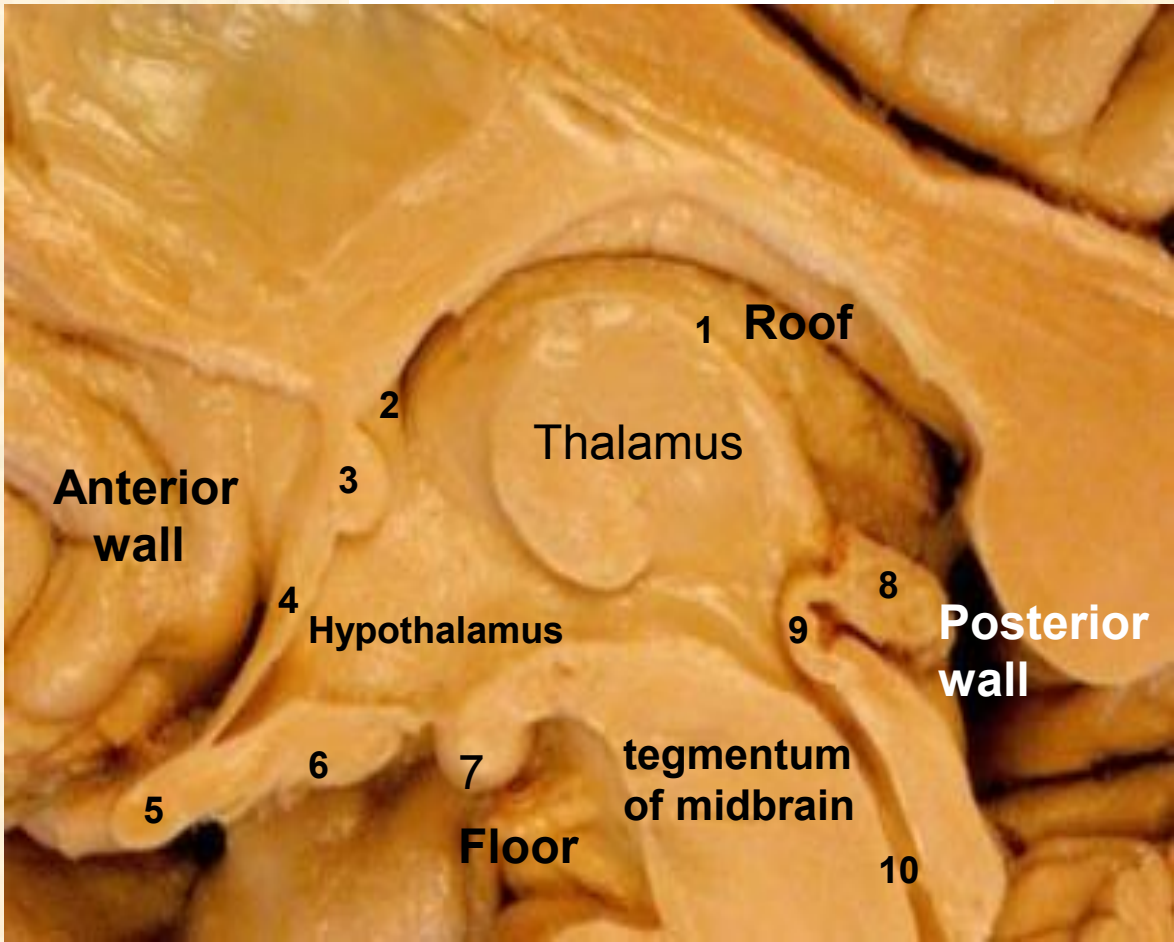
The third ventricle

It is a narrow slit like cleft between the 2 halves of the diencephalon.

Boundaries:

- **Roof**: Thin layer of ependyma stretched between lateral walls containg choroid plexus (1).
- More superiorly, fornix, septum pellicidum and corpus callosum
- **Anterior wall**: Columns of fornix (2), anterior commissure (3), Lamina terminalis (4) &
- **Floor**: Hypothalamus [optic chiasma (5), tuber cinereum (6) Mammillary body (7)] & tegmentum of midbrain.
- **Posterior wall**: Pineal body (8), posterior commissure (9) & aqueduct of sylvius (10).
- **Lateral wall:** Thalamus & hypothalamus.



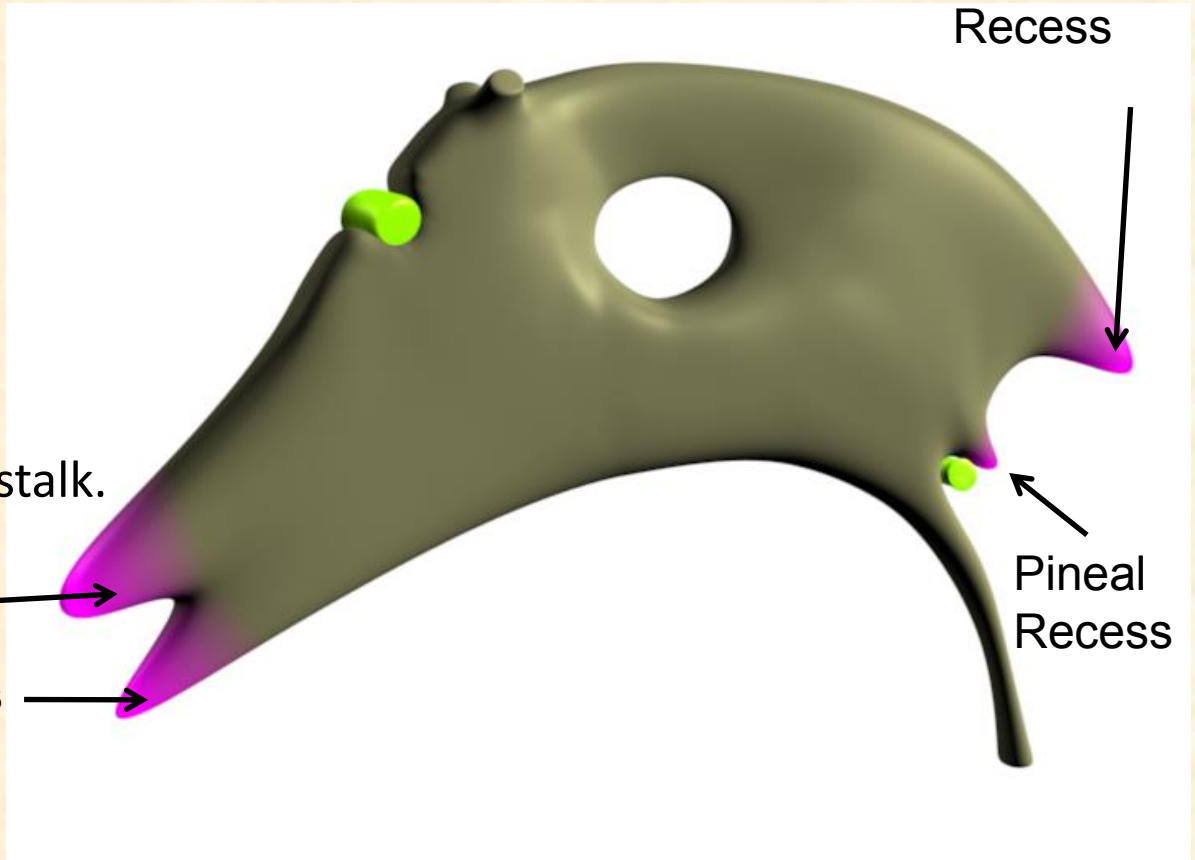


Connections:

It is connected with the lateral ventricle through interventricular foramen & with the 4th ventricle through cerebral aqueduct.

Recesses:

1) Optic.
2) Infundibular.
3) Suprapineal.
4) Pineal within the stalk.

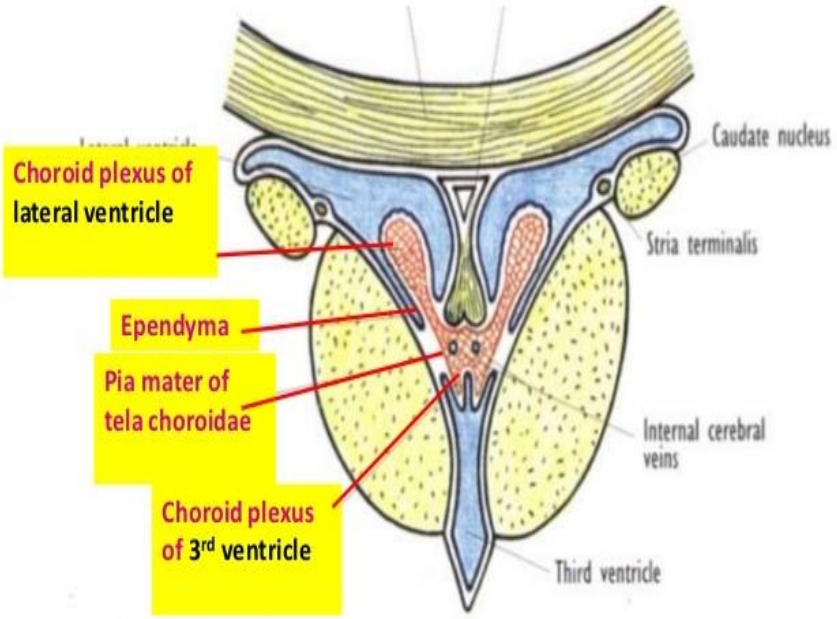


Choroid plexus of Third Ventricle

Formed of tela choroidea above **the roof** of the ventricle.

Vascular tela choroidea projects downward on each side of the midline, invaginating the **ependymal roof of the ventricle**.

Blood supply of choroid plexus of third ventricle is derived from **choroidal branch of posterior cerebral artery**



Coronal section of the interventricular foramen showing the choroid plexus of 3rd & lateral ventricles

The fourth ventricle

It is a diamond shaped cavity of the hindbrain.

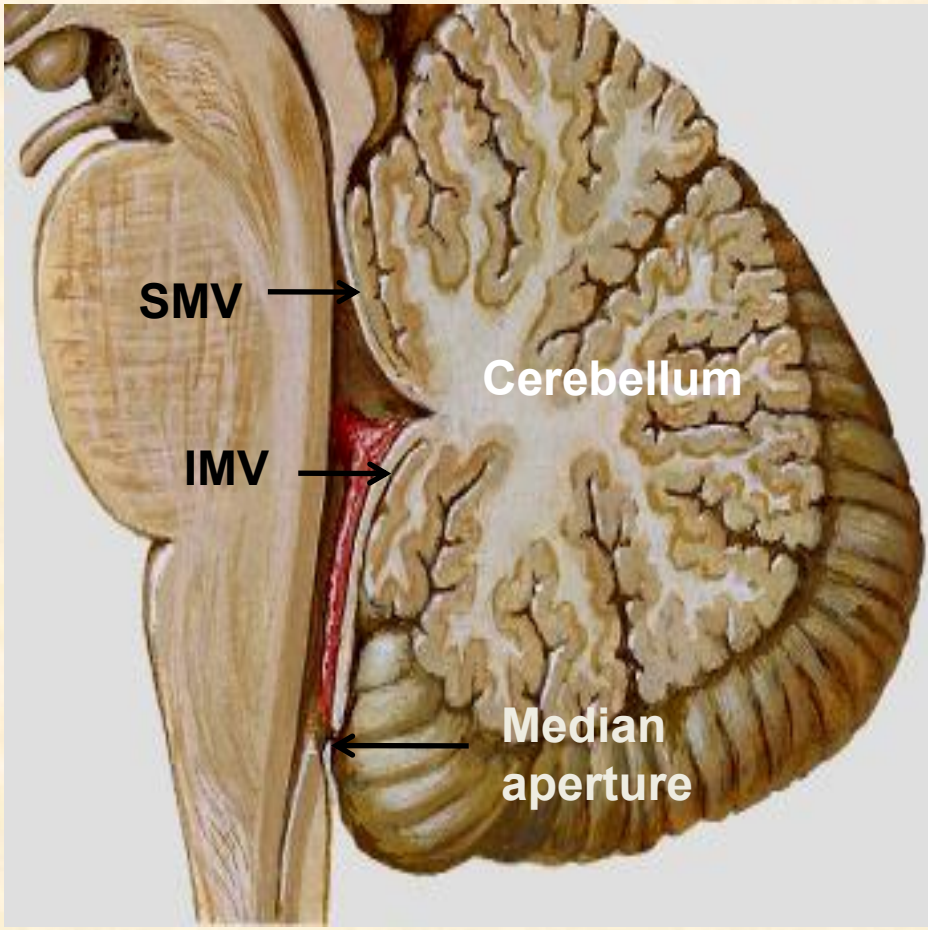
It lies behind the pons & open medulla & in front of the cerebellum.

Its **superior angle** is continuous with the cerebral aqueduct of midbrain & its **inferior angle** is continuous with the central canal of closed medulla (at the obex).

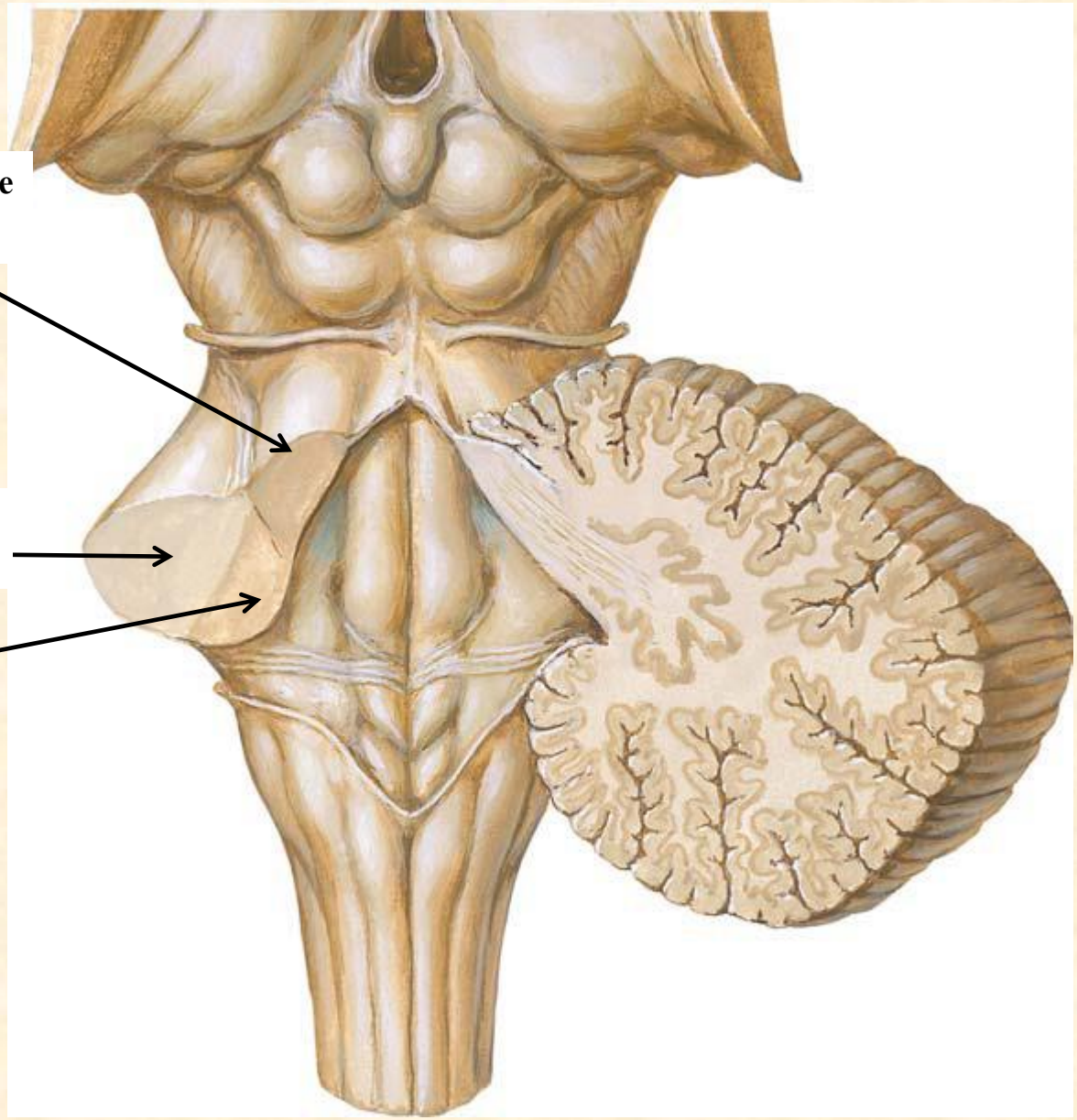
It has **2 lateral recesses** which curve around the inferior cerebellar peduncle & open by lateral apertures in the subarachnoid space at the flocculus .

The roof: Is tent shaped & is formed of

- The superior cerebellar peduncles (SCPs).
- the superior medullary velum (SMV) stretching between the 2 SCPs.
- The inferior medullary velum (IMV) which has a median aperture (of Magendie) connecting the 4th ventricle to the subarachnoid space.



Floor of the 4th ventricle



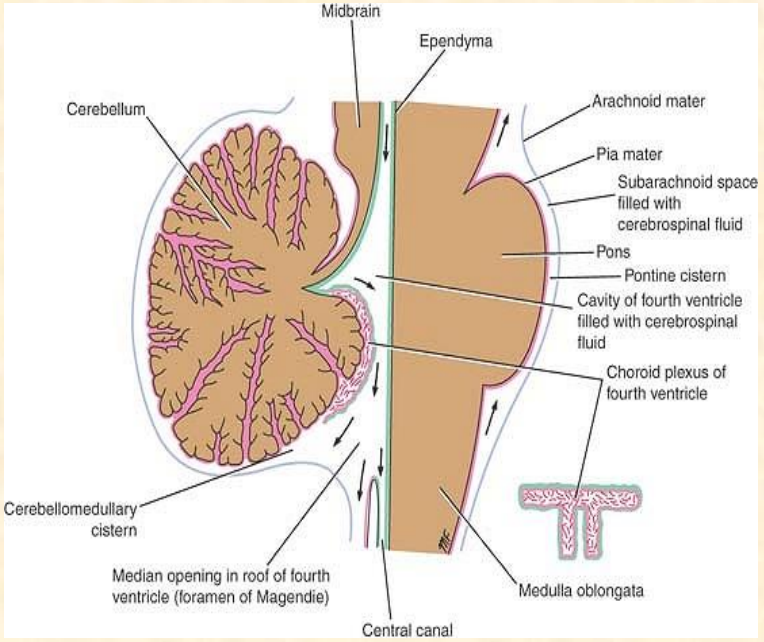
Choroid plexus of Fourth Ventricle

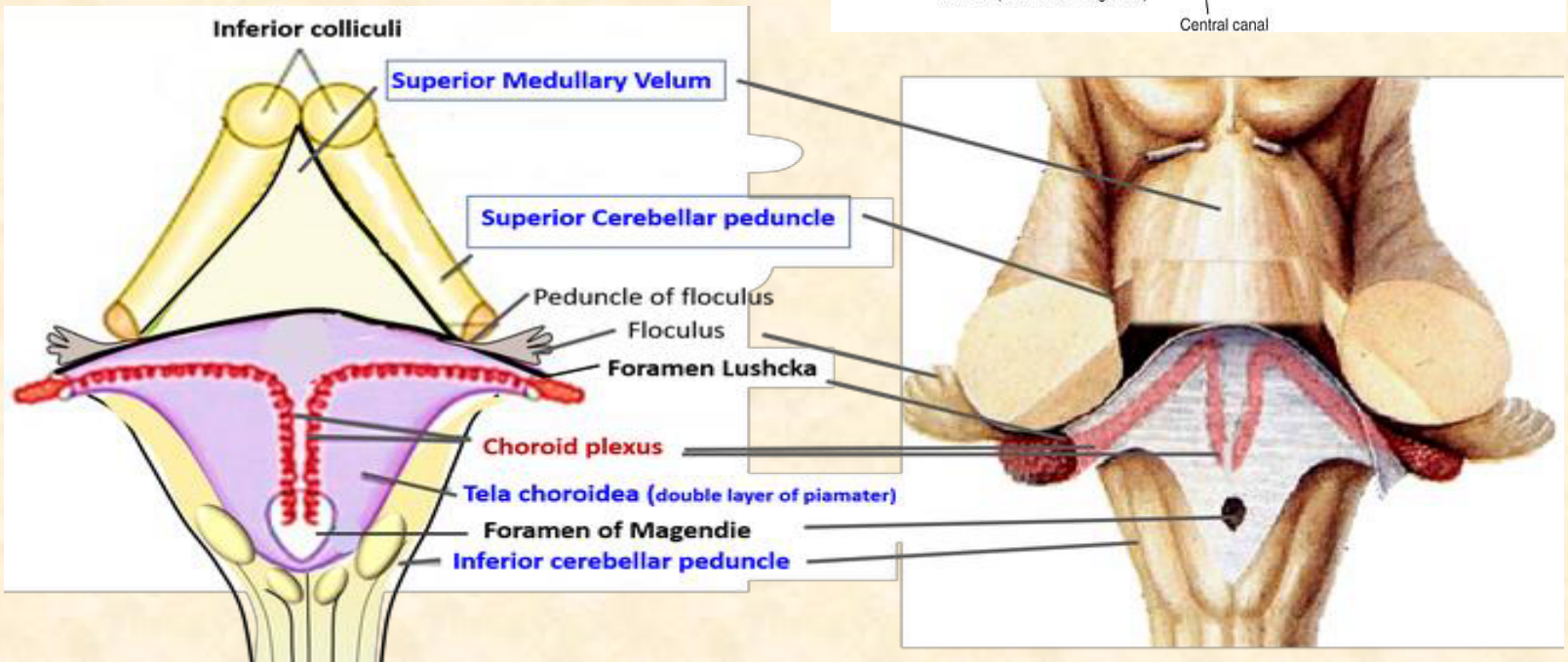
T shape.

Formed of highly vascular tela choroidea.

Suspended from the inferior half of the roof.

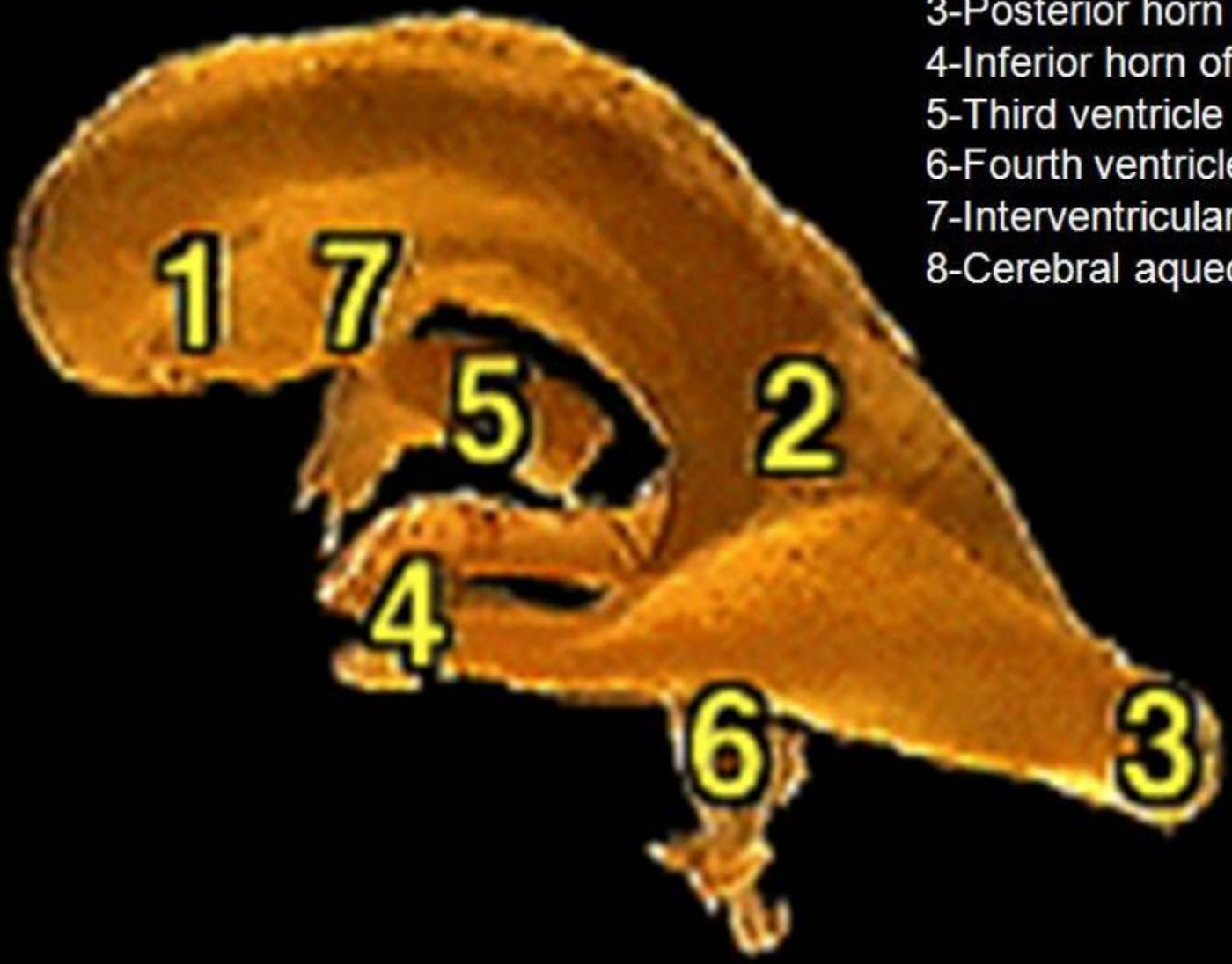
Blood supply: Posterior inferior cerebellar arteries (vertebral arteries)






1
7
5
2
4
6
3

?



1-Anterior horn of lateral ventricle
2-Body of lateral ventricle
3-Posterior horn of lateral ventricle
4-Inferior horn of lateral ventricle
5-Third ventricle
6-Fourth ventricle
7-Interventricular foramen
8-Cerebral aqueduct

Subarachnoid cisternes

1- Cerebello-medullary cisterna (Cisterna magna)

Between cerebellum and roof of 4th ventricle
Receives foramen of magendie

2- Pontine (ponto-medullary) cisterna

In front of pons and medulla
Contain basilar and vertebral arteries
Receives foramens of luchka
Transversed by roots of lower 8 cranial nerves

3- Interpeduncular cistern

Lies over interpeduncular fossa
Contains circle of willis
Transversed by roots of 3rd and 4th cranial nerves

4- Cistern of lateral fissure

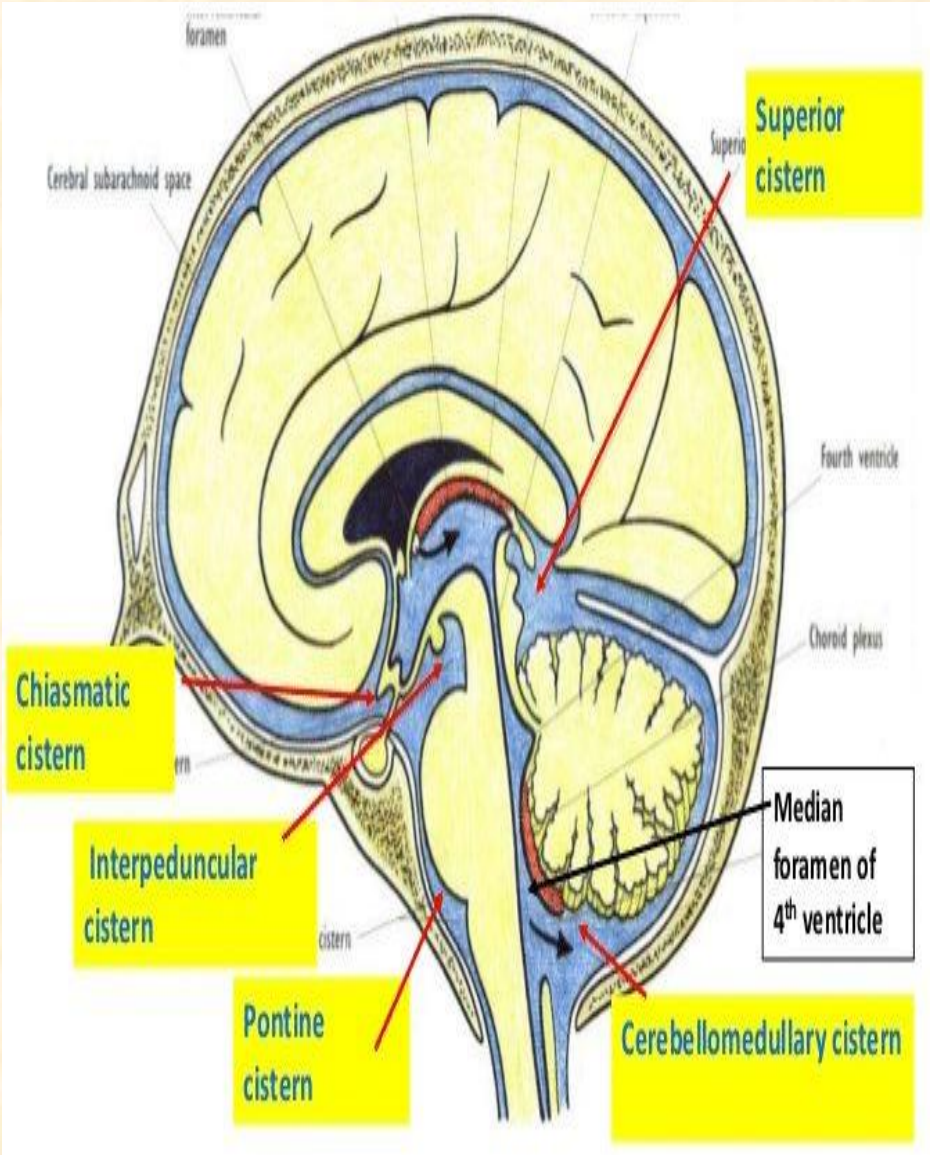
Contains the middle cerebral vessels

5- Callosal cistern

Lies above corpus callosum
Contains anterior cerebral vesseles

6- Chiasmatic cistern

Lies around optic chiasma



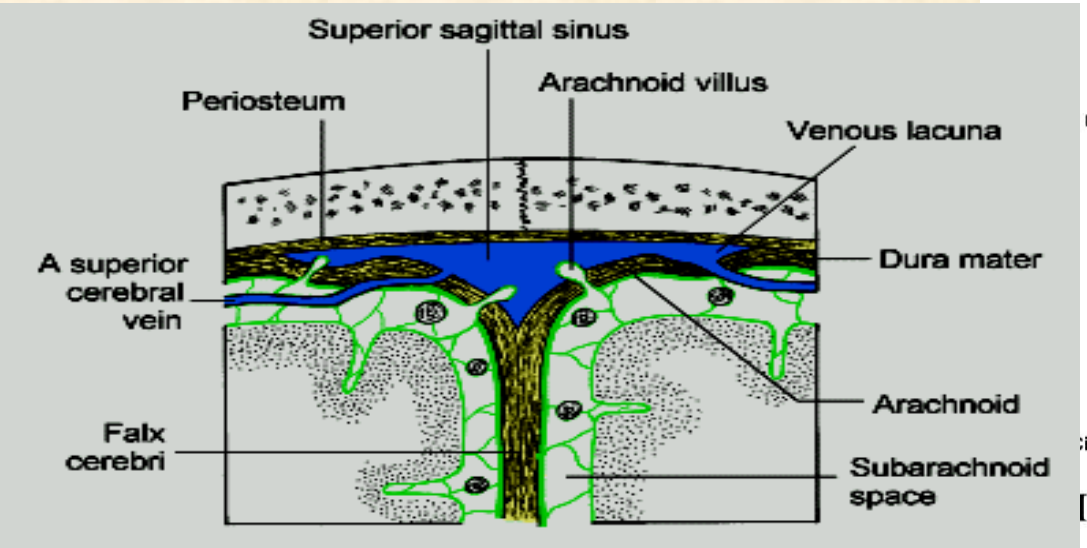
The Cerebrospinal Fluid (CSF)

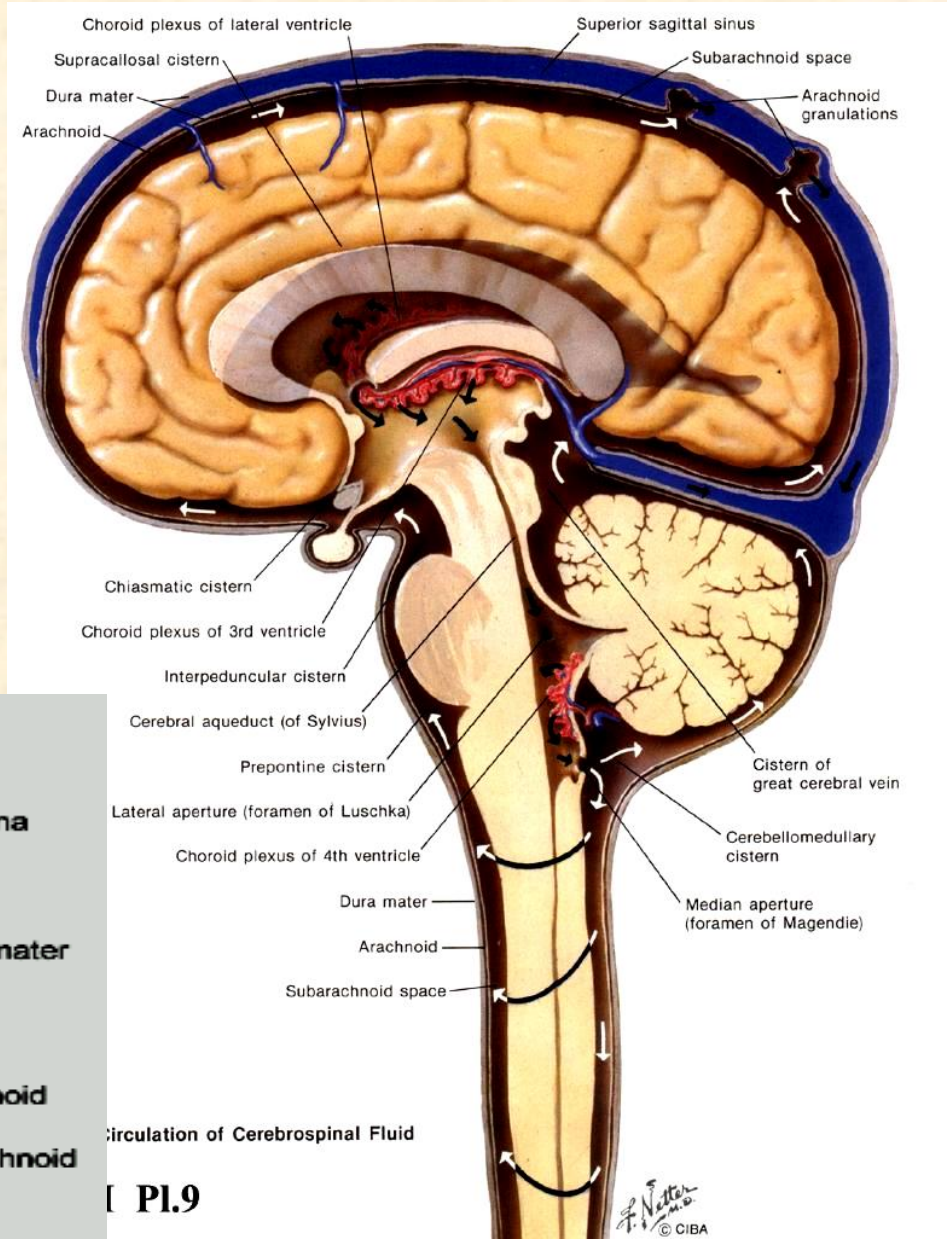
It is the fluid filling the ventricles & central canals of the CNS and subarachnoid spaces around brain and spinal cord.

Production of CSF: It is secreted by the **choroid plexuses** in the medial wall of the lateral ventricles & the roof of the 3rd & 4th ventricles

Circulation of CSF: It circulates in the ventricles & central canals of the CNS. It leaves the lateral ventricle through interventricular foramen to the 3rd ventricle then to the 4th ventricle through cerebral aqueduct of midbrain & leaves the 4th ventricle through its 3 apertures to the subarachnoid space forming a water cushion to protect the brain & spinal cord.

Absorption of CSF: It is absorbed by arachnoid villi & granulations to be excreted into the dural venous sinuses.





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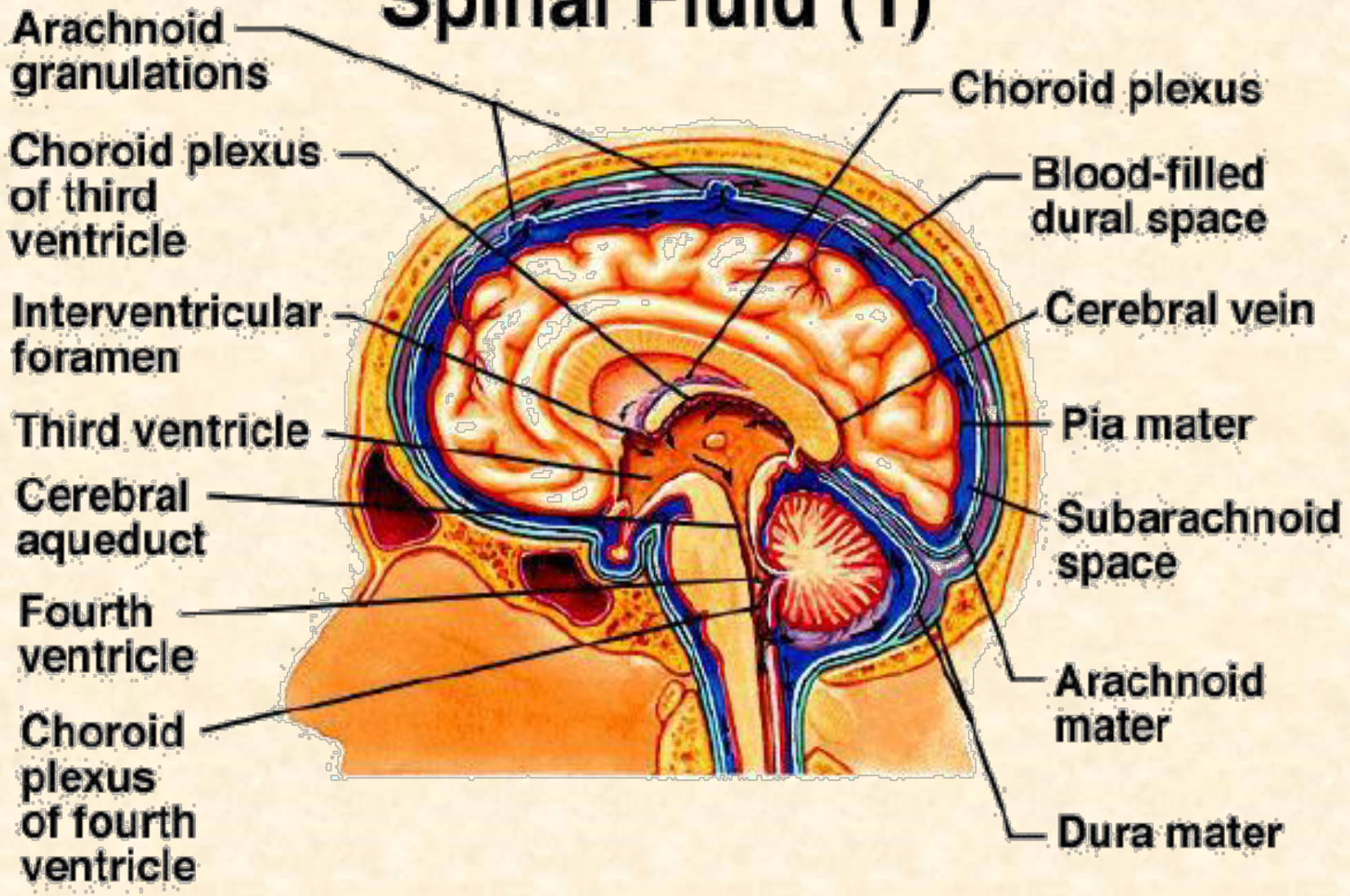
Properties

- Clear, colorless, transparent fluid
- Normal Volume is 150ml (varies between 100 – 200 ml)
- Rate of formation : 0.3ml /min (550ml/day)
- Specific gravity : 1005
- Reaction : alkaline

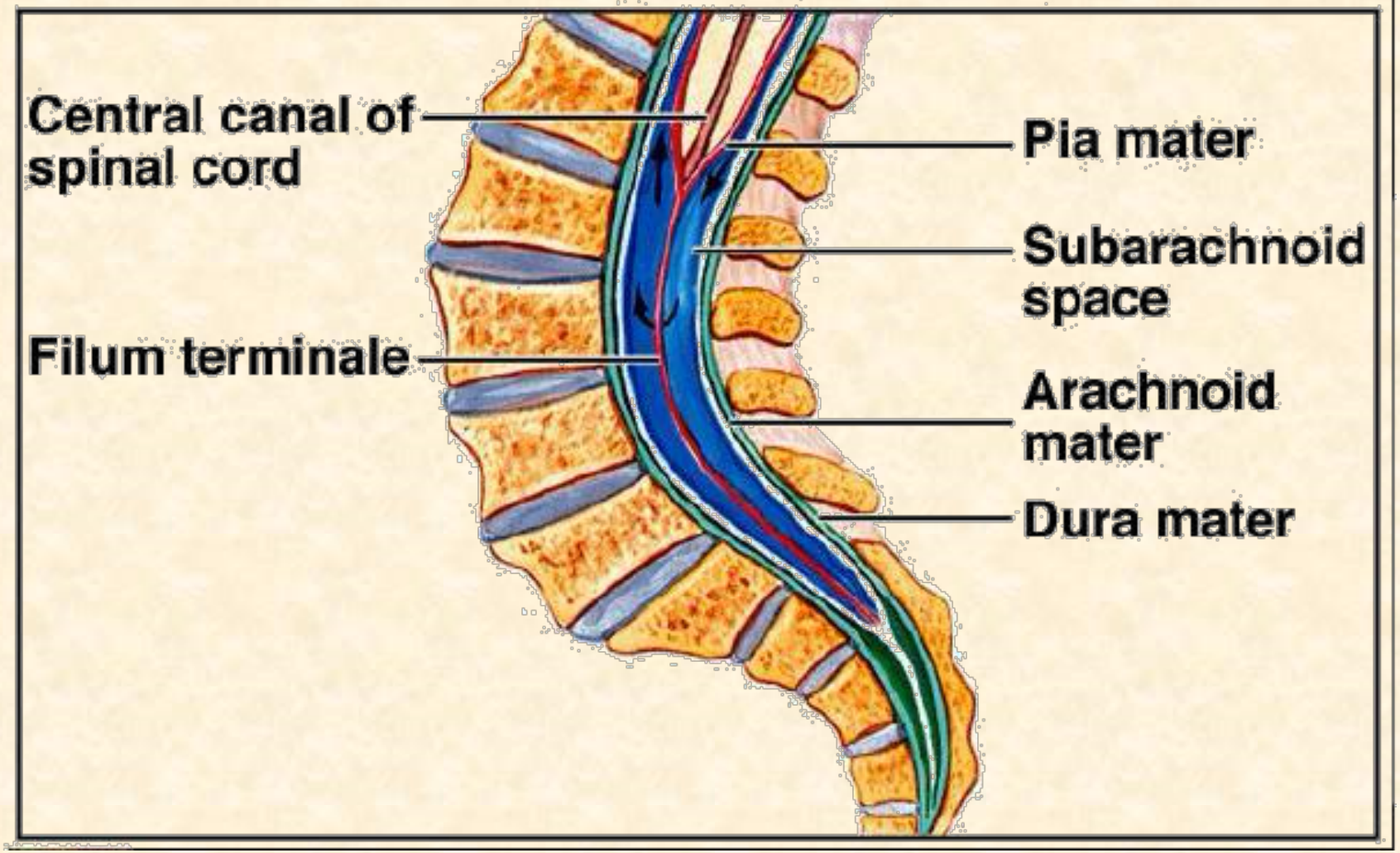
Functions

- Supports the weight of the brain
- Distributes the force of blows on the head
- Mechanical shock absorber
- Maintains the intracranial pressure
- Nutrient
- Removal of wastes

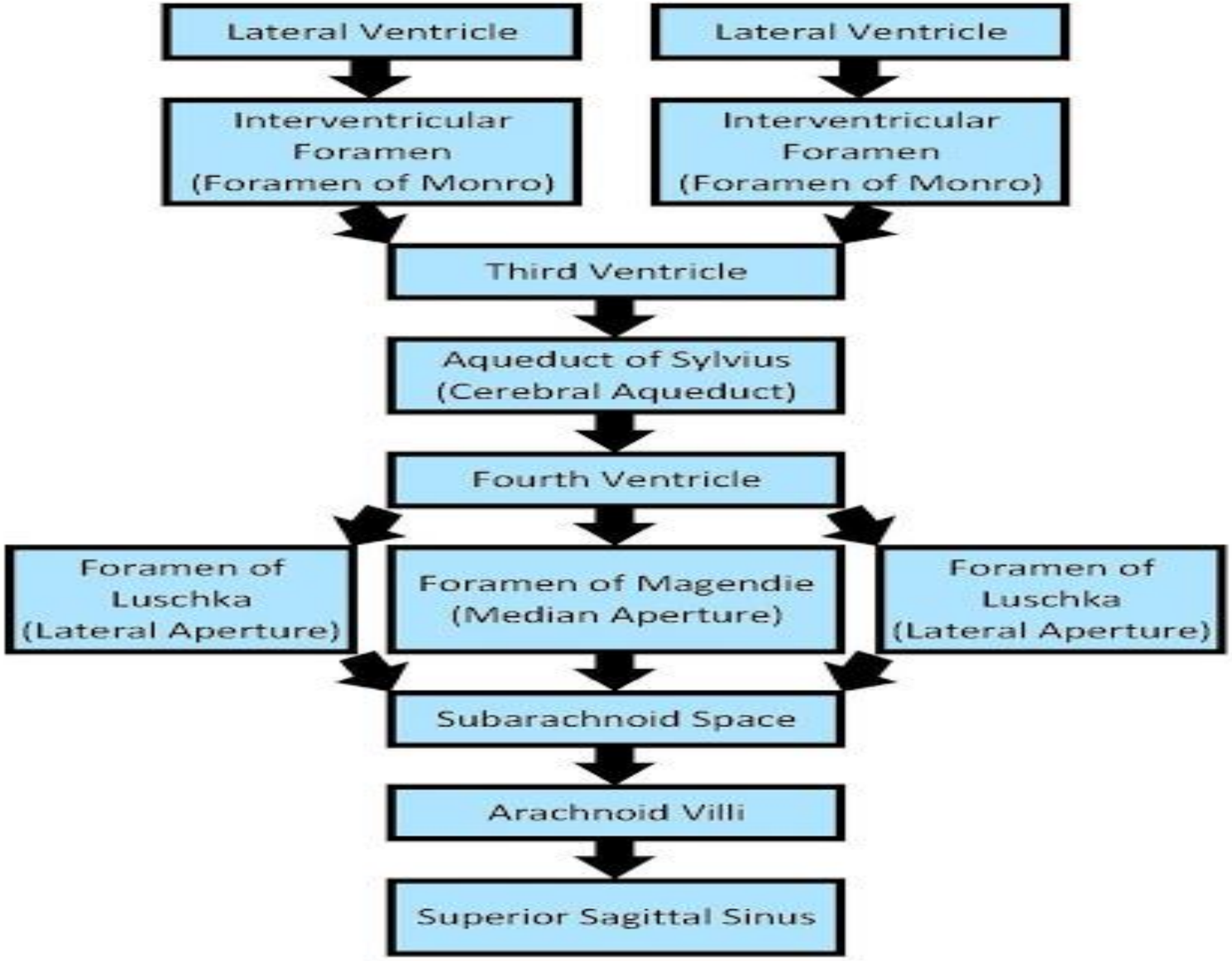
Ventricles and Cerebro Spinal Fluid (1)



Ventricles and Cerebrospinal Fluid (2)



Circulation of Cerebrospinal Fluid (CSF)



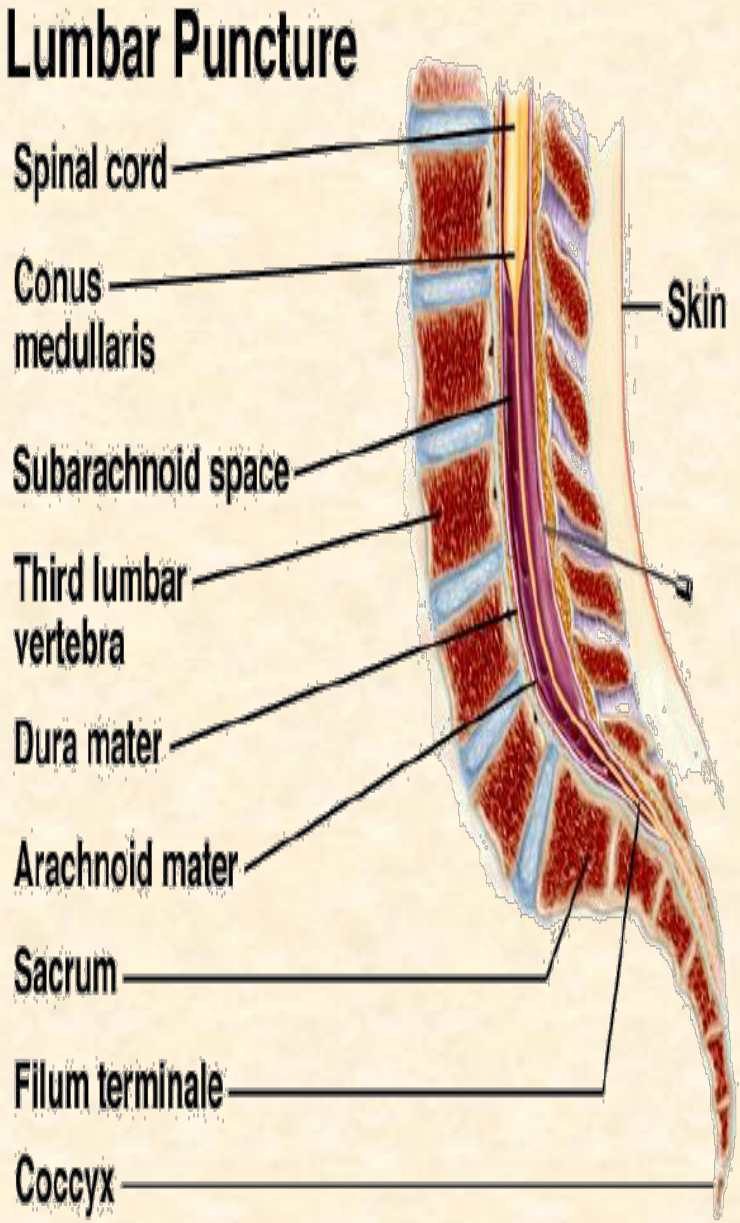
Lumbar Puncture

Procedure by which CSF is taken out from the subarchnoid space.

CSF is drawn by introducing a needle between the 3rd and 4th lumbar vertebrae.
(because the spinal cord terminates at lower border of L1 & subarachnoid space is wider).

Purpose of Lumbar puncture:

- For diagnostic purposes
- Spinal anesthesia
- To measure CSF pressure



Hydrocephalus

accumulation of cerebrospinal fluid (CSF) within the brain.

Not an exam material

headaches, double vision, poor balance, urinary incontinence, personality changes, or mental impairment.

In babies there may be a rapid increase in head size.

Other symptoms may include vomiting, sleepiness, seizures, and downward pointing of the eyes (sunset eyes).

Types of hydrocephalus

Not an exam material

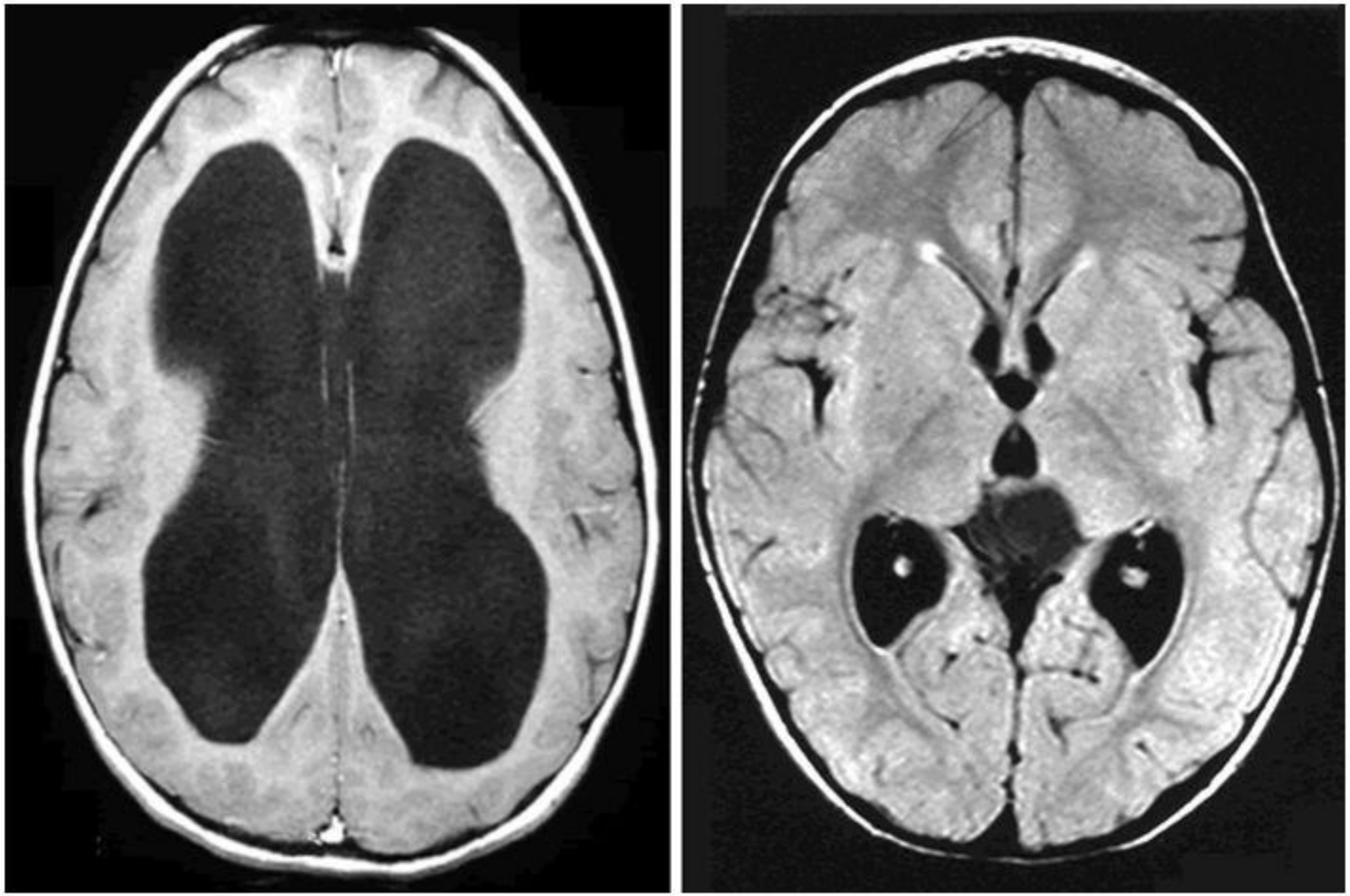
Communicating (non obstructive)
impaired cerebrospinal fluid reabsorption in absence of any CSF-flow obstruction between the ventricles and subarachnoid space.

functional impairment of the **arachnoid granulations**

Causes :**subarachnoid/intraventricular hemorrhage, meningitis and congenital absence of arachnoid villi**.

Non-communicating (obstructive)
caused by a CSF-flow obstruction.
Foramen of Monro
aqueduct of Sylvius dilation of both lateral ventricles and third ventricle.
Fourth ventricle (e.g., Chiari malformation).
foramina of Luschka and **foramen of Magendie** may be obstructed due to congenital malformation (Dandy-Walker malformation: cystic dilatation of 4th ventricle.

Hydrocephalus vs Normal – MRI view



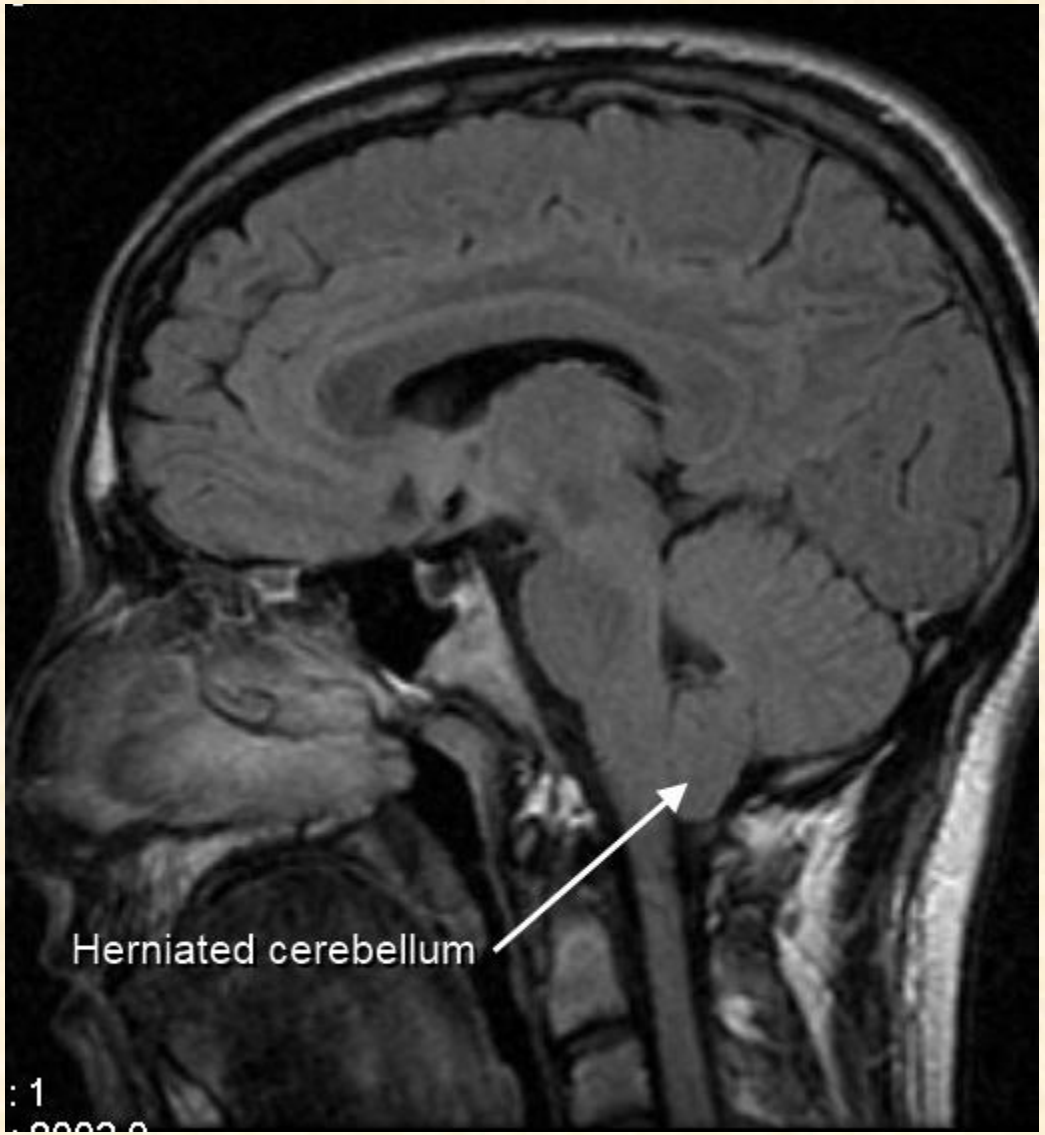
An MRI scan of a brain with hydrocephalus (left) and a normal MRI scan (right). The large dark area on the left is the ventricles, made bigger by a build-up of CSF

Not an exam material

Chiari malformation

Chiari malformations (**CMs**) are structural defects in the cerebellum. They consist of a downward displacement of the cerebellar tonsils through the foramen magnum causing non-communicating hydrocephalus as a result of obstruction of cerebrospinal fluid (CSF) outflow

Signs&symptoms:
Headache, tinnitus, dysphagia
May be paralysis.



Papilledma

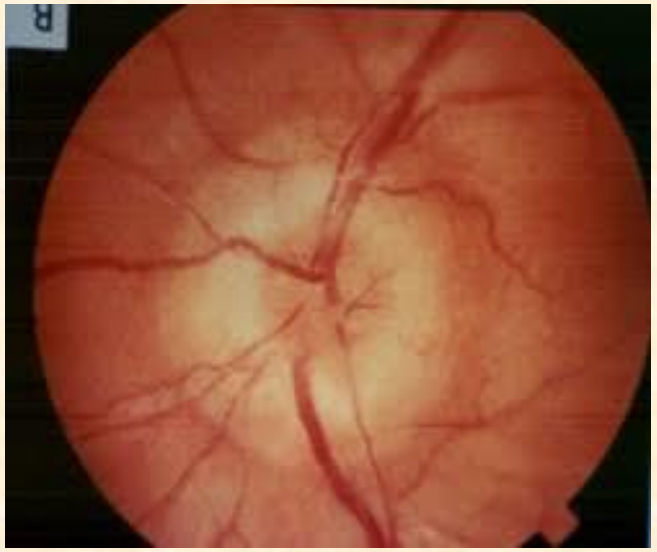
•Optic nerves are surrounded by piamatter, arachnoid mater and dura mater.

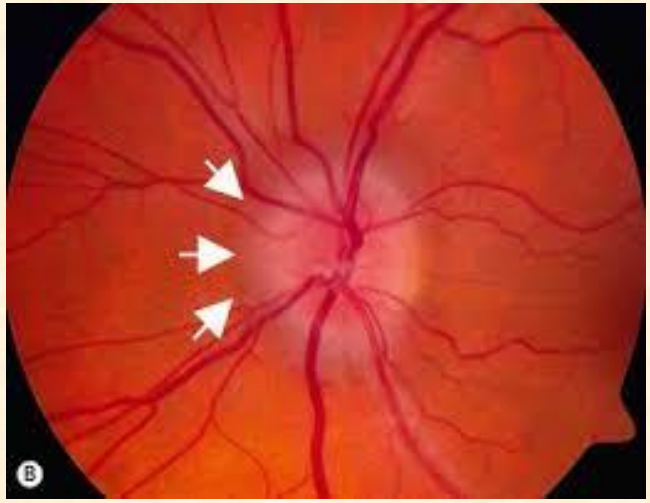
•Subarachnoid space is extending around optic nerve to the back of eyeball.

•Rise in CSF pressure compress retinal vein.

•Congestion of the retinal vein and bulging of the optic disc.

•Optic atrophy and blindness.





The blood brain barrier

barrier present between the brain and the blood

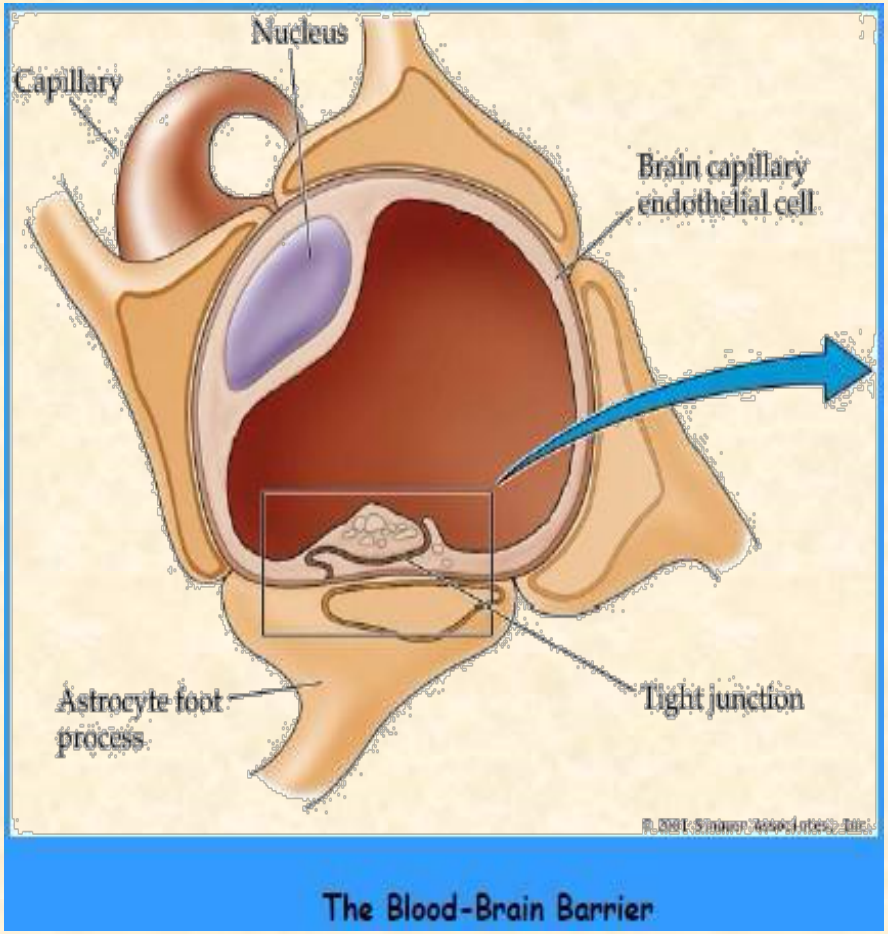
Structure

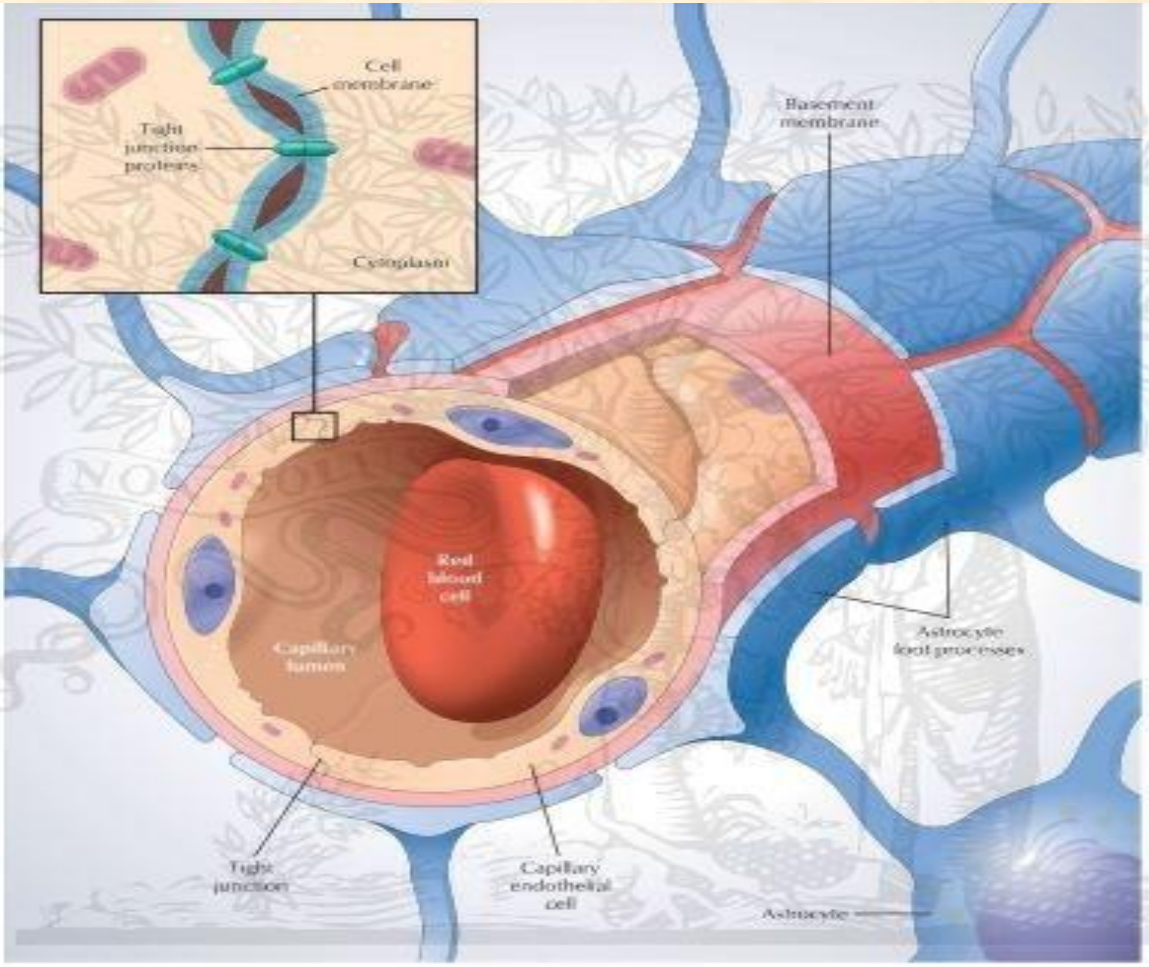
•The capillaries of the brain consist of **endothelial lining** which have **tight junctions** which close the pores in the blood vessels

•**Astrocytes** completely cover the capillaries and make it less porous

•The blood vessels have a **thick basement membrane**.

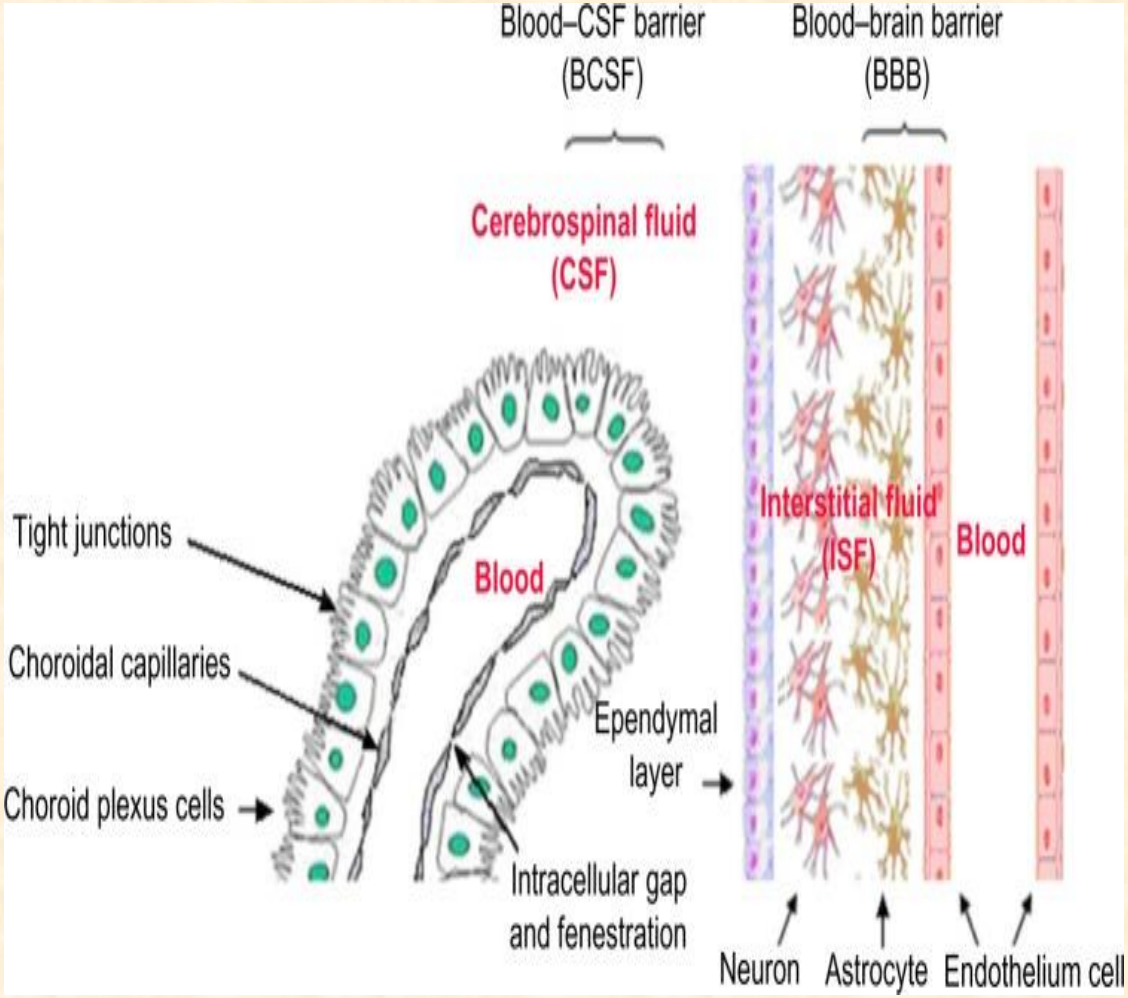
•Exists in all parts of the brain except hypothalamus, pineal gland and area posterema





The blood CSF barrier

Blood CSF barrier: barrier between the blood and CSF exists at the choroid plexus whose function is similar to blood brain barrier. Doesn't allow the entry of substances into the CSF from the blood



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Queckenstedt sign

The normal CSF pressure on lying on side is 60-150 mm water.
In case of obstruction , normal variation of pressure due to pulse or respiration is absent.
Compression of Jugular veins in the neck raises cerebral venous pressure and inhibits CSF absorption producing rise in CSF pressure.
Faiure of this phenomenon is referred as **positive queckenstedt sign**.

Kernicterus

In fetus, newborn or premature the blood brain barrier is not fully developed.
Toxic bilirubin enters CNS and produce yellowing of the brain.

Drugs and BBB

Easily pass (Chloramphenicol and tetracyclins, lipid soluble anestheia) + **L-dopa (treatment of parkinsonism**
Don't pass (water soluble norepinephrine, and Dopamine)