



CNS
Doctor 2021



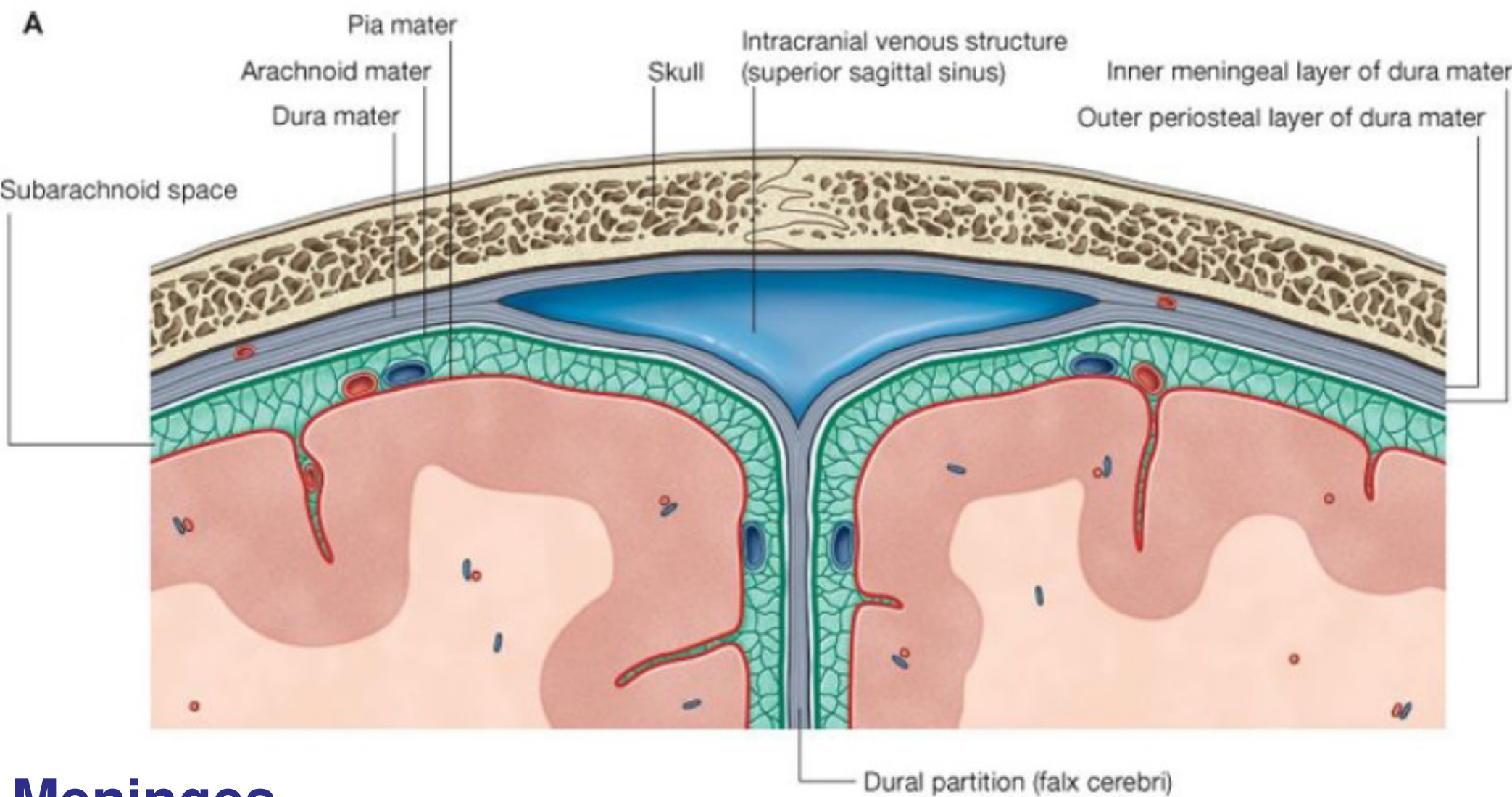
Anatomy

Modified (7)

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Meninges

- **Dura mater:** (outermost layer, near the bone)
- **Endosteal layer:** attached to the skull + meningeal arteries
- **Meningeal layer:** continuous with spinal dura
 → attached to arachnoid matter
- **Arachnoid mater:**
- **Pia mater** (firmly attached to the surface of the brain)

Both layers run together in most locations but in certain places they split forming
 - dural venous sinuses
 - folds of dura

a Hatchel to the bone

II. MENINGES OF BRAIN

3 layers, like spinal cord; Dura Mater – tough mother; Arachnoid = spiderlike; Pia Mater = tender mother; arrangement different

(dense)

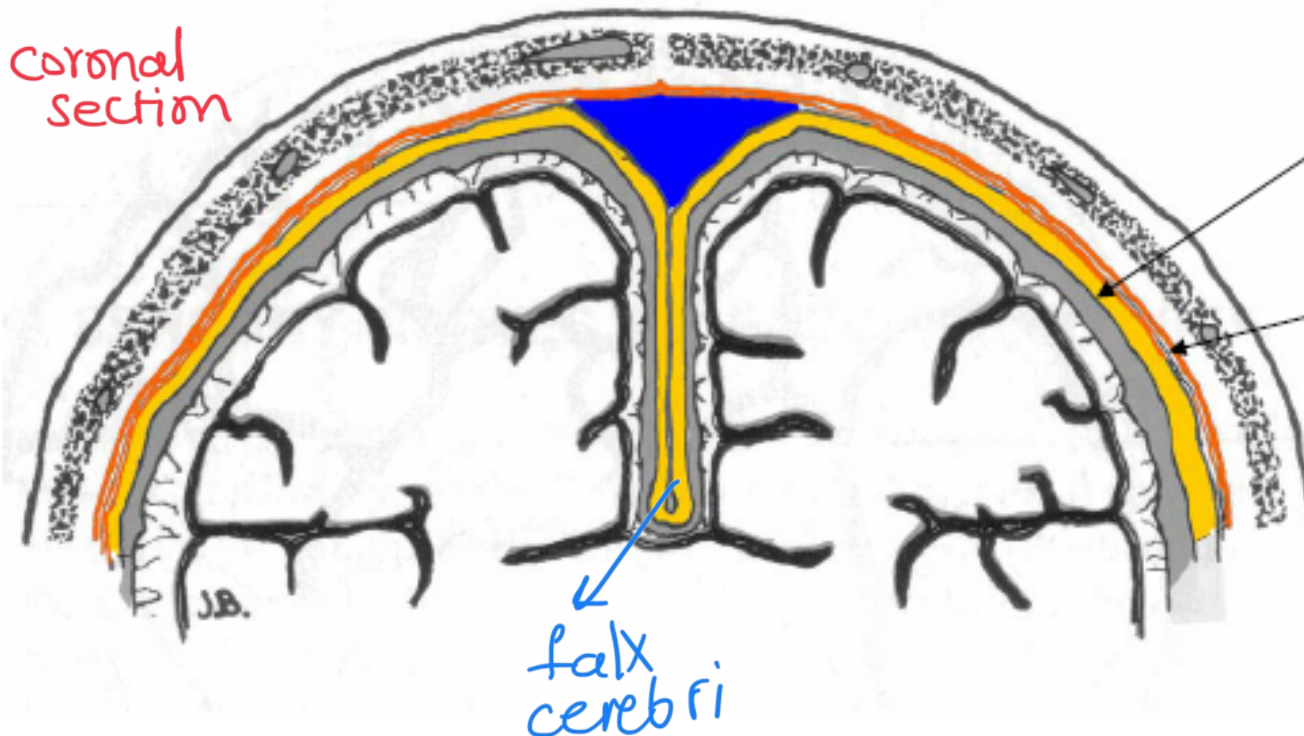
A. DURA MATER - tough connective tissue layer, composed of two layers -

INNER MEMBRANE LAYER (true dura)

OUTER ENDOSTEAL LAYER - periosteum on inner side of calvarium

Two layers - fused in most places - separate to form **DURAL REFLECTIONS**

coronal section



falx cerebri

DURA - 2 LAYERS ARE FUSED IN MOST PLACES

superior view

Bones of the skull removed



- Dura is tightly attached to inner side of calvarium

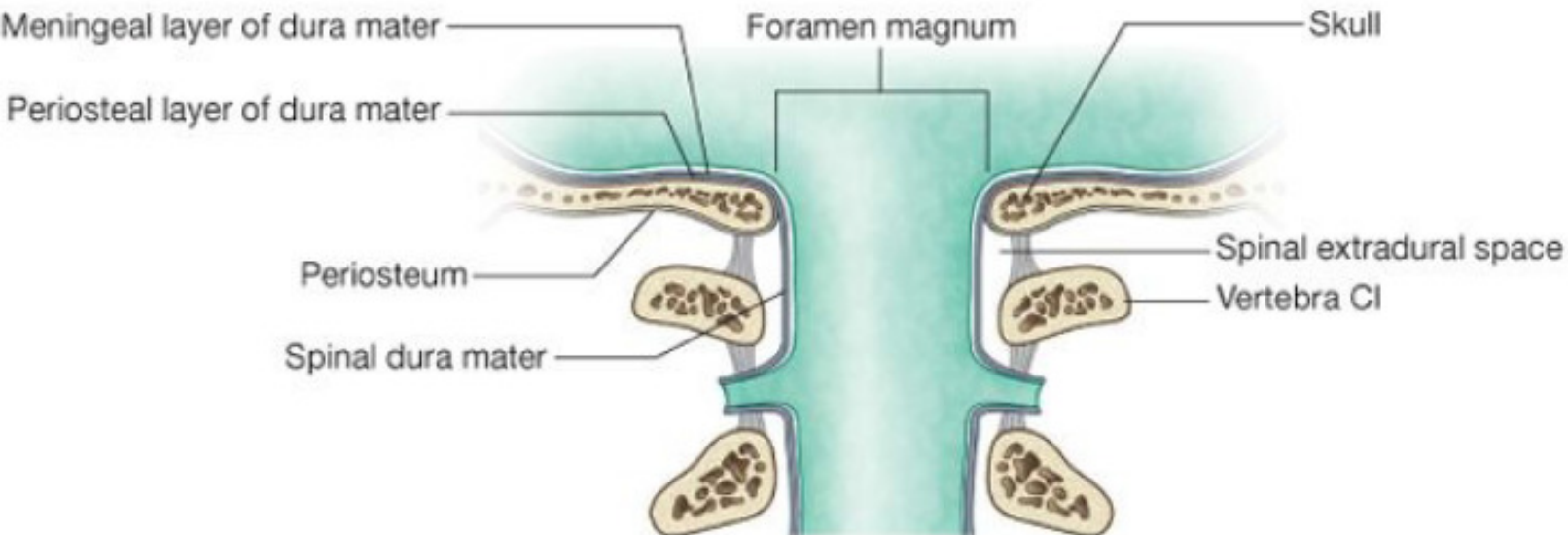
↳ Bones of the cranium

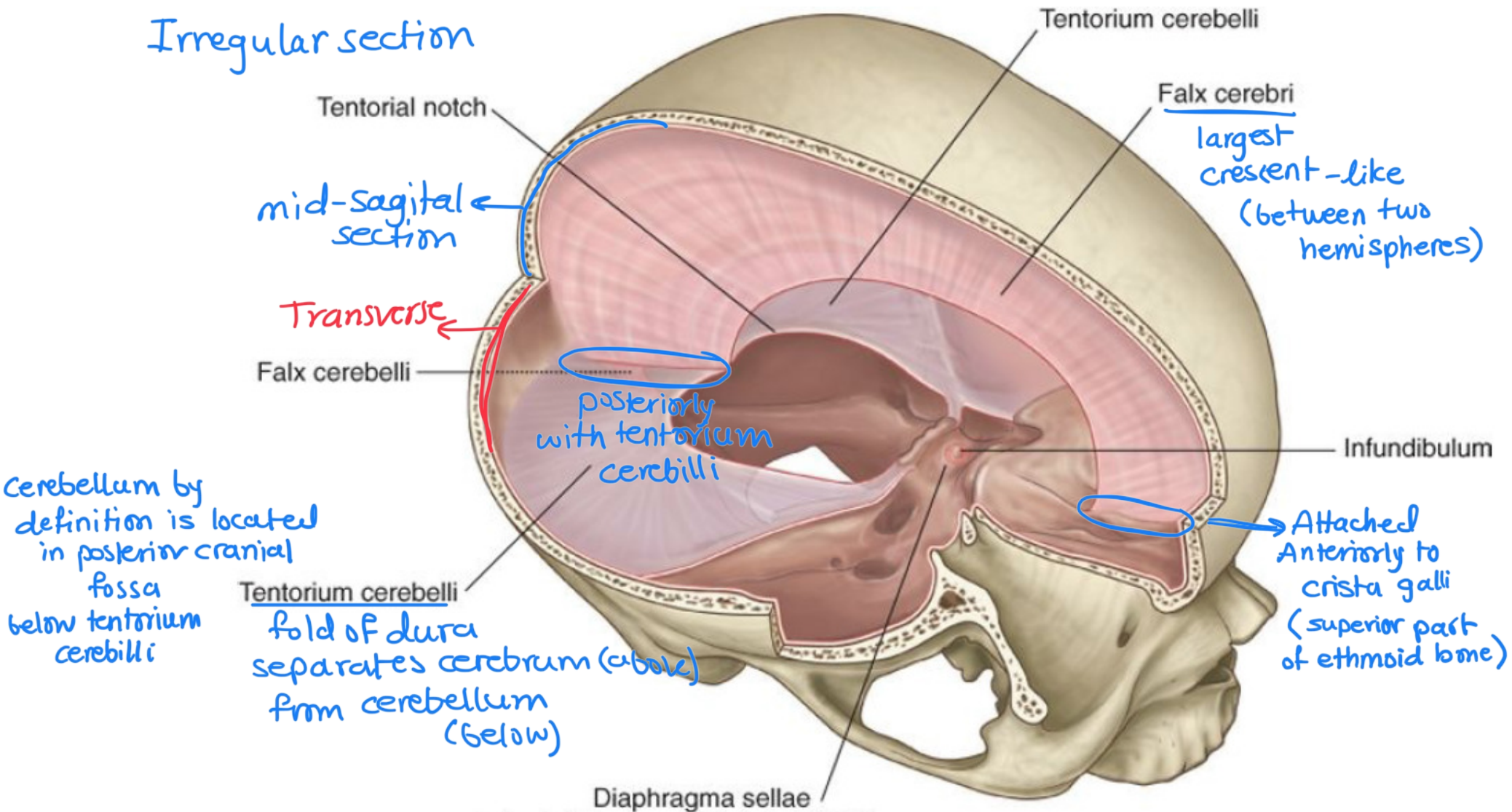
- Normally No Epidural Space (unlike spinal cord)

firmly attached to the bones

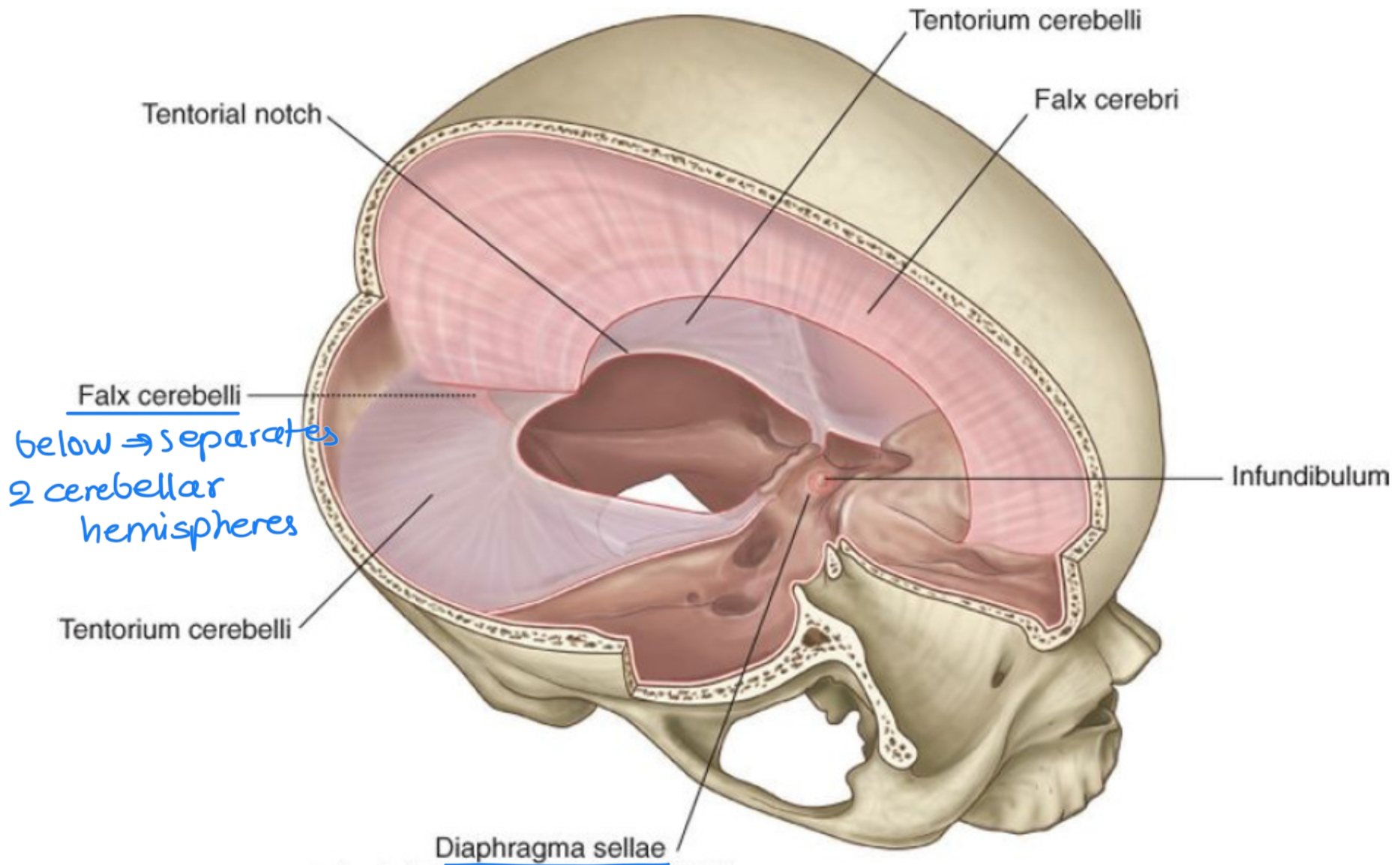
Calvarium removed by pulling away bone from dura

➤ The two layers of dura separate to form folds, dural partitions





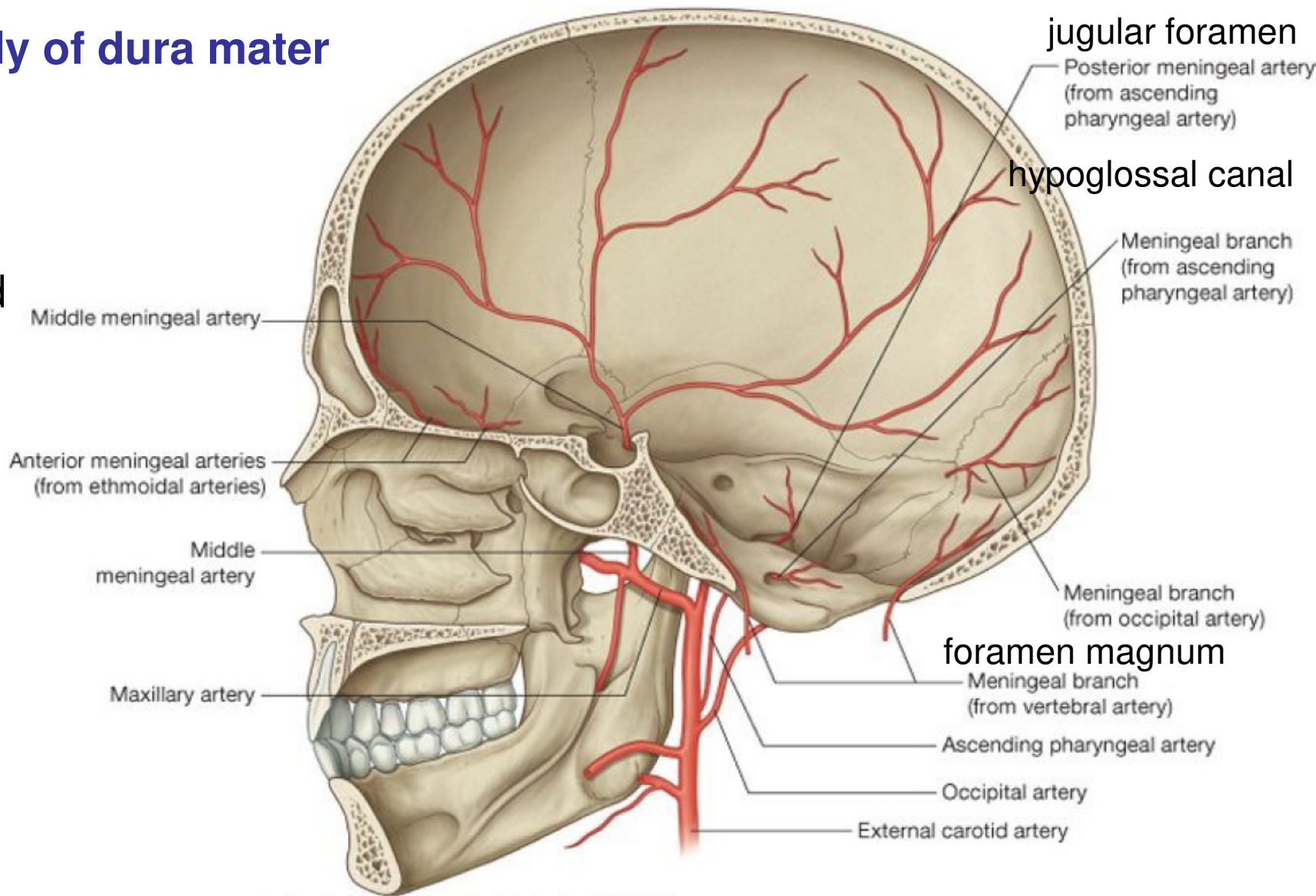
- **Falx cerebri:** crescent-shaped, Attachments:
 - **Anterior:** crista galli **Posterior:** tentorium cerebelli
- **Tentorium cerebelli:** horizontal, Attachments:
 - **Anteriolateral:** superior border of the petrous. **Posterior:** occipital bone, **Anteriolmedial:** free, tentorial notch



- **Falx cerebelli:** small midline projection, Attachment:
 - **Anterior:** free, between the two cerebellar hemispheres, **Posterior:** internal occipital protuberance (Bony attachment)
- **Diaphragma sellae:** horizontal shelf, covers the hypophysial fossa in the sella turcica

Arterial supply of dura mater

- Anterior meningeal arteries
- Middle and accessory meningeal arteries
- posterior meningeal artery



- Middle meningeal artery (branch of maxillary artery), enters through the foramen spinosum
- Accessory meningeal artery (branch of maxillary artery), enters through the foramen ovale
- ❖ ***All in the outer periosteal layer of the dura***

① Anterior meningeal artery :

- Branch from ethmoidal arteries

Ant. + post.
ethmoidal = Ant. meningeal arteries
(more than one)

- Supply dura in the anterior cranial fossa.

② Middle meningeal artery (the only large artery)

- Branch from first part of maxillary artery
(enters through foramen spinosum)

- Gives Anterior and posterior divisions deep to pterion

mainly related to pterion
(weakest point of skull)

↓
fracture

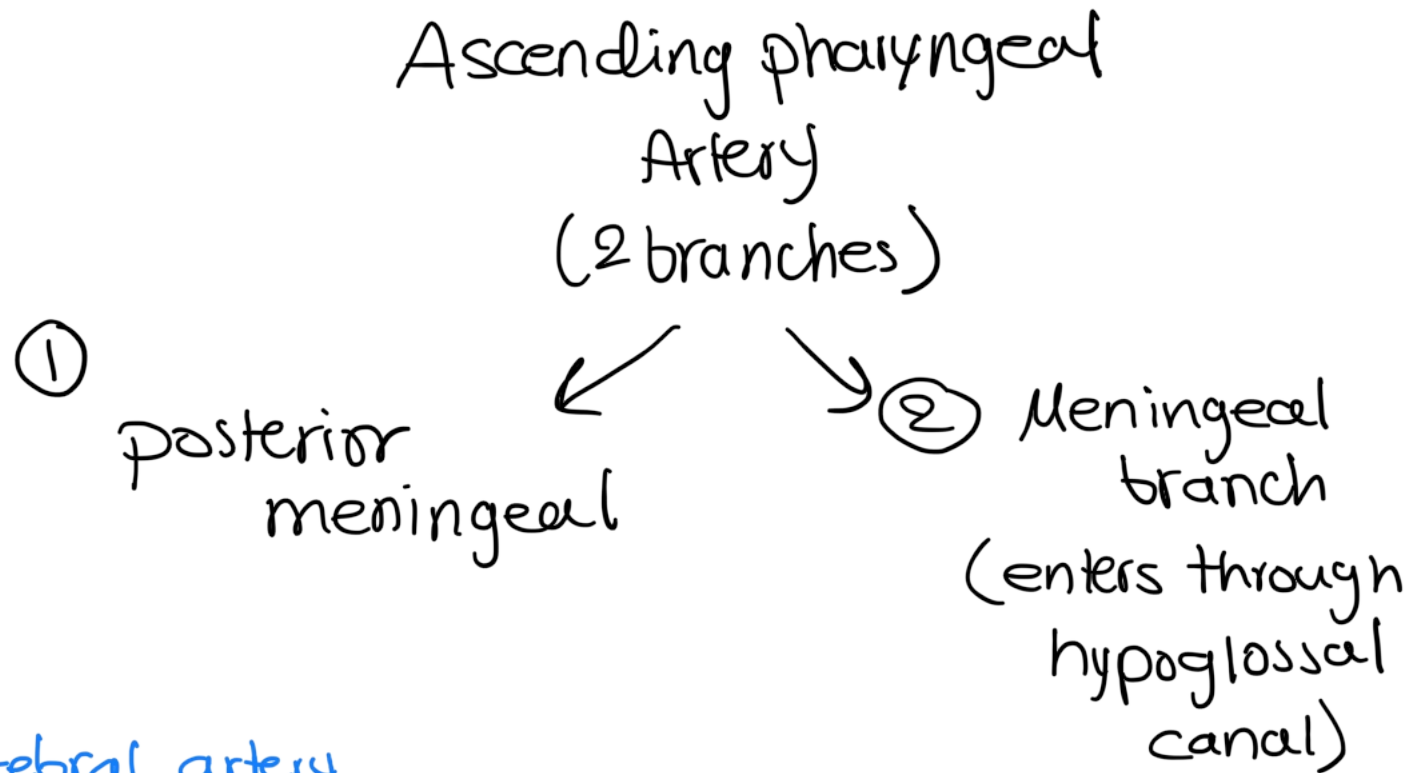
↓
Epidural hematoma

③ Accessory Meningeal

- Branch of maxillary artery (enters through foramen ovale)
- smaller than middle meningeal

④ Posterior Meningeal Artery

- Branch from Ascending pharyngeal artery
- Enters through jugular foramen.



⑤ vertebral artery

- Branch from first part of subclavian
- Enters through foramen magnum
- Gives meningeal branch

Nerve supply of dura mater

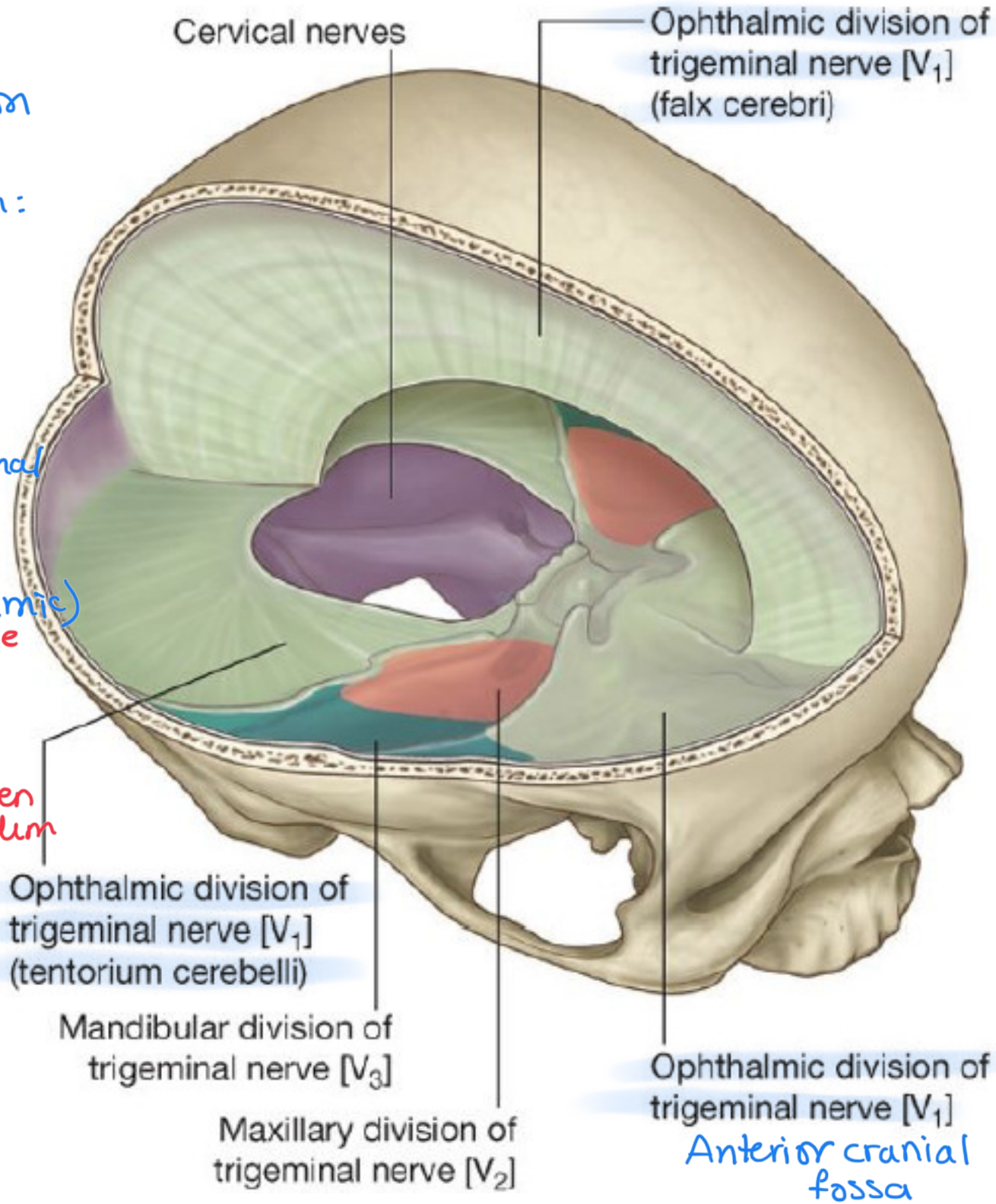
like the innervation of the scalp

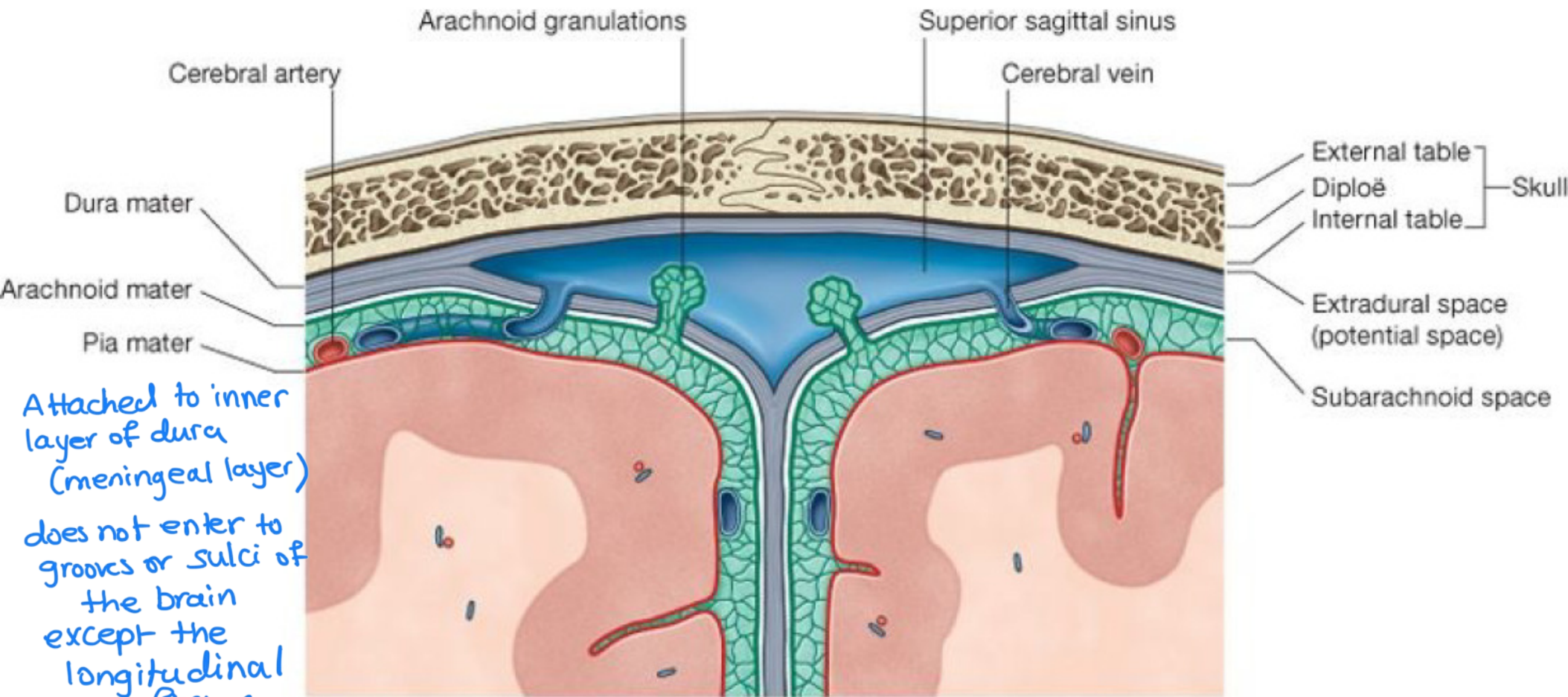
It gets innervation from:

① Branches from cervical plexus
 posterior cranial fossa below tentorium cerebelli

② Branches from trigeminal nerve
 ophthalmic
 mandibular
 maxillary } All 3 branches but mainly (ophthalmic)
 see the photo

Mandibular + Maxillary supply the middle cranial fossa
 from foramen ovale
 ↓
 Infratemporal fossa
 ↓
 Gives sensory branches to the dura
 foramen rotundum





Attached to inner layer of dura (meningeal layer)
 does not enter to grooves or sulci of the brain except the longitudinal fissure (Big fissure)

➤ **Arachnoid:** does not enter the grooves or fissures of the brain, except for the longitudinal fissure

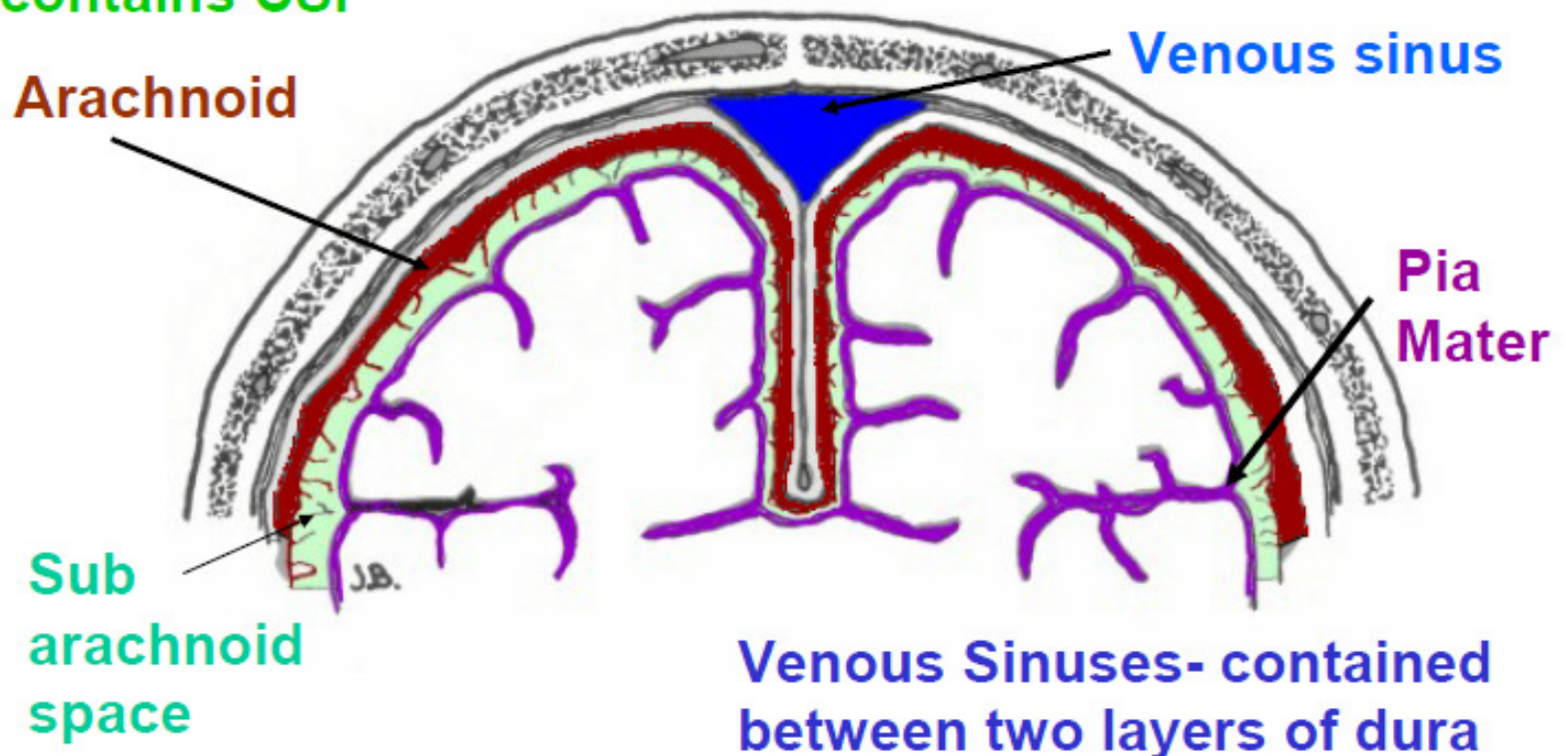
➤ **Pia:** follows the contours of the brain → firmly attached to the surface of the brain (enters inside grooves and sulci).

❖ Spaces

- Epidural: → potential space where (not true space) bleeding can occur
- Subdural
- Subarachnoid real space (between arachnoid and pia) → where CSF circulate

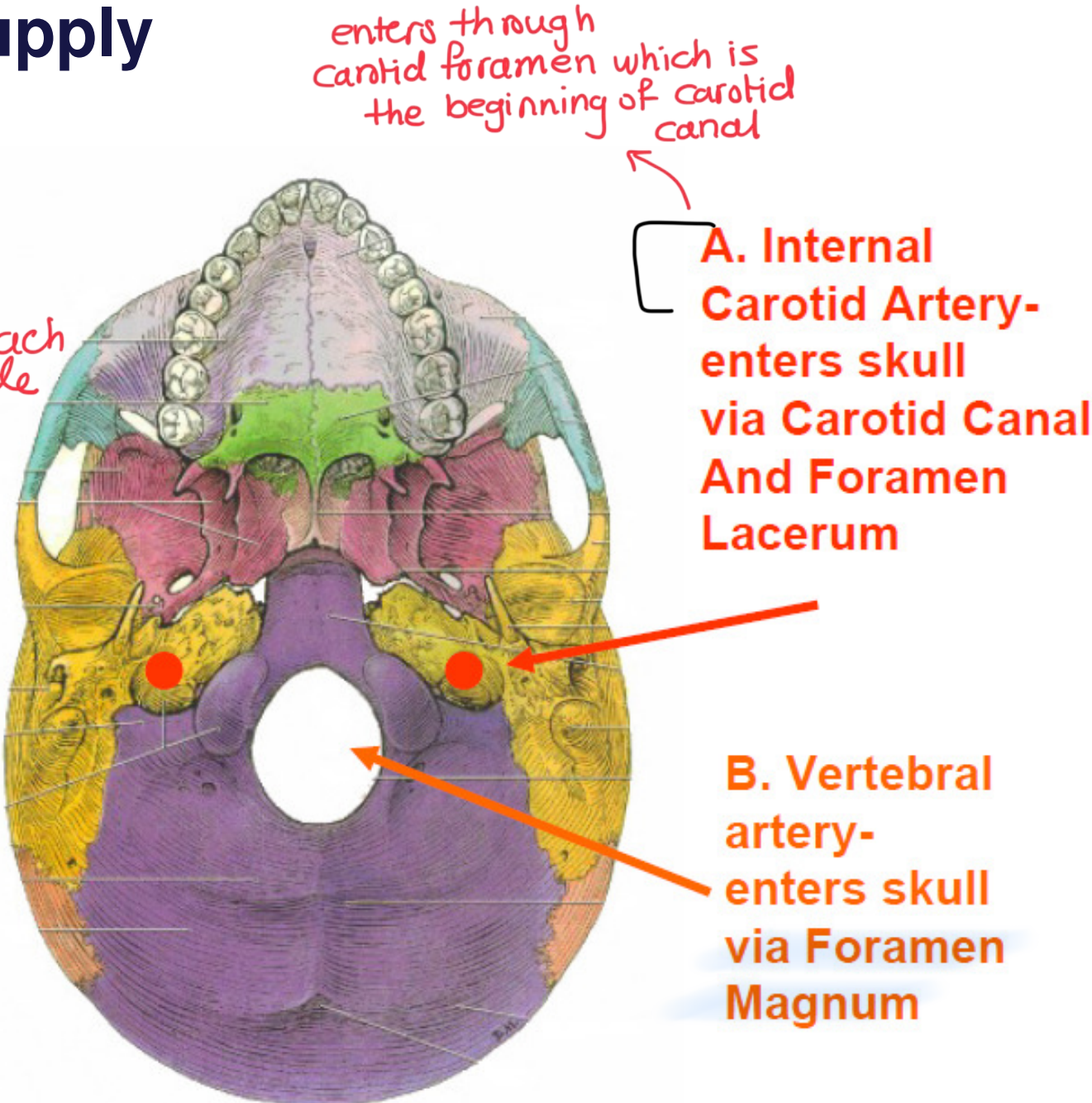
MENINGES OF BRAIN

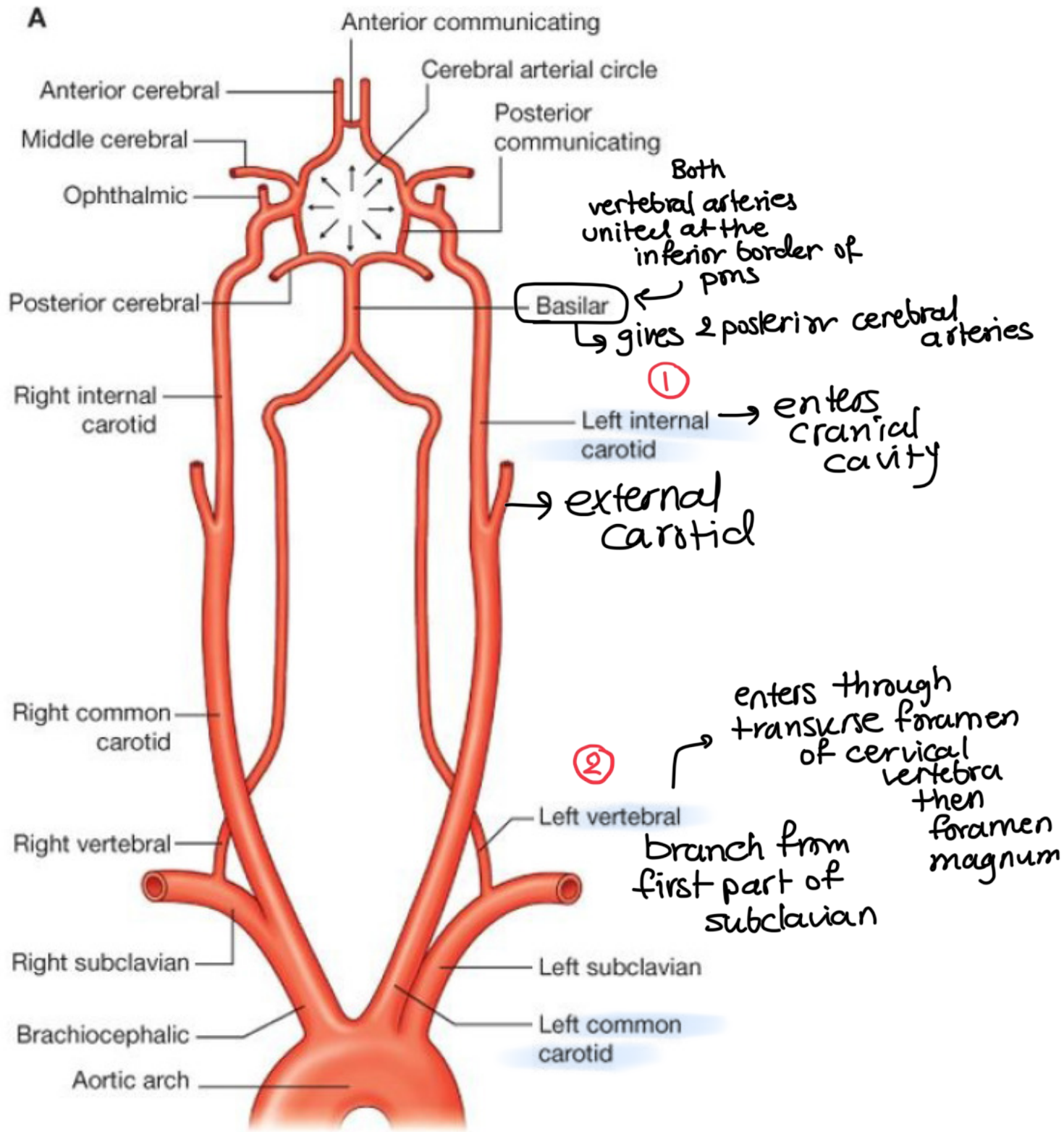
Other layers like spinal cord: **B. Arachnoid**- attached to inner side dura (potential space= Subdural Space); **C. Pia Mater**-adheres to brain; **Subarachnoid Space**- real space contains **CSF**



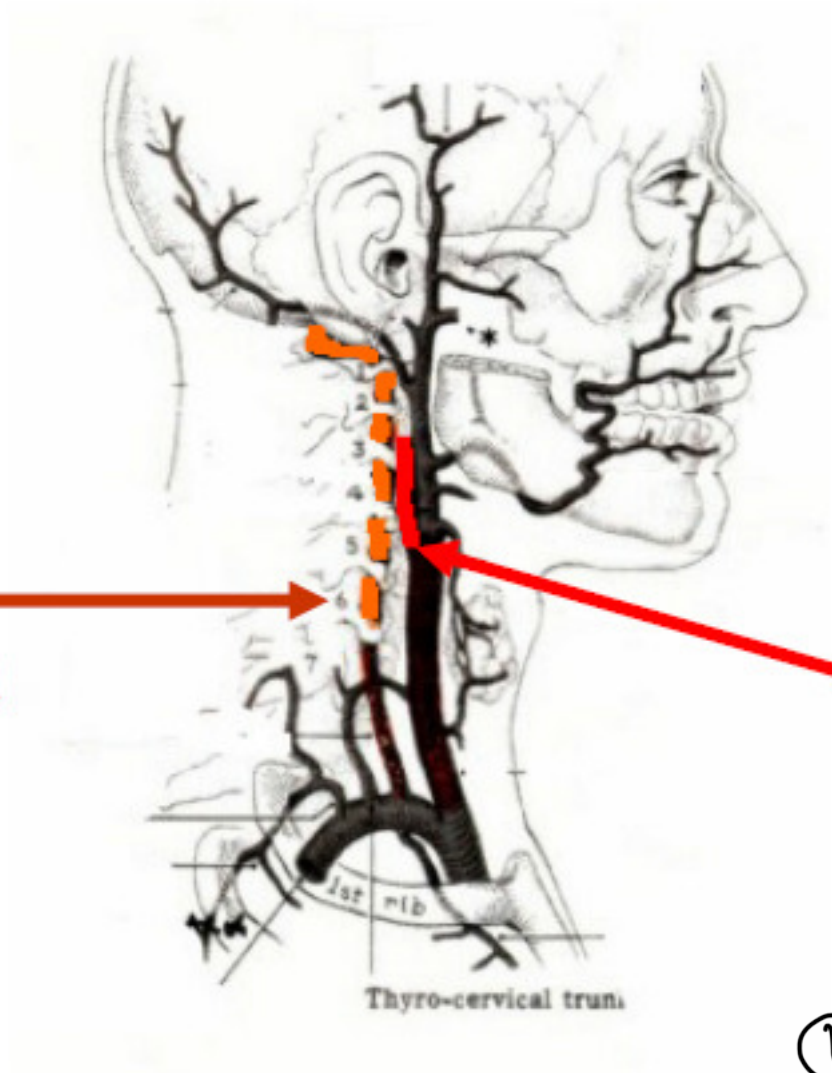
Arterial Blood Supply

- Brain is supplied by pairs of internal carotid artery and vertebral artery. *2 on each side*
- The four arteries lie within the subarachnoid space
- Their branches anastomose on the inferior surface of the brain to form the circle of Willis





**Vertebral A.
Courses
Through
Foramina
Transversaria
C1-C6**



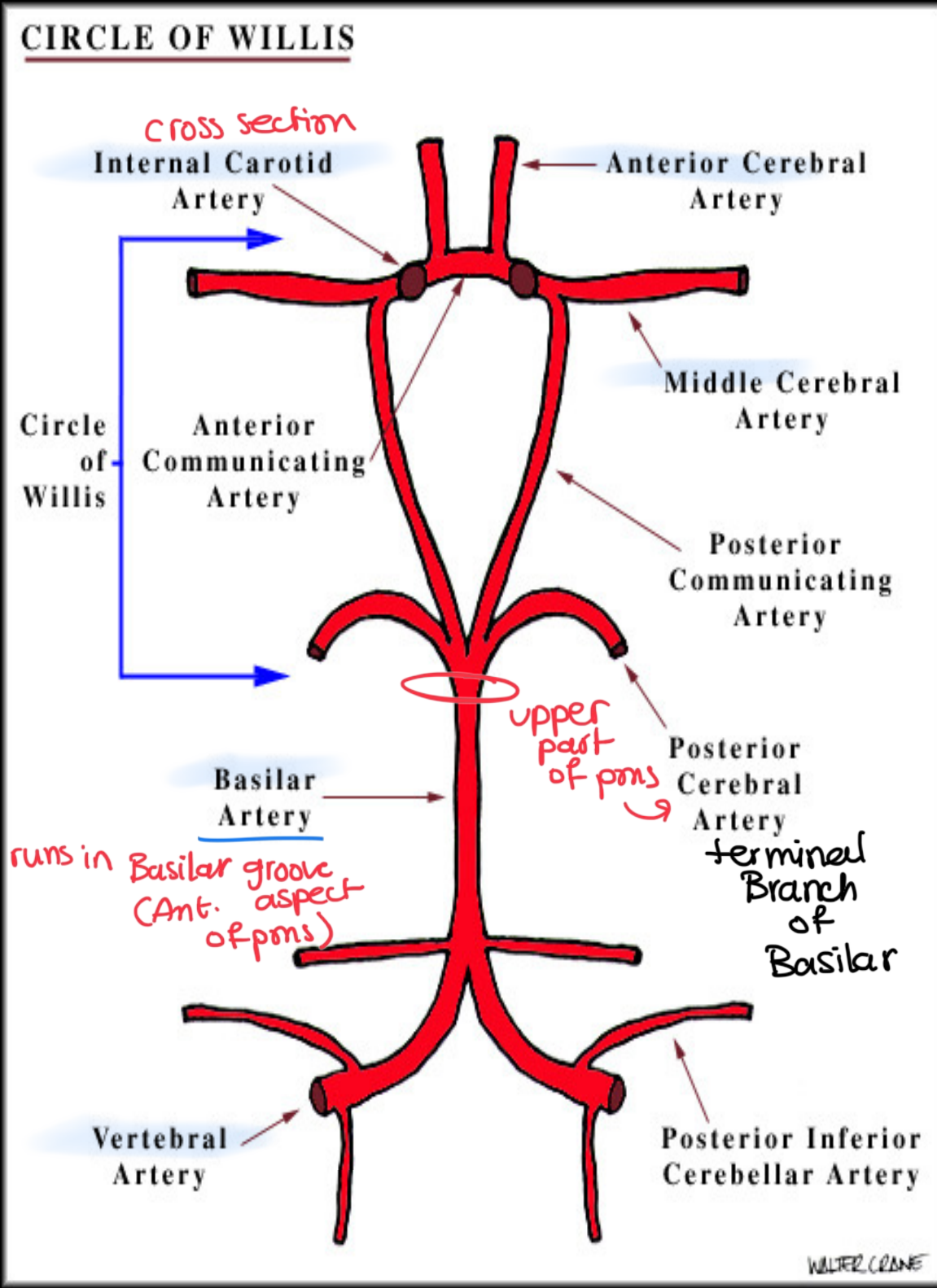
**Int. Carotid A.
Ascends
without
Branching
into Skull (via
Carotid
Canal)**

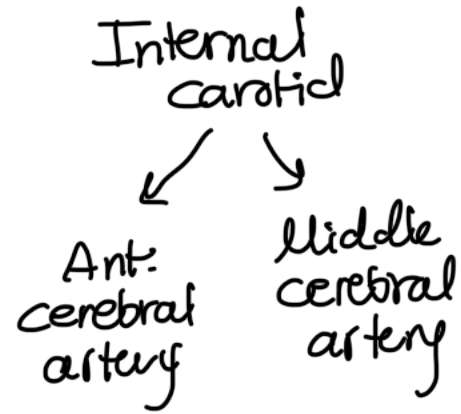
Gives 2 branches

- ① *Ant. cerebral artery*
- ② *Middle cerebral artery*

Internal Carotid Artery

- Terminal branch of common carotid artery *enters the orbital cavity through optic canal*
- Branches
 - **Ophthalmic artery**: supply eyes, paranasal sinuses and parts of the nose
 - **Posterior communicating artery**: runs backward to join the posterior cerebral artery
 - **choroidal artery**: supply choroid plexus of lateral ventricles and other areas including optic tract, lateral geniculate nucleus, etc. *roof of lateral and 3rd ventricles*
- Terminal branches:
 - **Middle cerebral artery**
 - **Anterior cerebral artery**





* for circle of willis to be formed there must be a communication between the arteries which are:

①

Ant. communicating artery between the 2 Anterior cerebral arteries

②

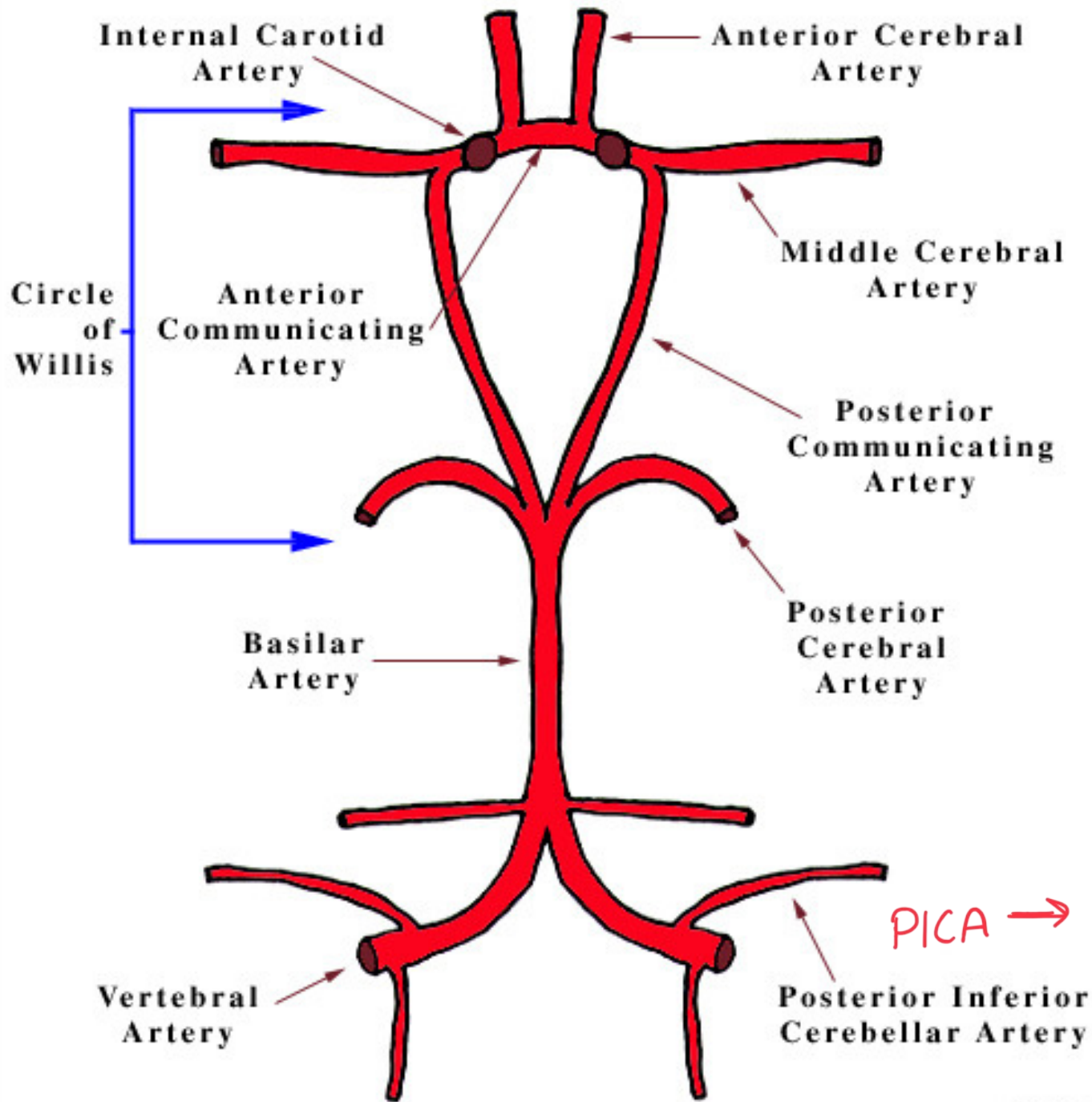
posterior communicating arteries
(starts from the internal carotid and runs posteriorly to the post. cerebral artery)

Go to slide 22 see the picture

Vertebral Artery

- Branch of first part of subclavian A
- Passes – foramen transversarium C6 – C1
- Enters through foramen magnum – perforates dura & arachnoid mater – enters subarachnoid space
- Turns upward, forward, medially – medulla oblongata
- Lower border of pons – joins opposite side to form
 - **BASILAR** artery

CIRCLE OF WILLIS



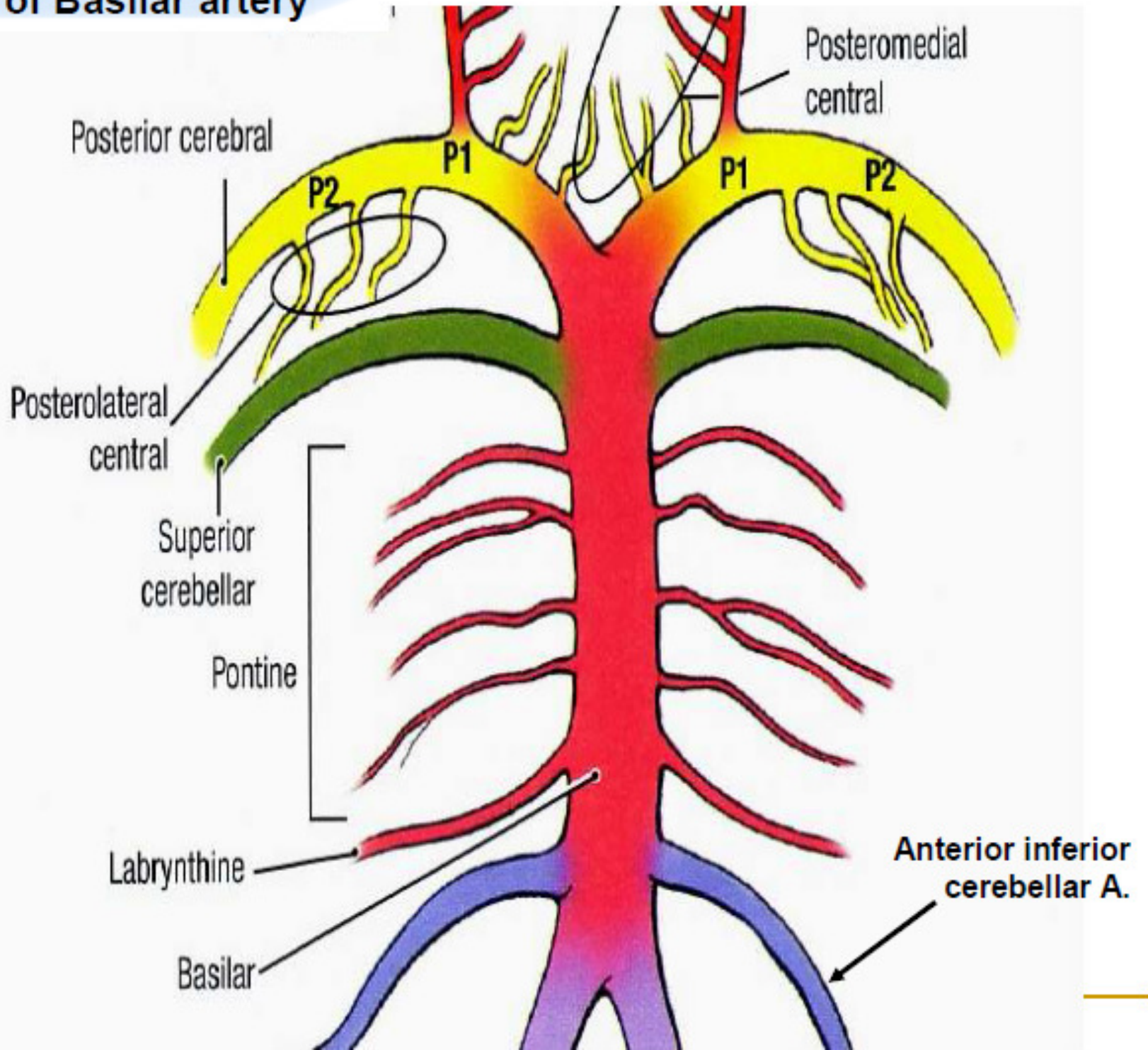
PICA →

discussed
with Blood
supply of
Brain stem
and
cerebellum

Basilar artery

- Formed by the **union** of the two vertebral arteries at the **lower border** of the **pons**
- Ascends on the front of the pons lodged in the **basilar groove**
- Ends at the **upper border** of the pons by dividing into 2 **Posterior cerebral arteries (PCA)**

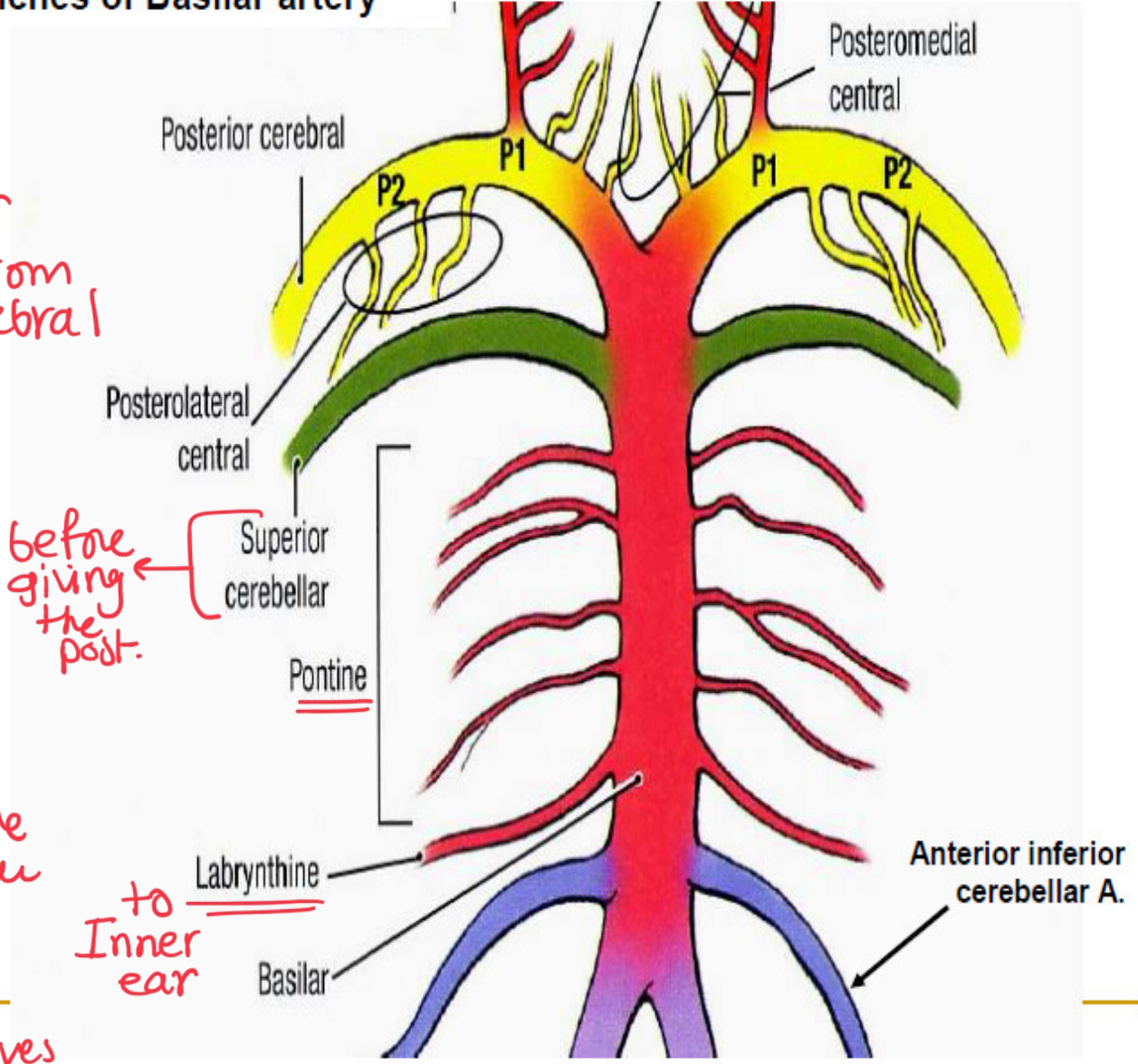
Branches of Basilar artery



Basilar artery

- Branches of basilar artery
 - anterior inferior cerebellar artery (AICA) supplies inferior surface of the cerebellum
 - labyrinthine artery supplies the membranous labyrinth of the internal ear
 - Pontine arteries supply pons
 - superior cerebellar artery supplies superior surface of cerebellum and pons

Branches of Basilar artery



remember PICA from vertebral

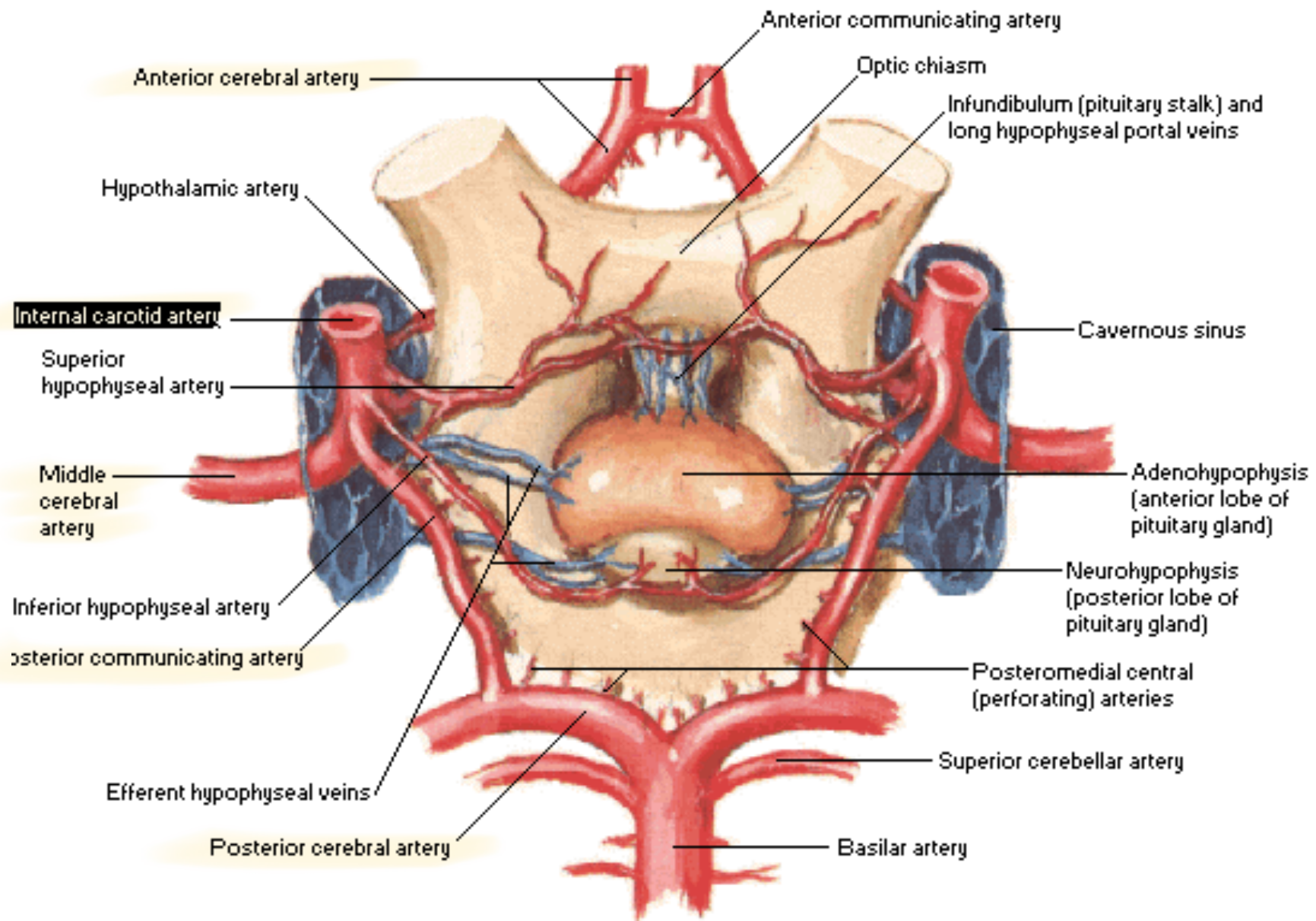
before giving the post.

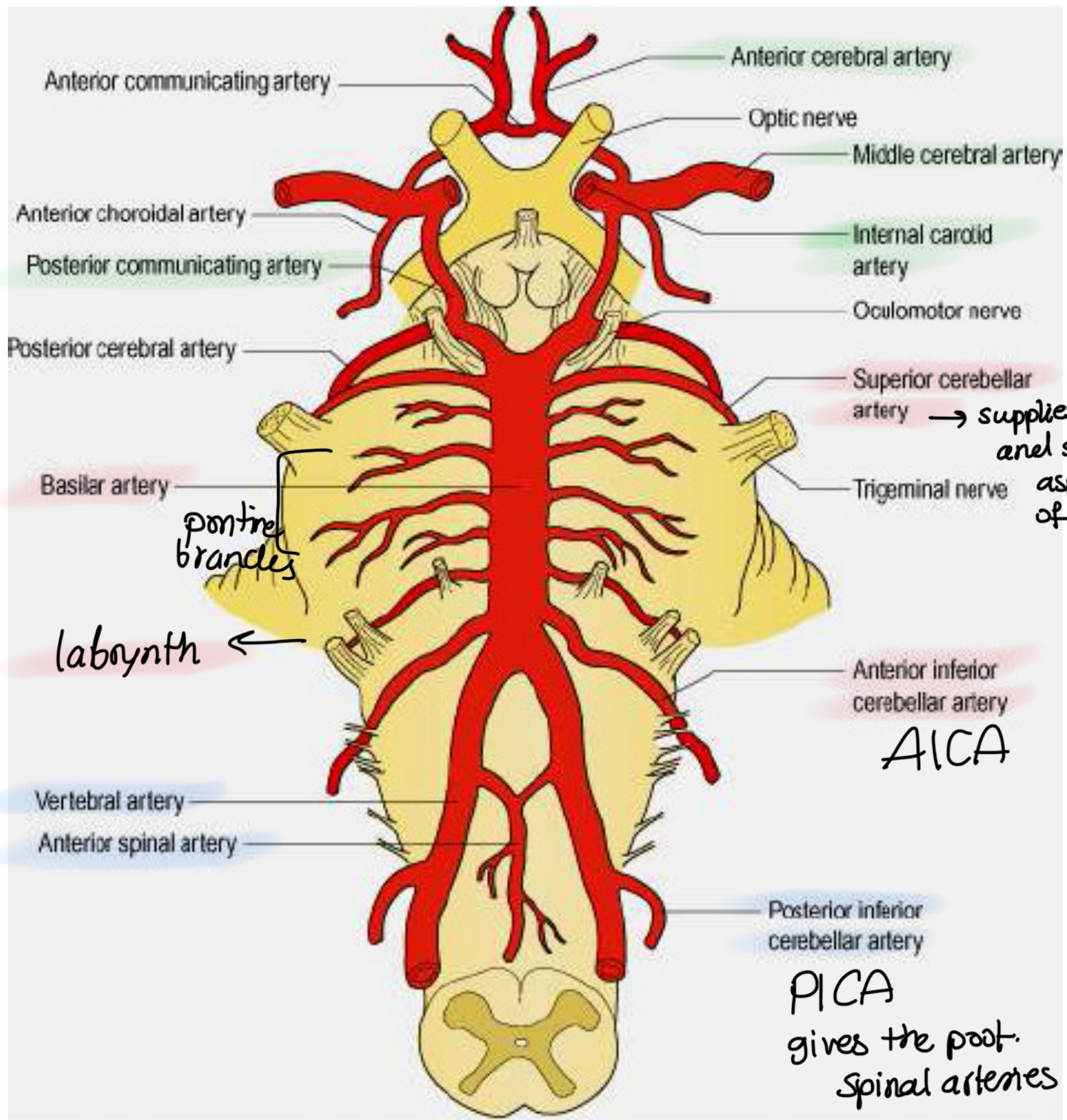
Basilar artery lies on the Ant. border of pons in Basilar groove and gives many branches

to Inner ear

Cerebral Arterial Circle [Willis] - Vessels in Situ

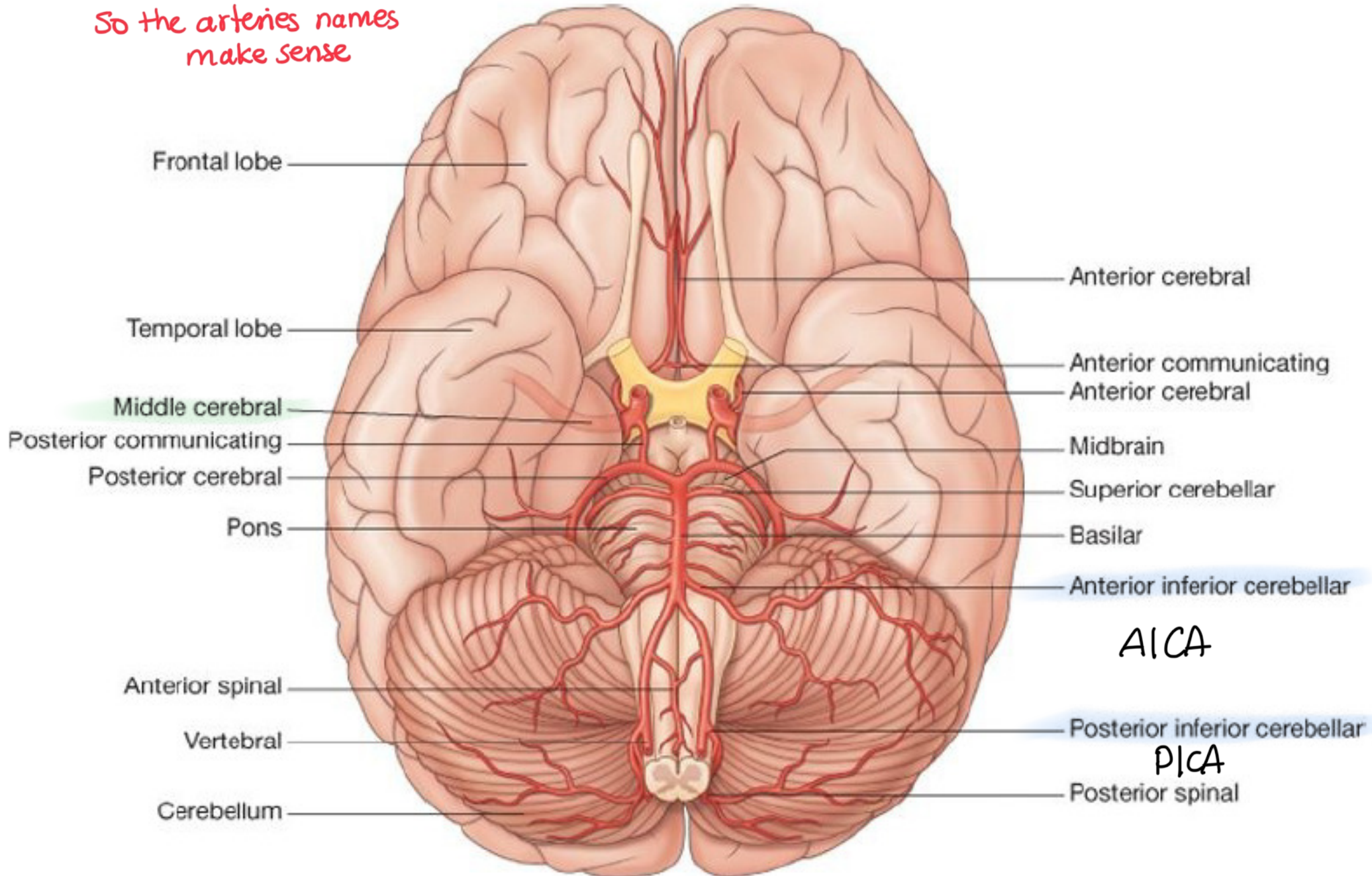
Inferior View





This picture shows the arteries in relation to cerebellum

So the arteries names make sense

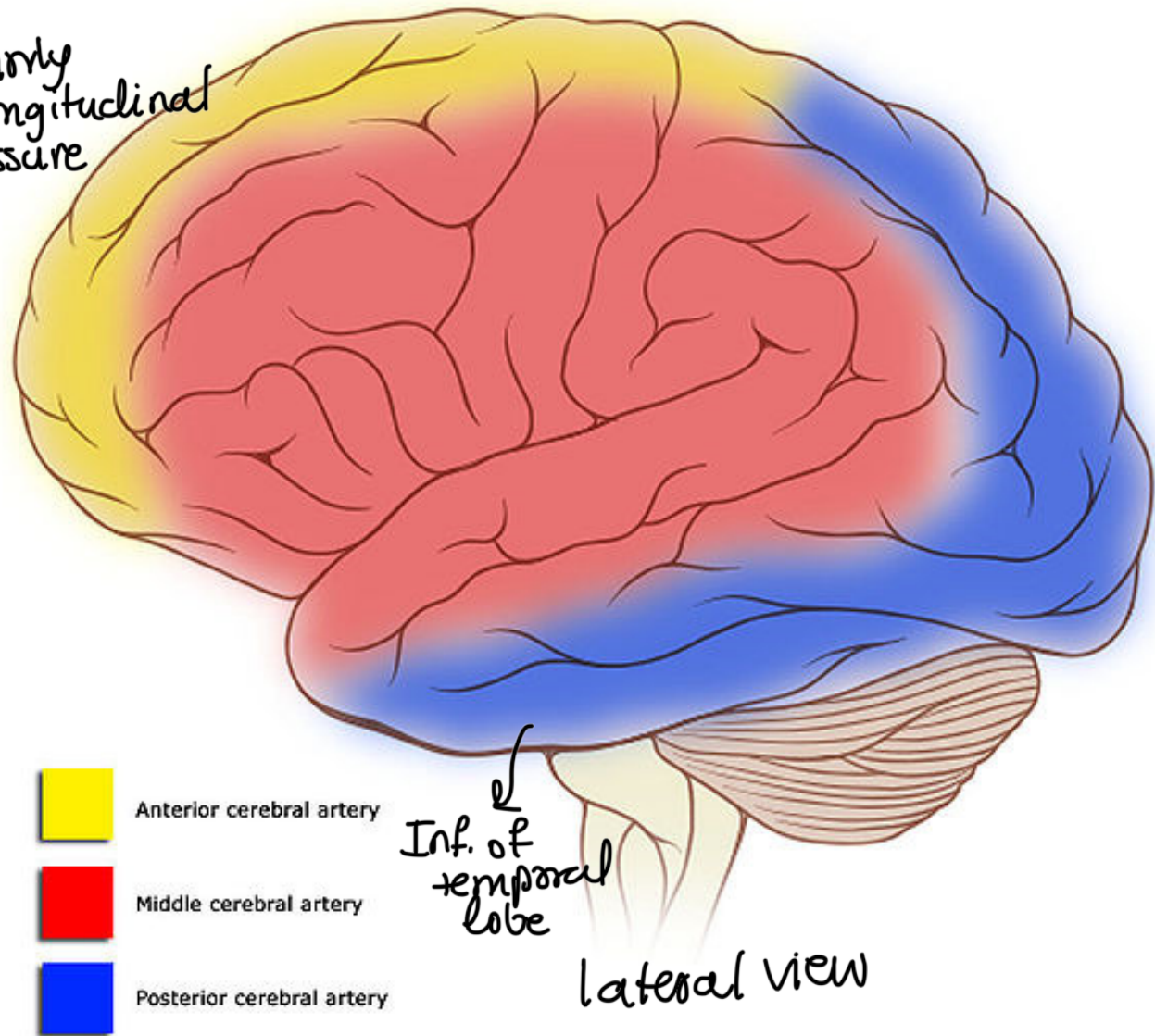





Middle Cerebral Artery

- bigger branch of the two terminal branches
- Supply the **lateral surface of the hemisphere** except for the narrow strip supplied by the ACA, the occipital lobe and the inferiorlateral surface of the hemisphere supplied by the PCA.
 - supplies all motor area except the leg area
- Occlusion of middle cerebral artery: contralateral paralysis and sensory deficits of face, arm, aphasia (language center)

superiorly near longitudinal fissure

Cortical vascular territories



	Anterior cerebral artery
	Middle cerebral artery
	Posterior cerebral artery

occlusion of middle cerebral artery

- Contralateral paralysis and sensory deficits

→ Contralateral (decussation)

of face, arm,

→ face, arm without leg or foot?

Aphasia (language center)

↓
furnel
on the lateral surface
of hemisphere

- Broca's (frontal lobe)
area

- Wernicke's area
(temporal and parietal
lobes)

Remember the homunculus

Middle cerebral artery supply areas
near the lateral fissure
which are the head and neck
(face, arm, trunk)

Anterior Cerebral Artery

passes through longitudinal fissure

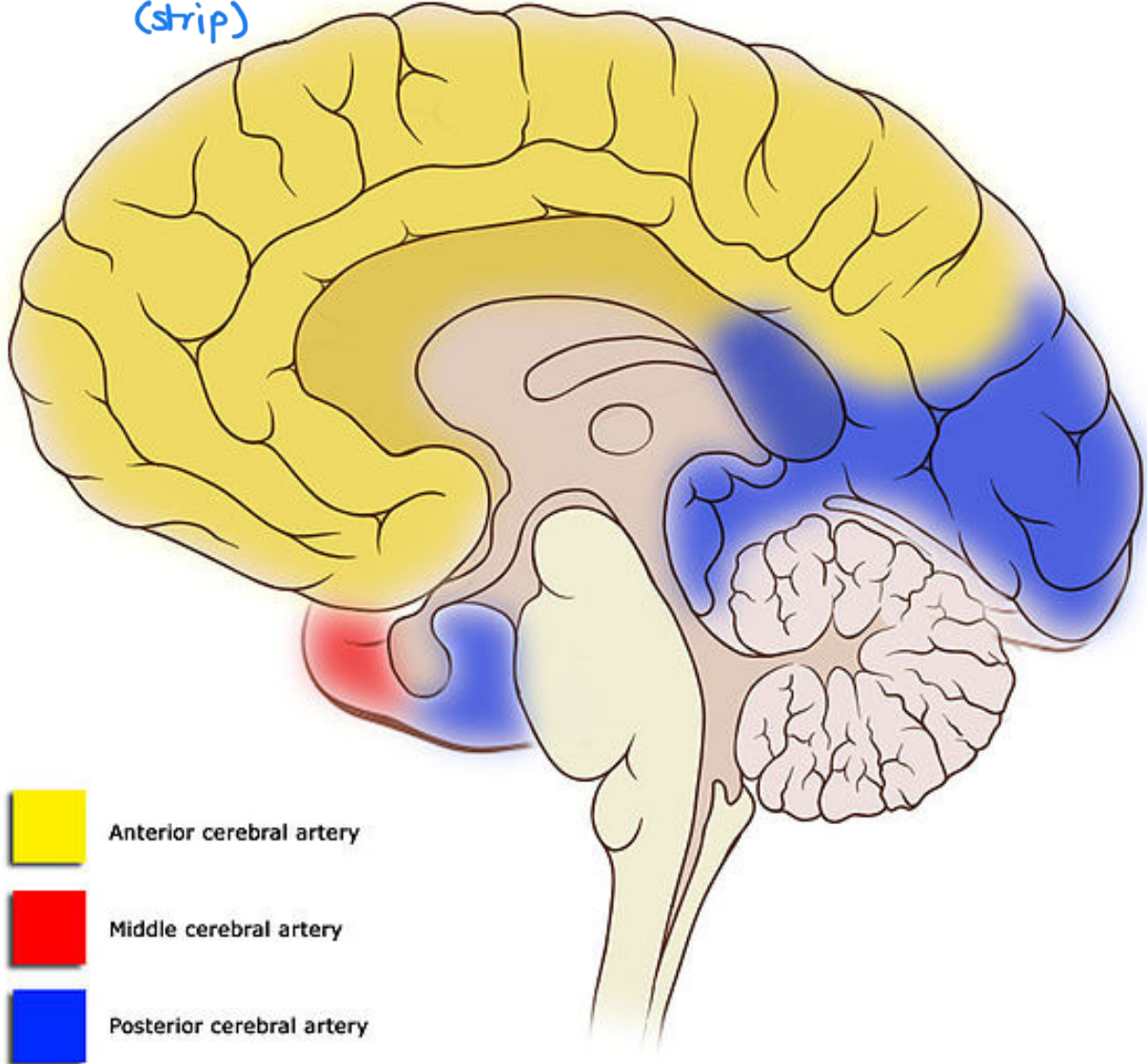
- Joined to the ACA of the opposite side by the anterior communicating artery
- Supply all the medial surface of cerebral cortex as far as the parieto-occipital sulcus
- Supply a strip of cortex (about 1 inch wide) on lateral surface
- supplies the leg area of precentral gyrus
- Occlusion of anterior cerebral artery: contralateral paralysis and sensory deficits in the leg/foot and perineum

medial surface

Medial surface + corpus callosum except the posterior area behind the parieto-occipital sulcus

+1 inch of the lateral surface (strip)

Cortical vascular territories



- Anterior cerebral artery
- Middle cerebral artery
- Posterior cerebral artery

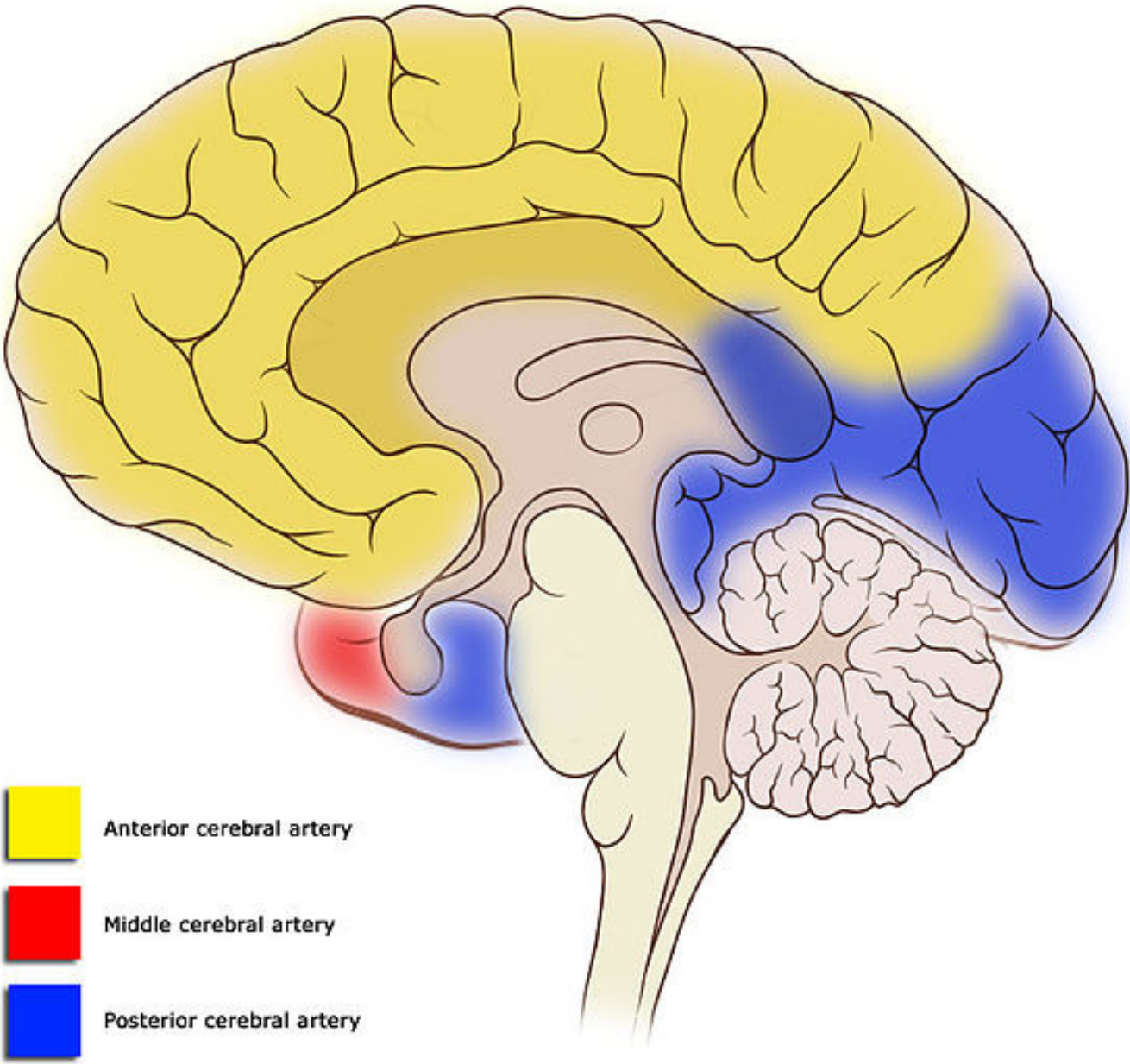
Posterior Cerebral Artery

occipital lobe + part of temporal

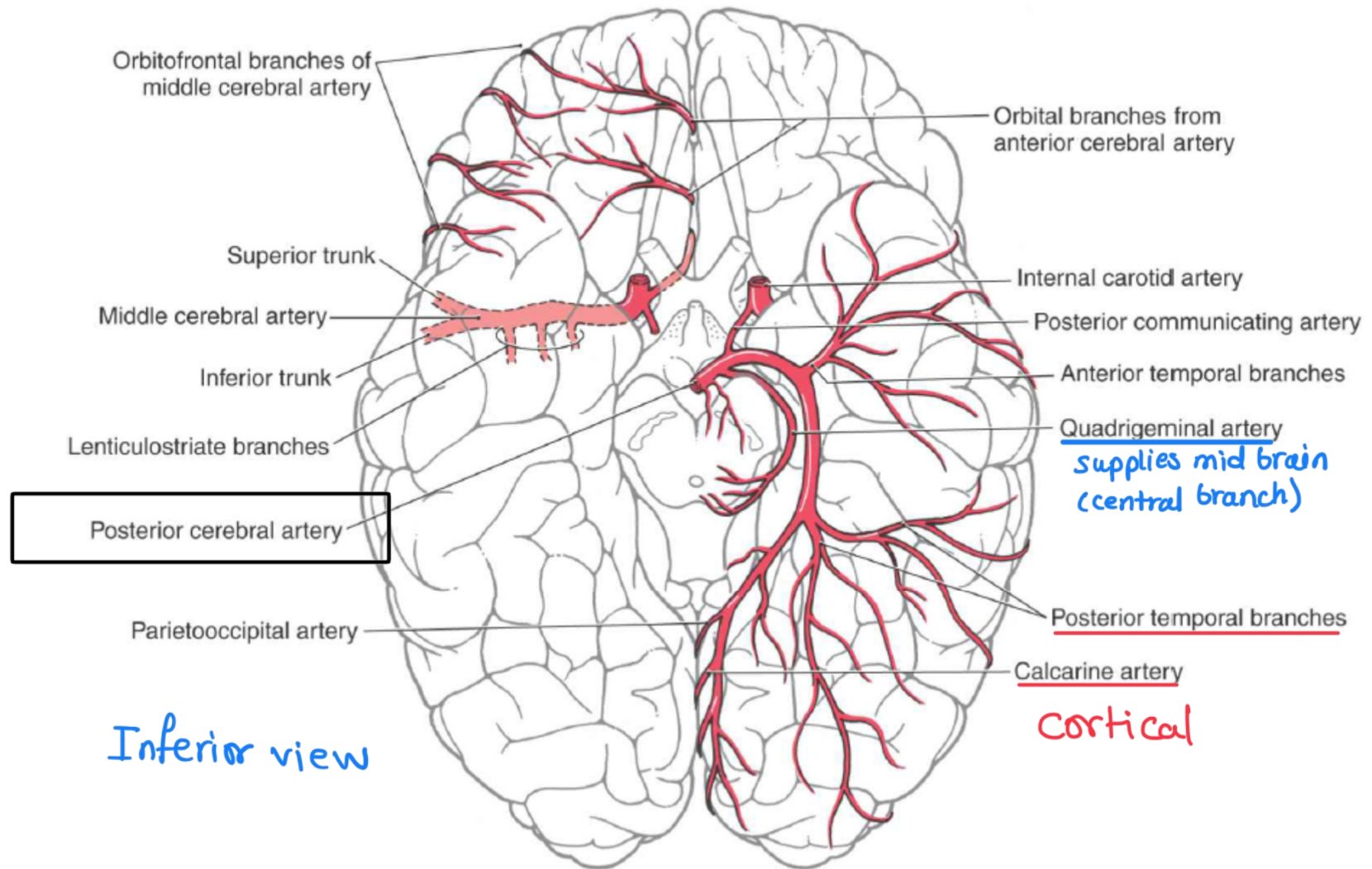
- Supplies the inferiolateral and medial surfaces of the temporal lobe and the lateral and medial surfaces of occipital lobe (visual cortex)

occlusion ⇒ visual deficits or lesion

Cortical vascular territories



Posterior Cerebral Artery



also called perforating branches

Inferior view

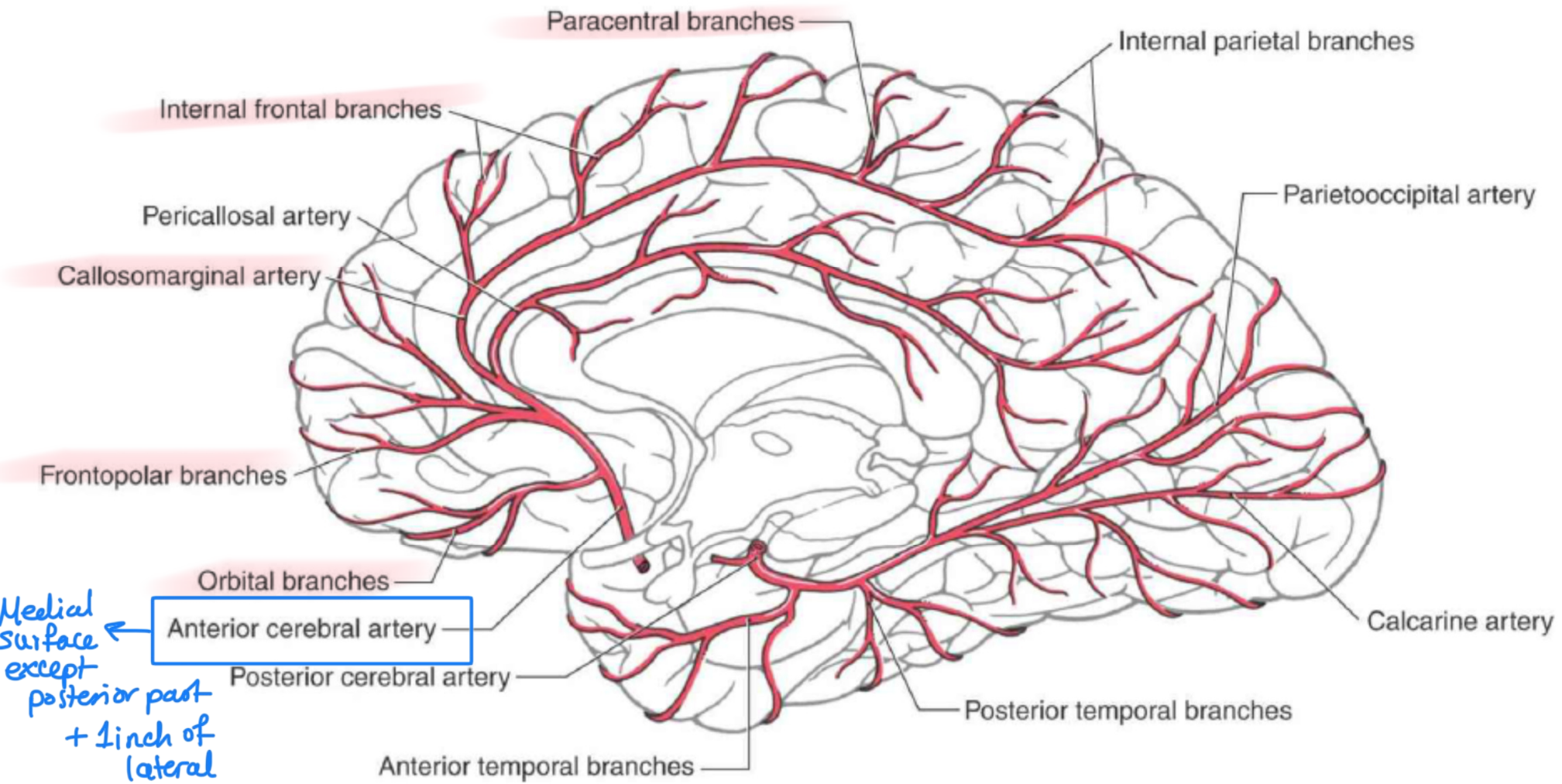
Cortical

- **Cortical branches** → *supplies cortex (inferior surface of temporal lobe)* *basal nuclei*
- **Central branches:** parts of the thalamus and the lentiform nucleus as well as the midbrain, the pineal, and the medial geniculate bodies.
- **Choroidal branch:** enters the inferior horn of the lateral ventricle and supplies the choroid plexus; it also supplies the choroid plexus of the third ventricle.

found in temporal lobe

Anterior Cerebral Artery

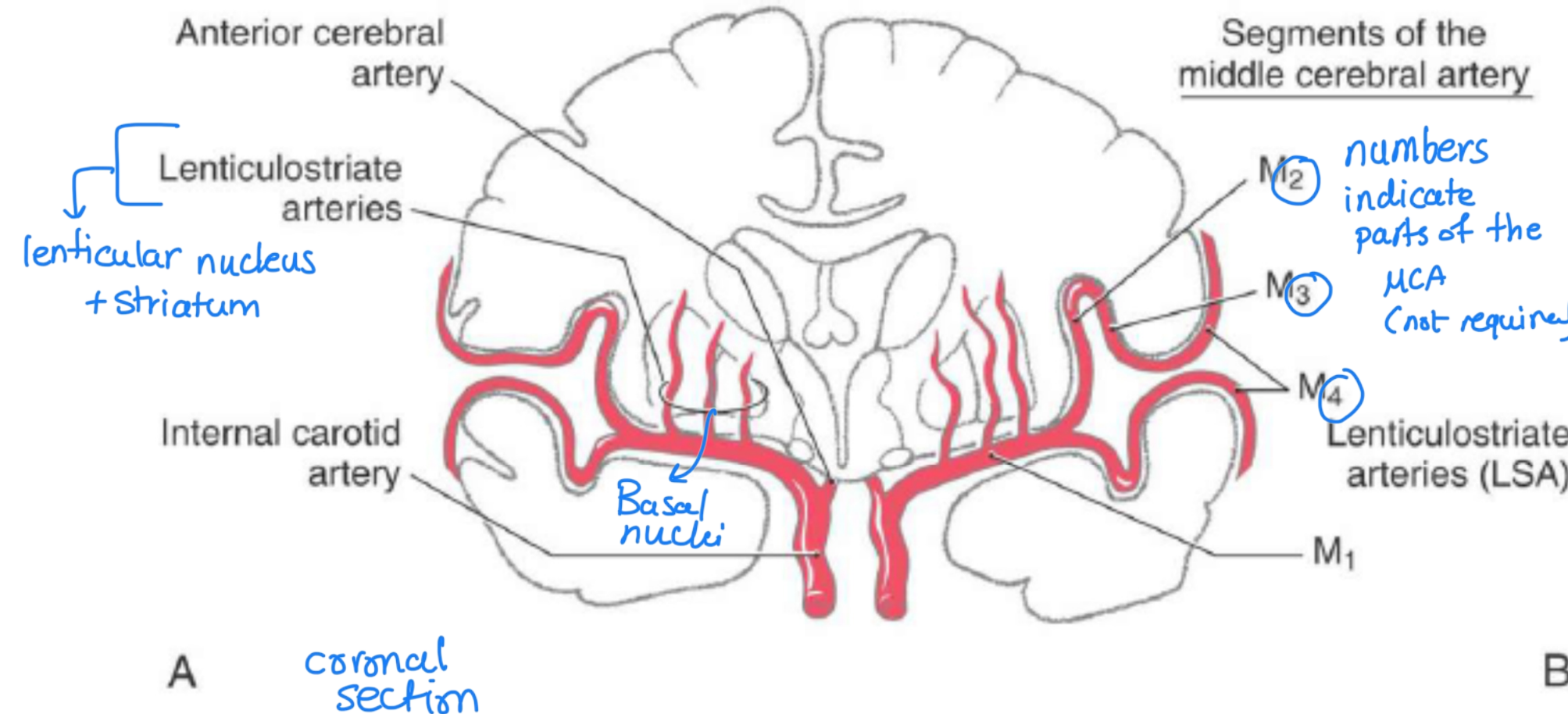
- **Cortical branches**
- **Central branches:** supply parts of the lentiform and caudate nuclei and the internal capsule.



Middle Cerebral Artery

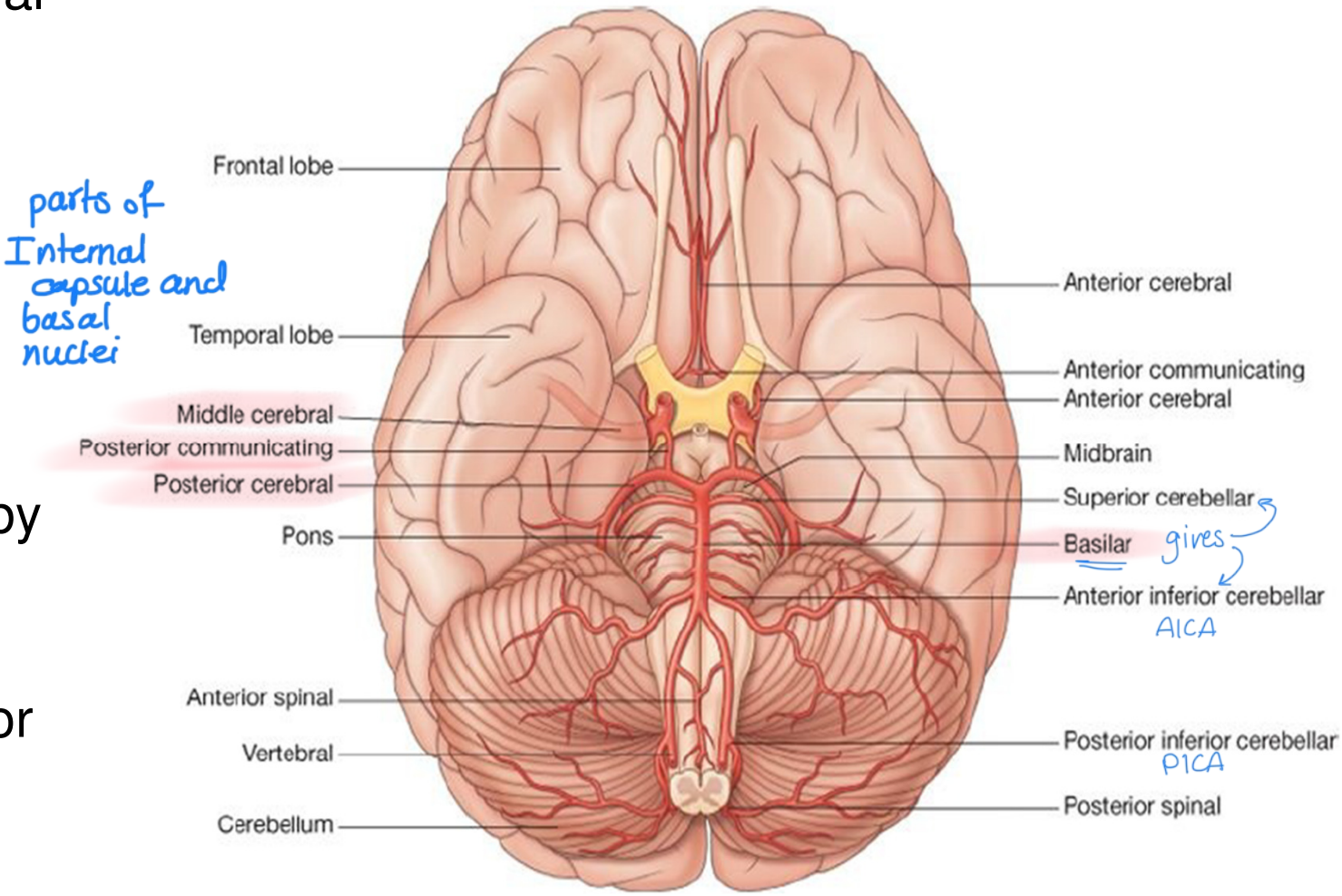
*lateral surface
except 1 inch supplied by
ACA*

- **Cortical branches**
- **Central branches:** supply the lentiform and caudate nuclei and the internal capsule.

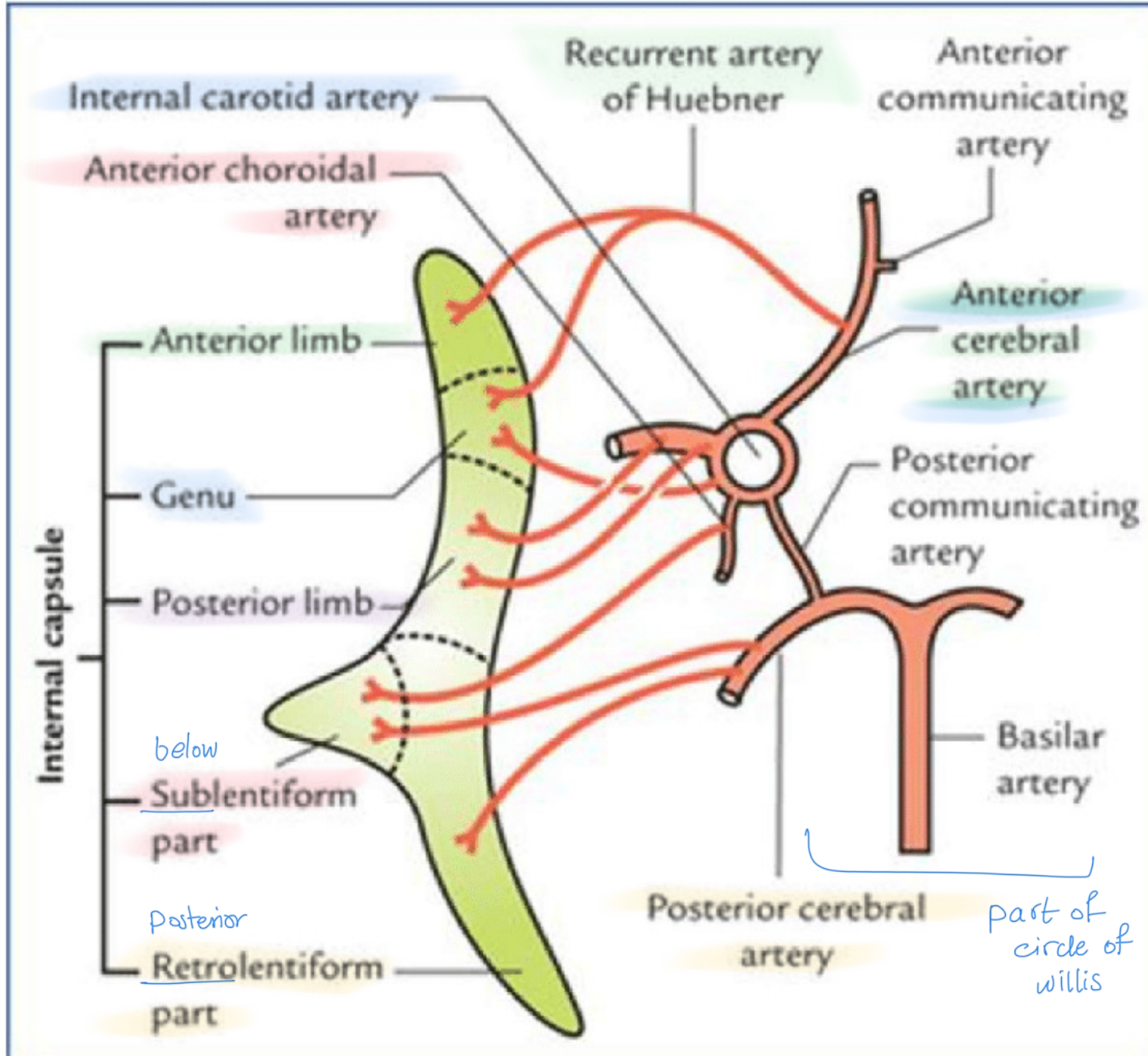


Arteries to Specific Brain Areas

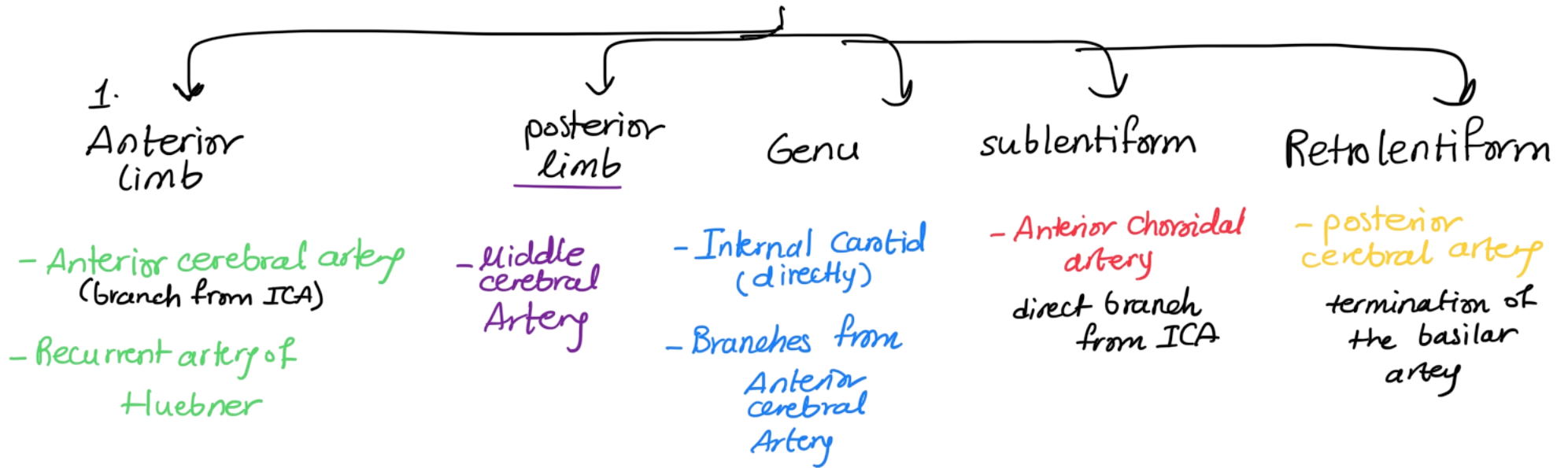
- Corpus striatum and the internal capsule:** mainly by the medial and lateral striate central branches of the **middle cerebral artery**; the central branches of the anterior cerebral artery supply the remainder of these structures.
- Thalamus:** mainly by branches of the posterior communicating, basilar, and posterior cerebral arteries.
- Cerebellum:** superior cerebellar, anterior inferior cerebellar, and posterior inferior cerebellar arteries



Blood supply of the internal capsule



Internal Capsule



Veinous drainage of the brain

Brain is the highest point of the body (Gravity is enough) no need for valves

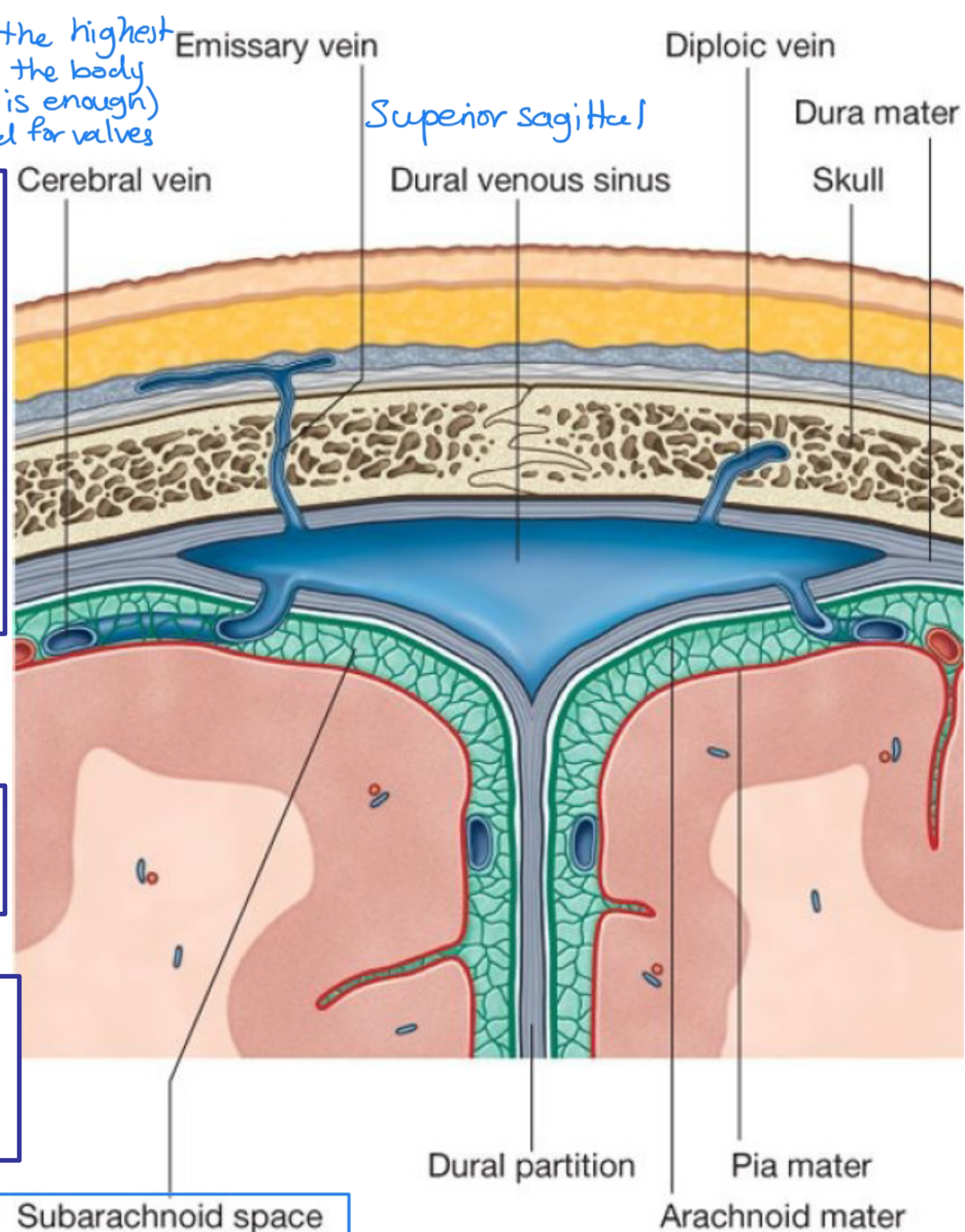
- Veins of the brain have no muscular tissue in their wall
- No valves
- Lie in subarachnoid space
- Pierce the arachnoid mater and the meningeal layer of the dura and drain into the cranial venous sinuses

❖ Veins of the brain

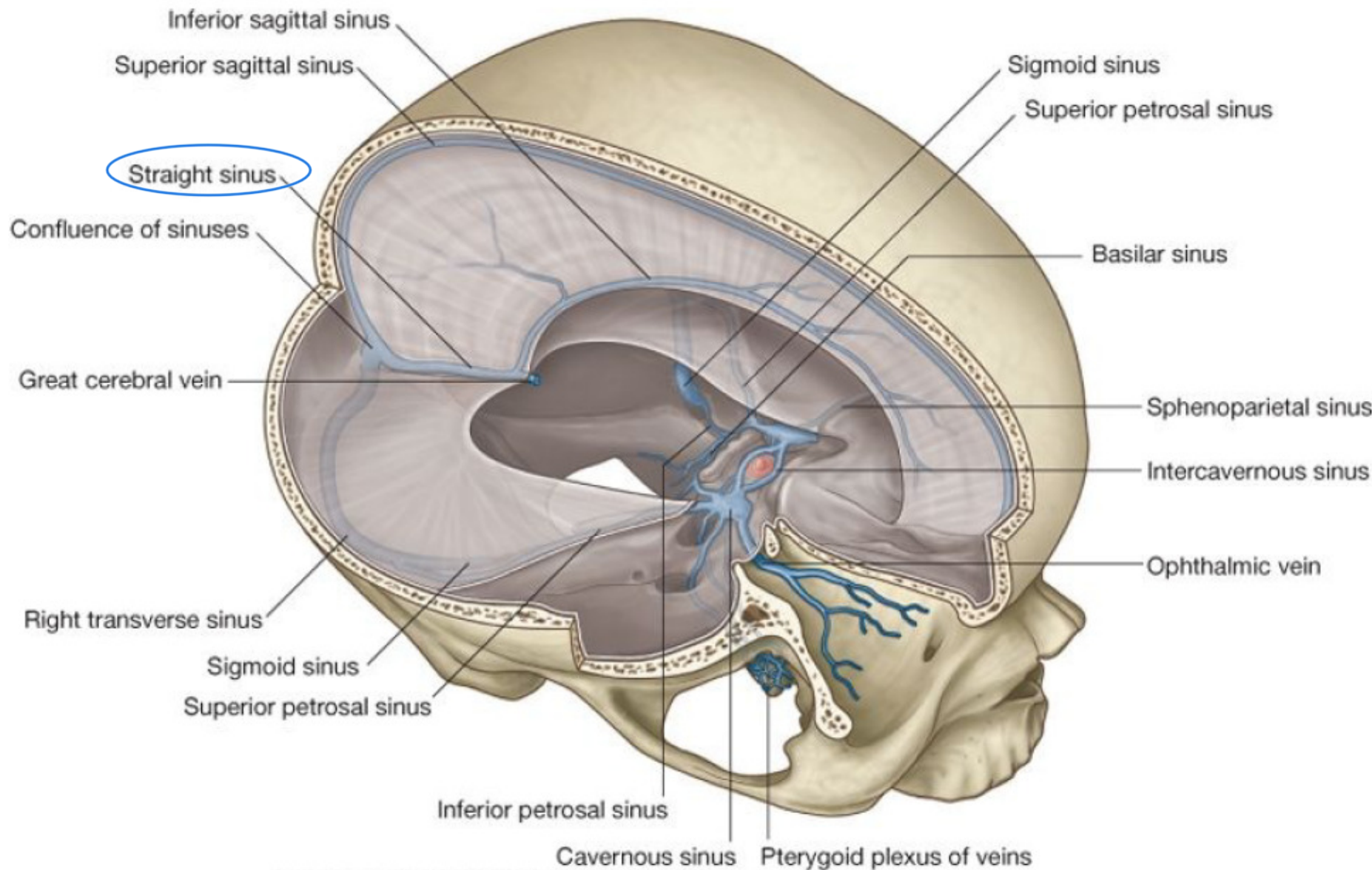
- **Superficial:** composed of dural venous sinuses

- **Deep:** traditional veins inside the deep structures of the brain

small veins that unite to form bigger veins (tributaries) then pass outside to reach

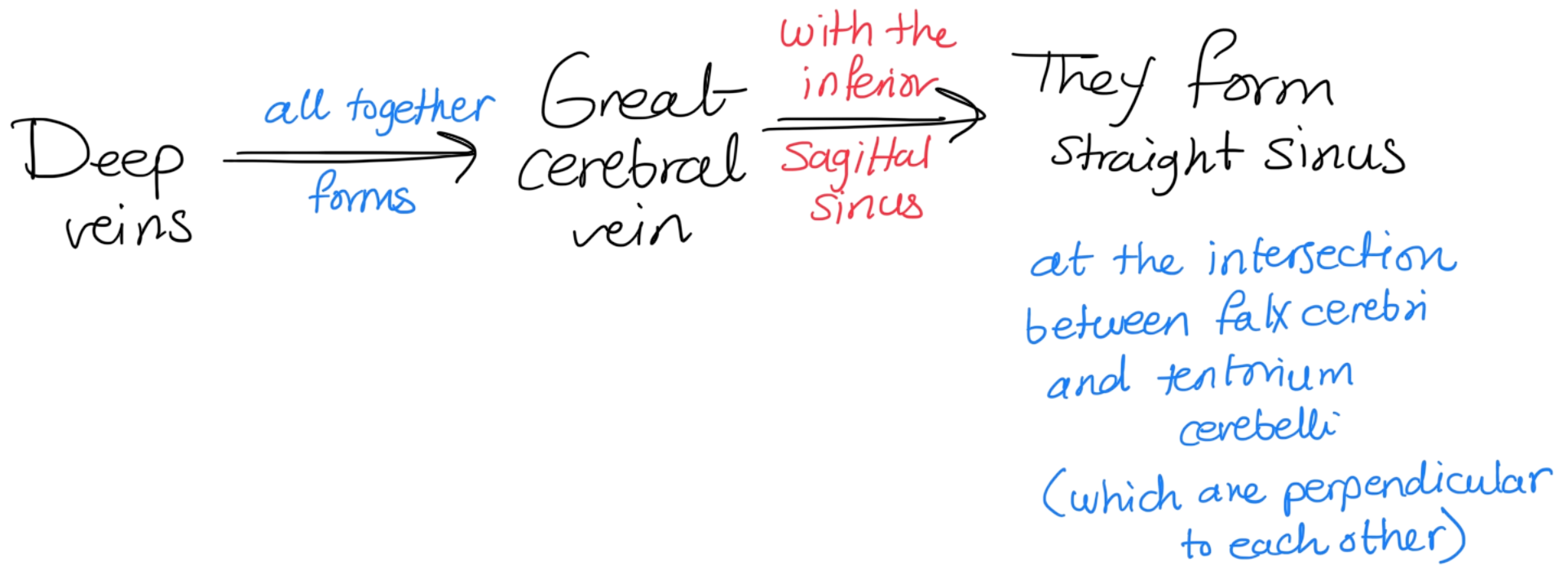


Subarachnoid space



The **deep** venous drainage is primarily composed of traditional veins inside the deep structures of the brain, which join behind the midbrain to form the vein of Galen (**great cerebral vein**). This vein merges with the inferior sagittal sinus to form the straight sinus which then joins the superficial venous system at the confluence of sinuses

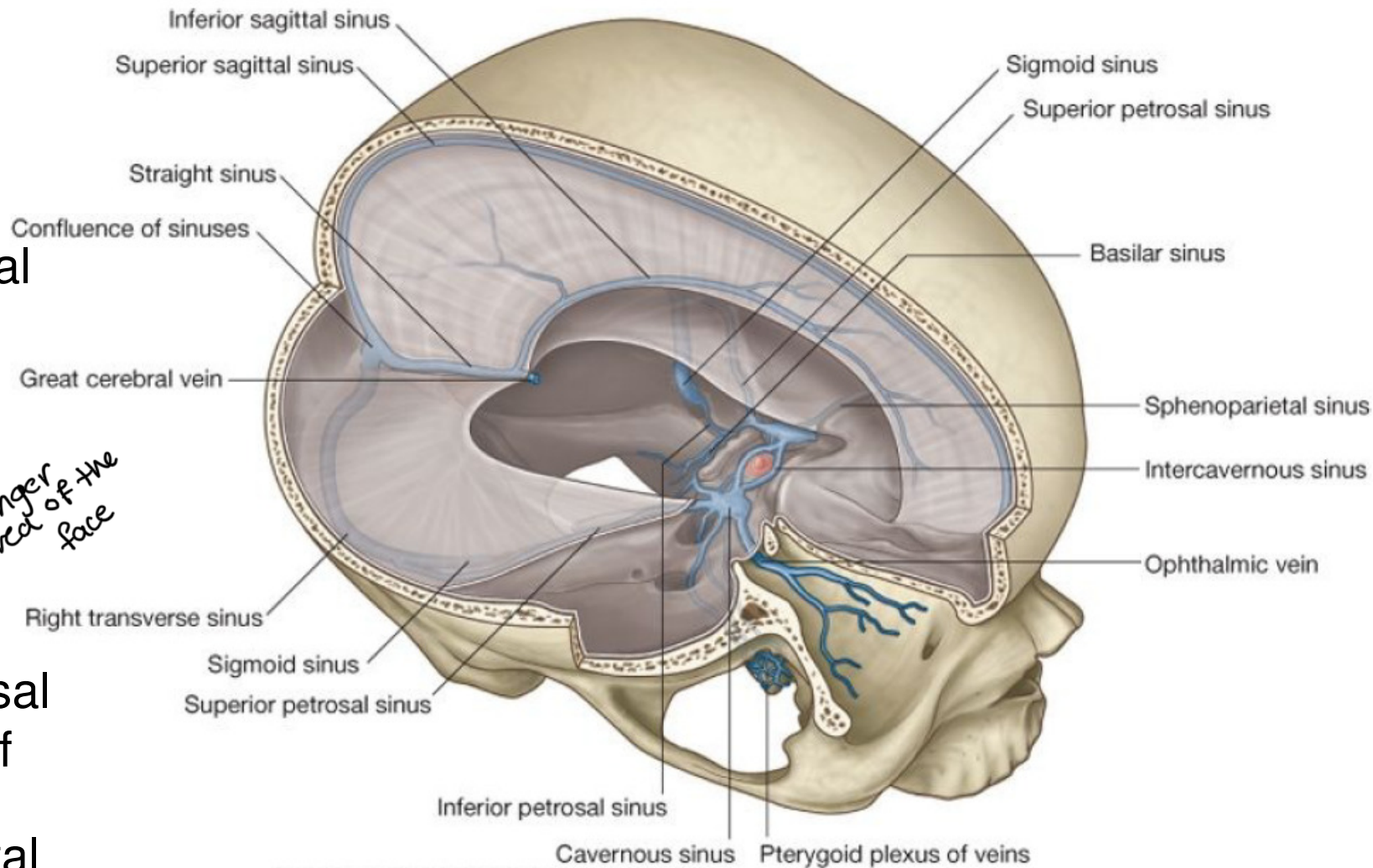
inferior end of
falx cerebri



Dural venous sinuses

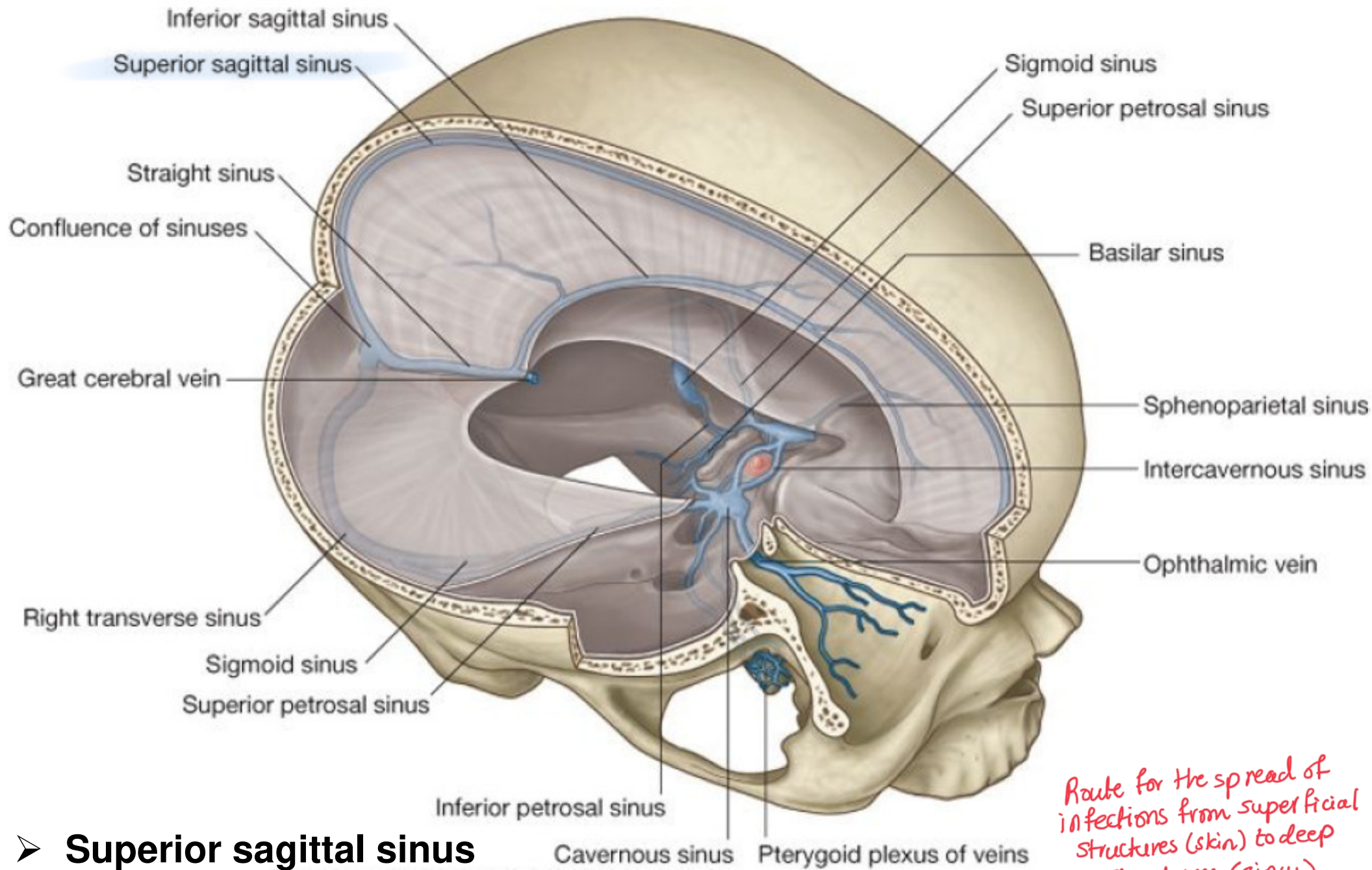
- 1) Superior sagittal
- 2) Inferior sagittal
- 3) Straight
- 4) Transverse
- 5) Sigmoid
- 6) Occipital sinuses
- 7) Cavernous
- 8) Superior and Inferior petrosal
- 9) Confluence of sinuses
- 10) Sphenoparietal
- 11) Basilar sinus

danger area of the face



- ❖ Endothelial-lined spaces
- ❖ **Location:** between the outer periosteal and the inner meningeal layers of the dura mater
- ❖ **Empty into:** internal jugular veins.

extension of sigmoid sinus



Route for the spread of infections from superficial structures (skin) to deep structures (sinus) which is very dangerous sometimes

valveless

from superficial structures

reabsorbed by arachnoid microvilli

➤ **Superior sagittal sinus**

- **Location:** Superior border of falx cerebri
- **Receives from:** Superior cerebral, diploic, and emissary veins and CSF

from bone



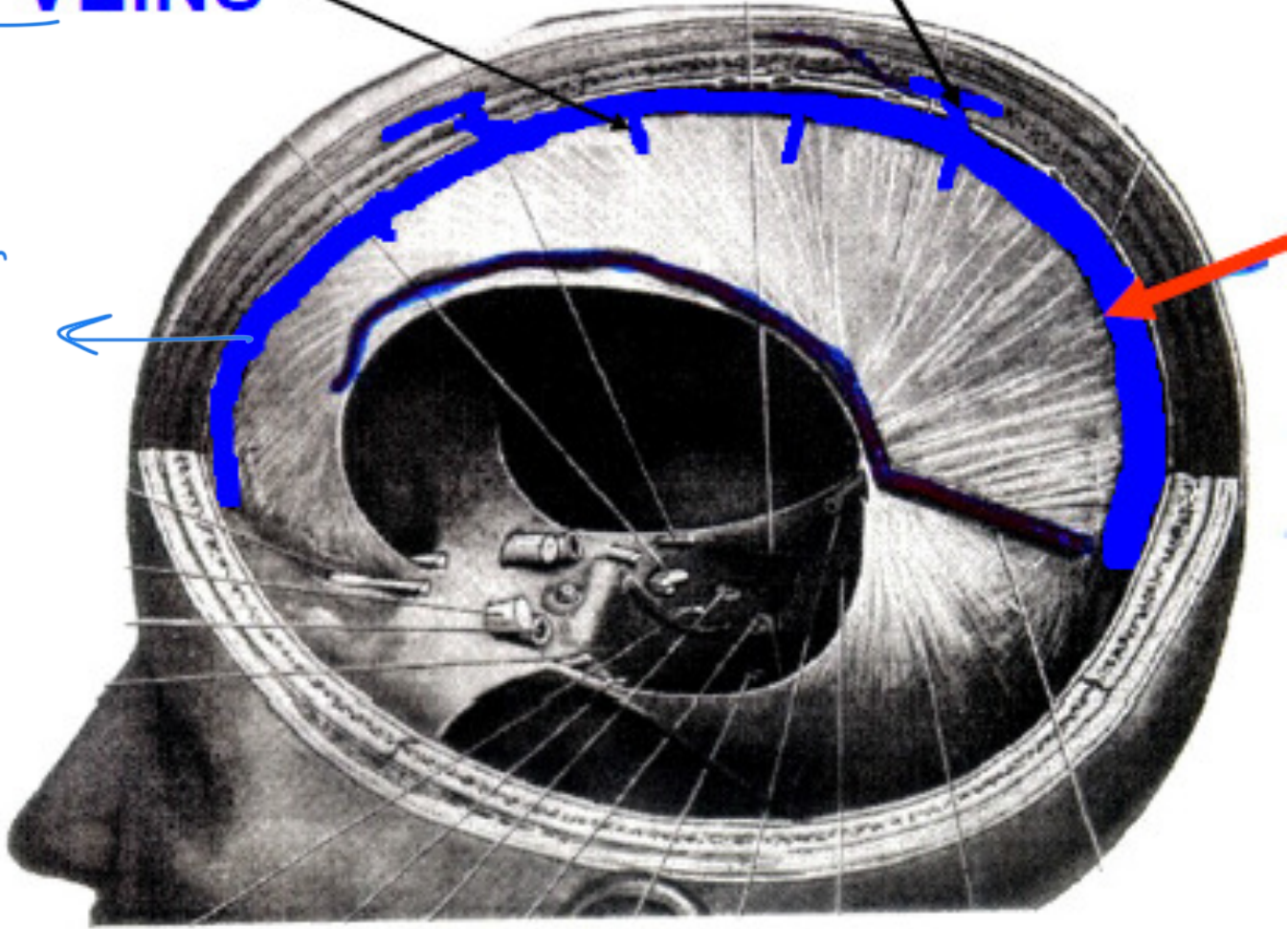
from outer surface of the brain
(superior cerebral veins)
to superior sagittal sinus

EMISSARY VEINS

'BRIDGING' VEINS



Superior
Sagittal
Sinus



Brain removed

Brain not removed

DURA
REFLECTED

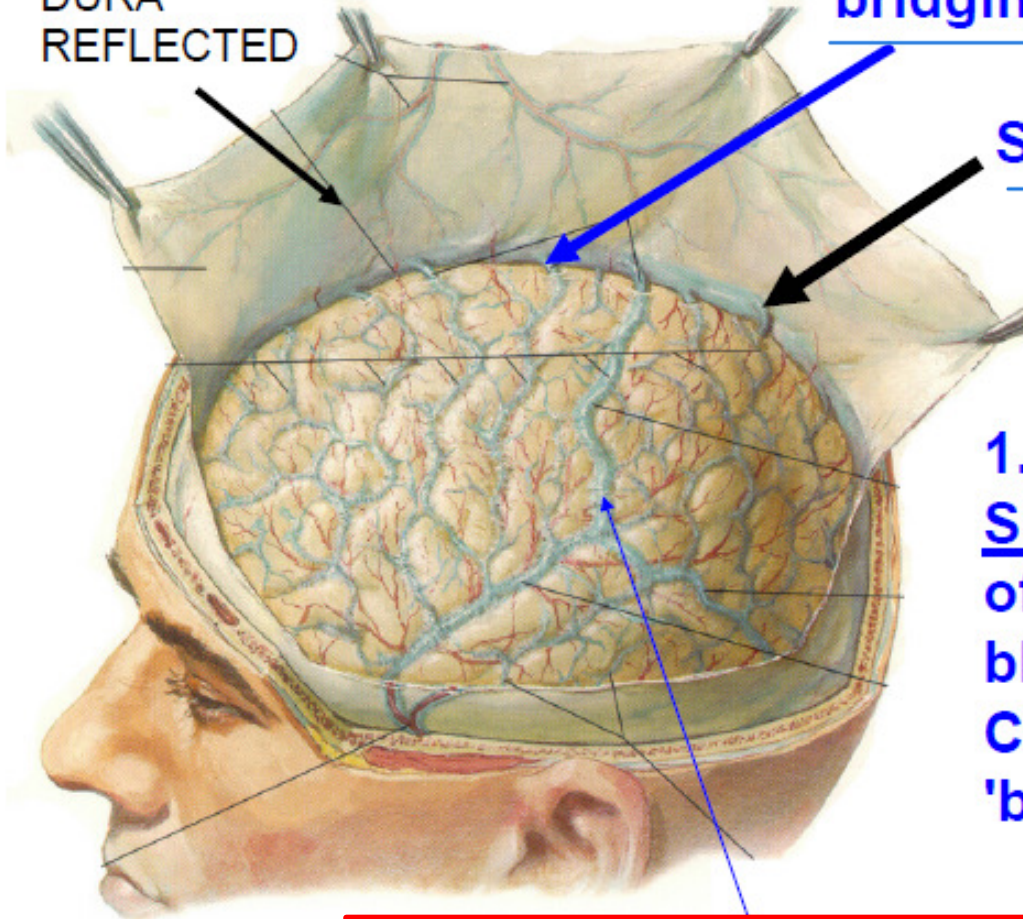
'bridging veins'

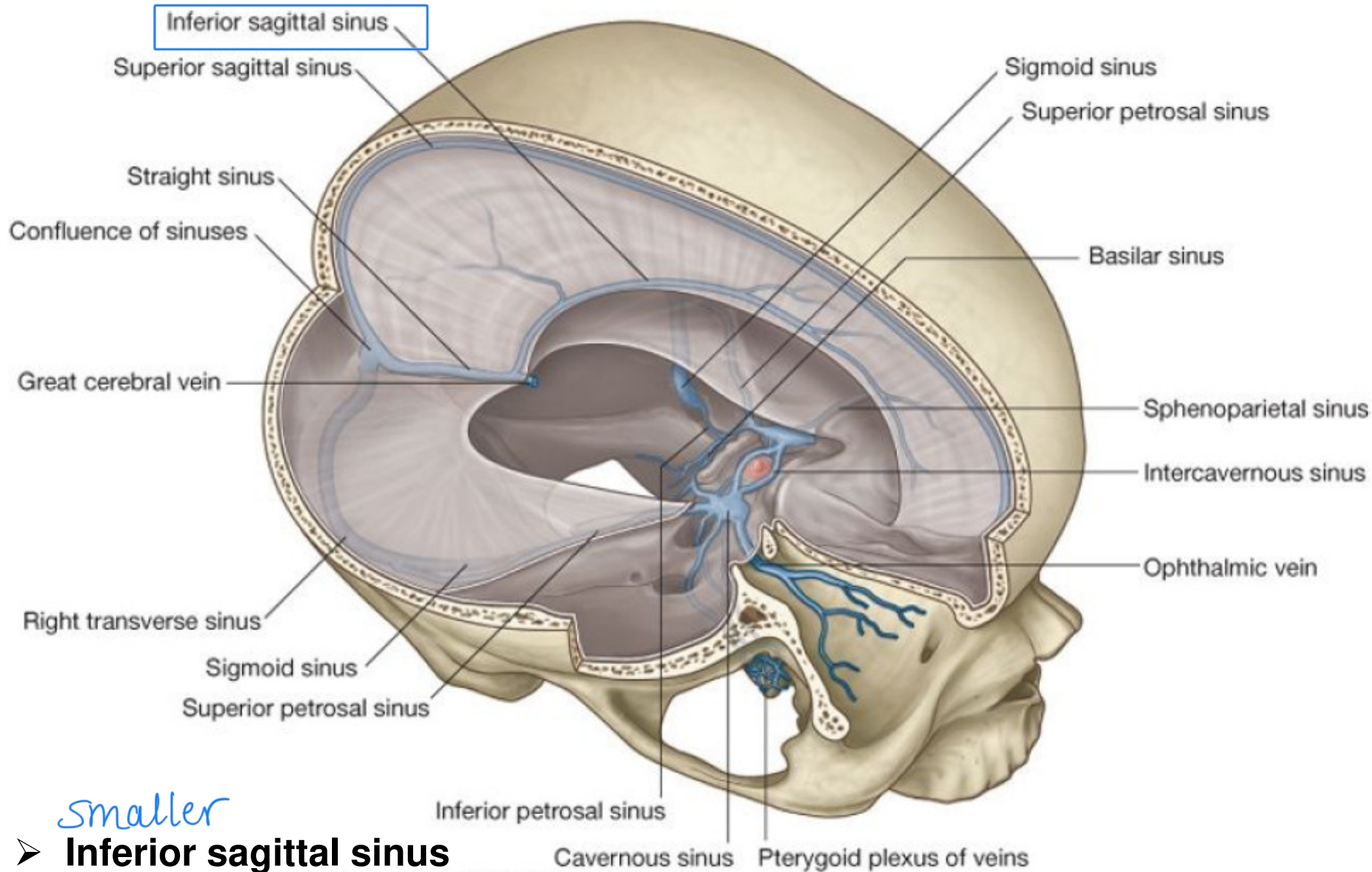
Superior Sagittal Sinus

*inside the dura
receives blood from bridging
veins*

1. Superior Sagittal Sinus – in upper border of falx cerebri; receives blood from Superior Cerebral veins through 'bridging veins'

Superior Cerebral veins





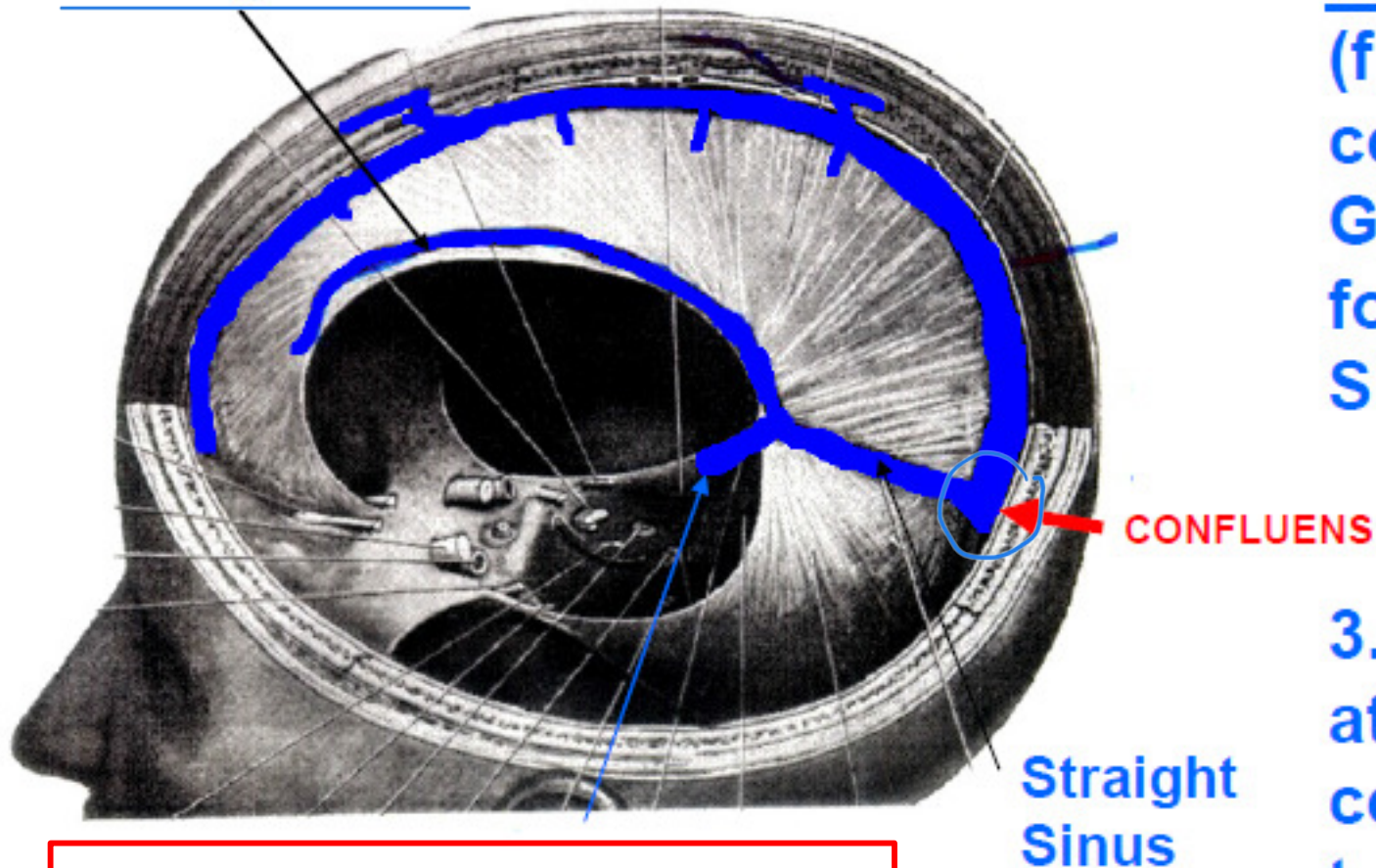
smaller

➤ Inferior sagittal sinus

- **Location:** Inferior margin of falx Cerebri
- **Receives from:** few cerebral veins and veins from the falx cerebri

VENOUS SINUSES

Inf. Sagittal Sinus



2. Inferior Sagittal Sinus - in lower (free) border of falx cerebri; - joins Great Cerebral V. form Straight Sinus

3. Straight sinus - at junction of falx cerebri and tentorium

Great Cerebral Vein (of Galen)

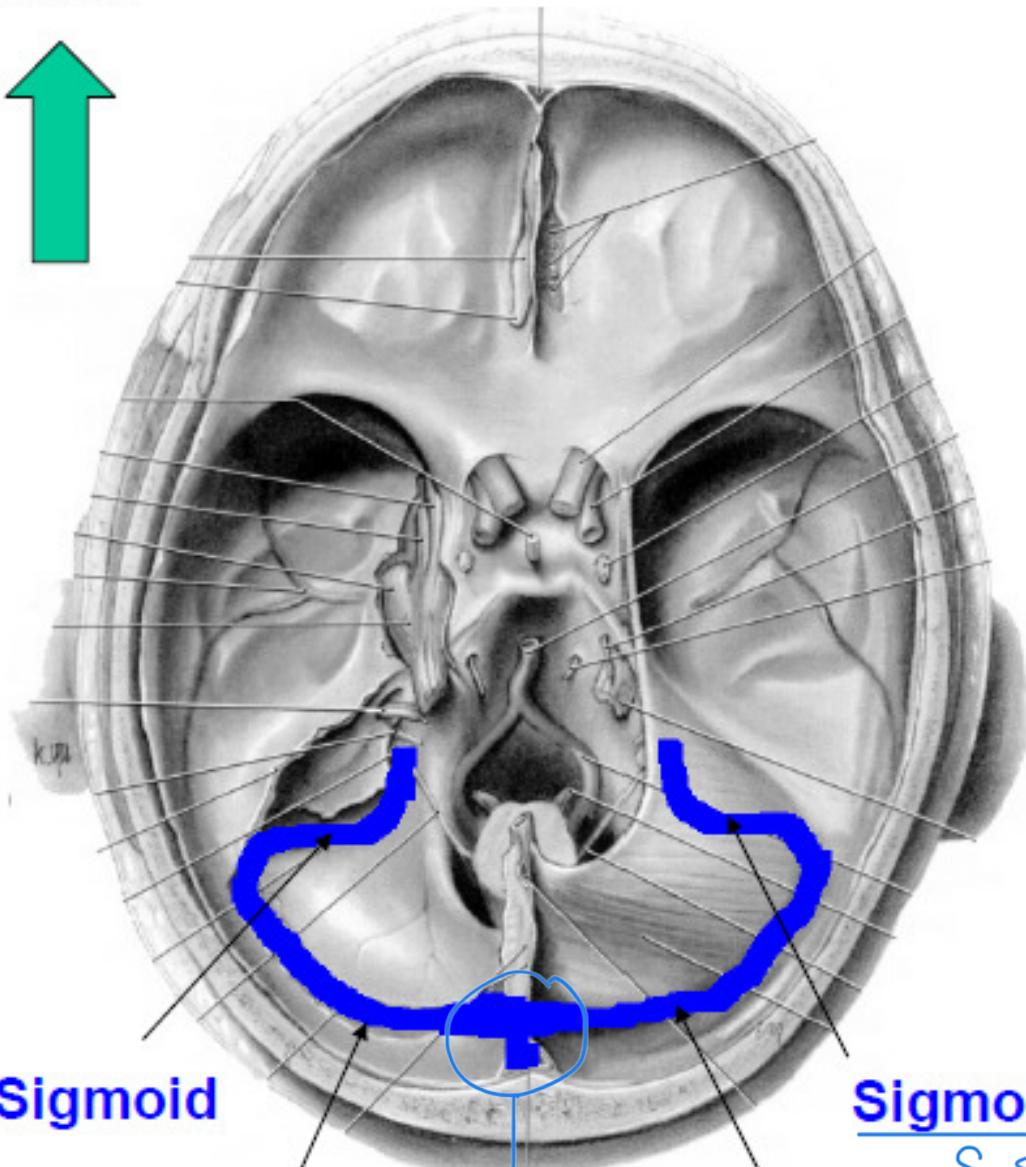
Straight Sinus can join Superior Sagittal Sinus at Confluens of Sinuses or turn left

located posteriorly

deep vein

VENOUS SINUSES

NOSE



Sigmoid

Transverse

Confluens
of sinuses

Transverse

Sigmoid

S-shaped

4. Transverse sinuses - in lateral fixed part of tentorium; receive blood from Sup. Sagittal or Confluens

5. Sigmoid sinuses - S-shaped continuation of Transverse; end in Jugular Foramen; form Internal Jugular Vein

6. Occipital Sinuses - in falx cerebelli; drain to Confluens

Inferior

Its a content of the Ant. triangle of the neck and the carotid sheath

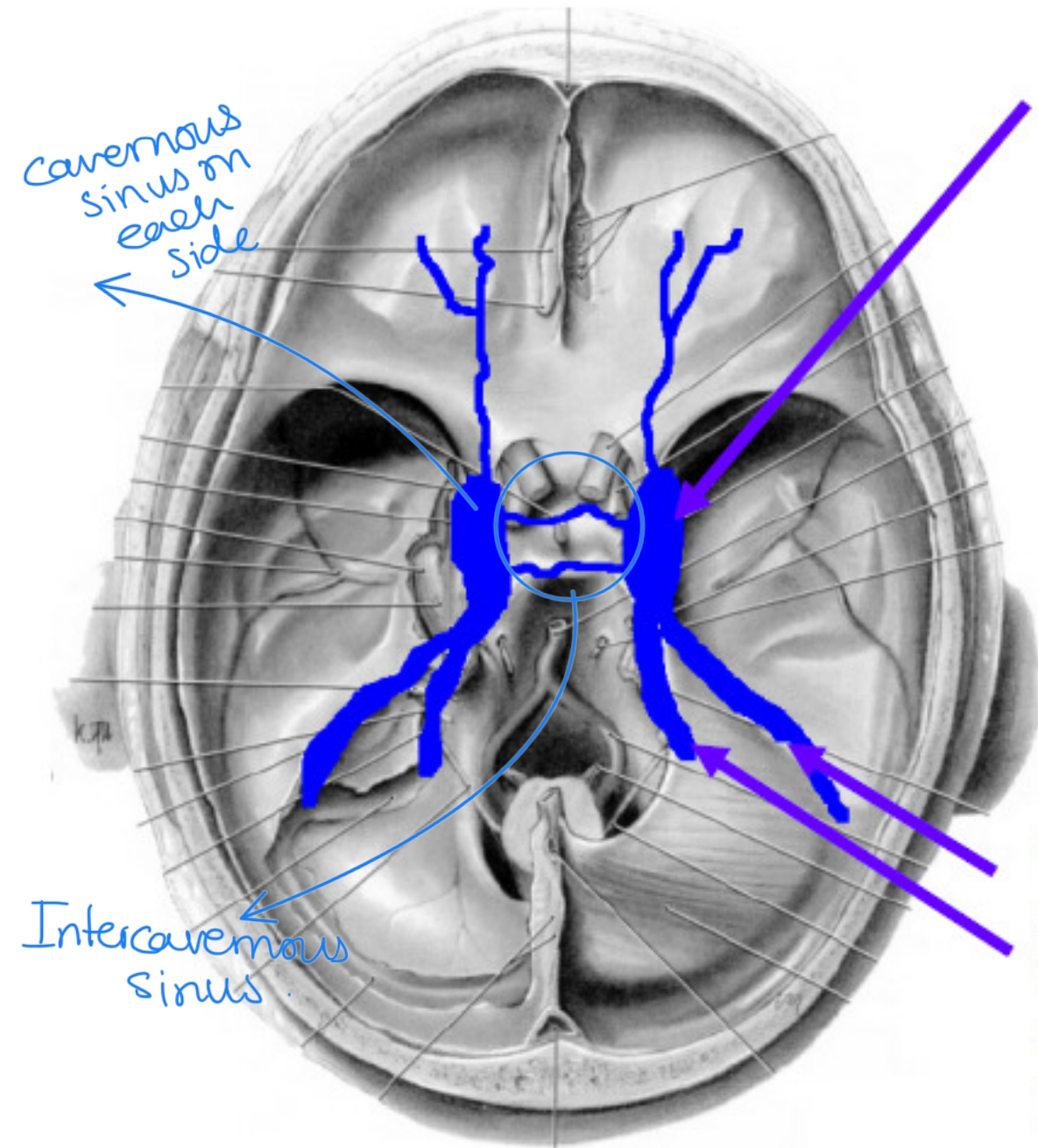
Internal jugular vein + carotid arteries + vagus nerve

VENOUS SINUSES

discussed earlier
in the venous
drainage of the
face

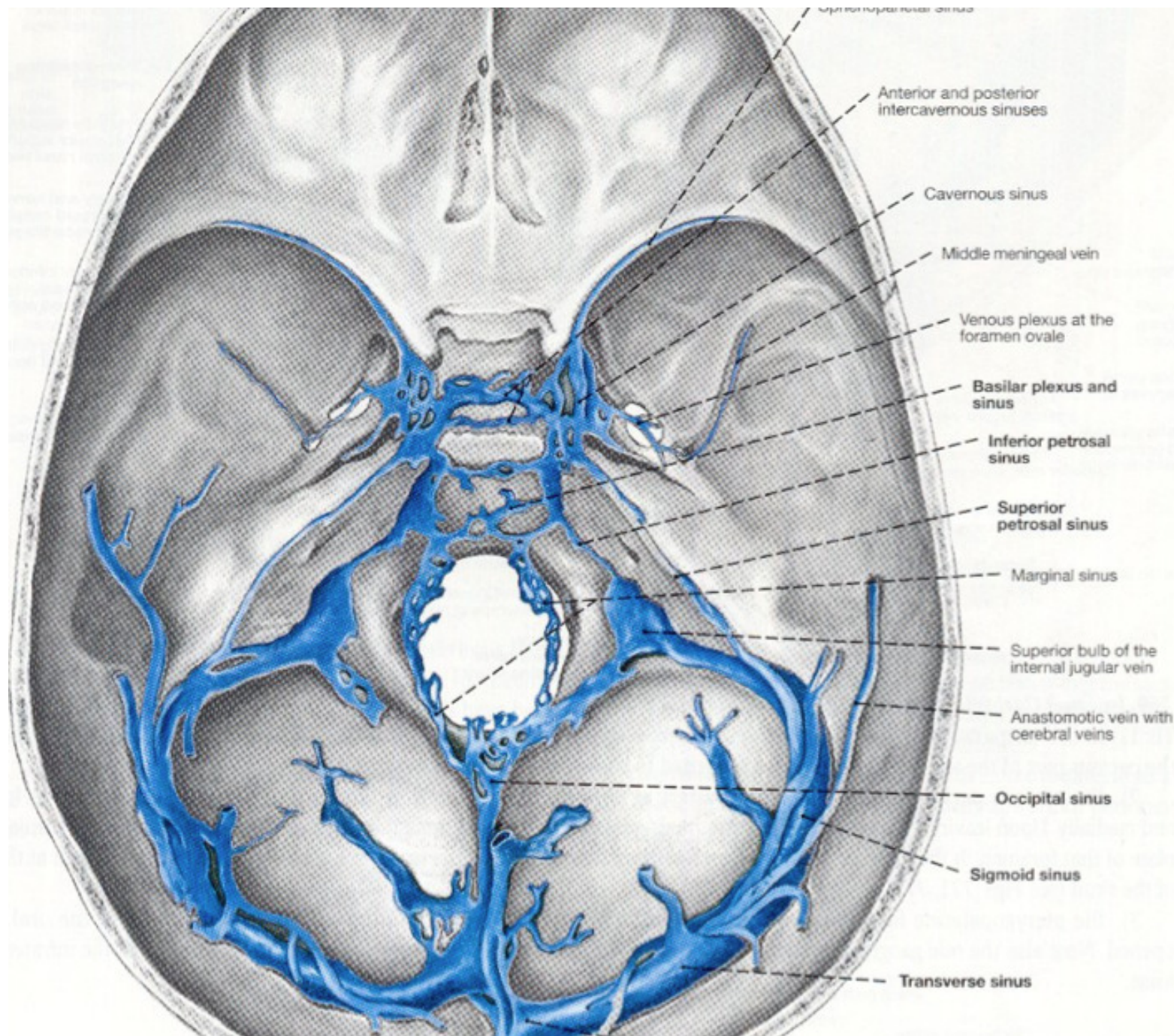
7. Cavernous sinuses - in middle cranial fossa; on side of the body of the sphenoid bone; connected by Intercavernous sinus; receive blood from Sup. and Inf. Ophthalmic veins, Cerebral veins; drain to Sup. and Inf. Petrosal sinuses

8. Sup. and Inf. Petrosal sinuses - on petrous part of temporal bone
Sup. drains to Transverse
Inf. Drains to Internal Jugular



Cavernous sinus on each side

Intercavernous sinus



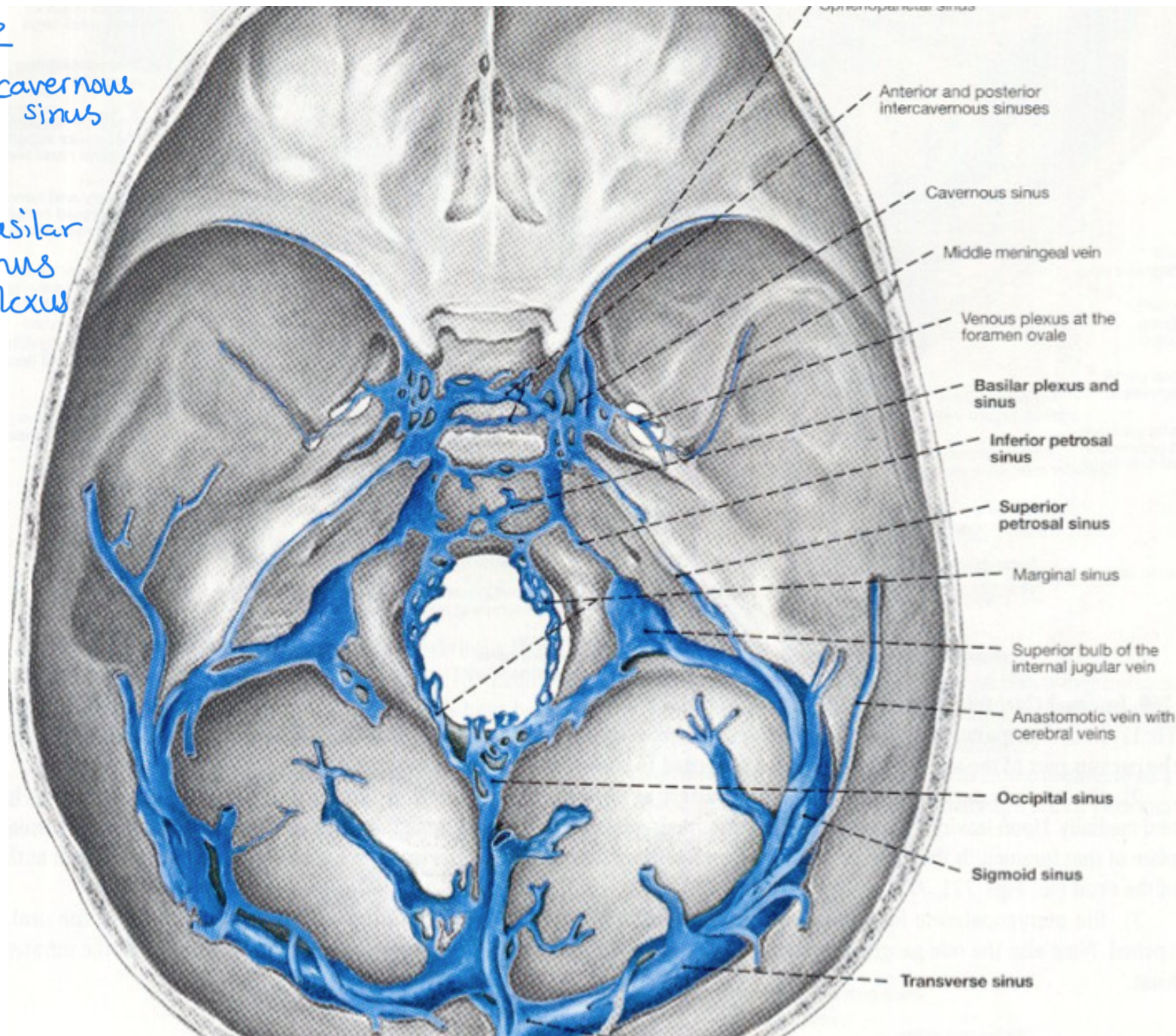
➤ Confluence of sinuses

- **Location:** internal occipital protuberance
- **Receives from:** Superior sagittal, straight, and occipital sinuses

from falk cerebelli

* on either sides of sella turcica ⇒ cavernous sinus

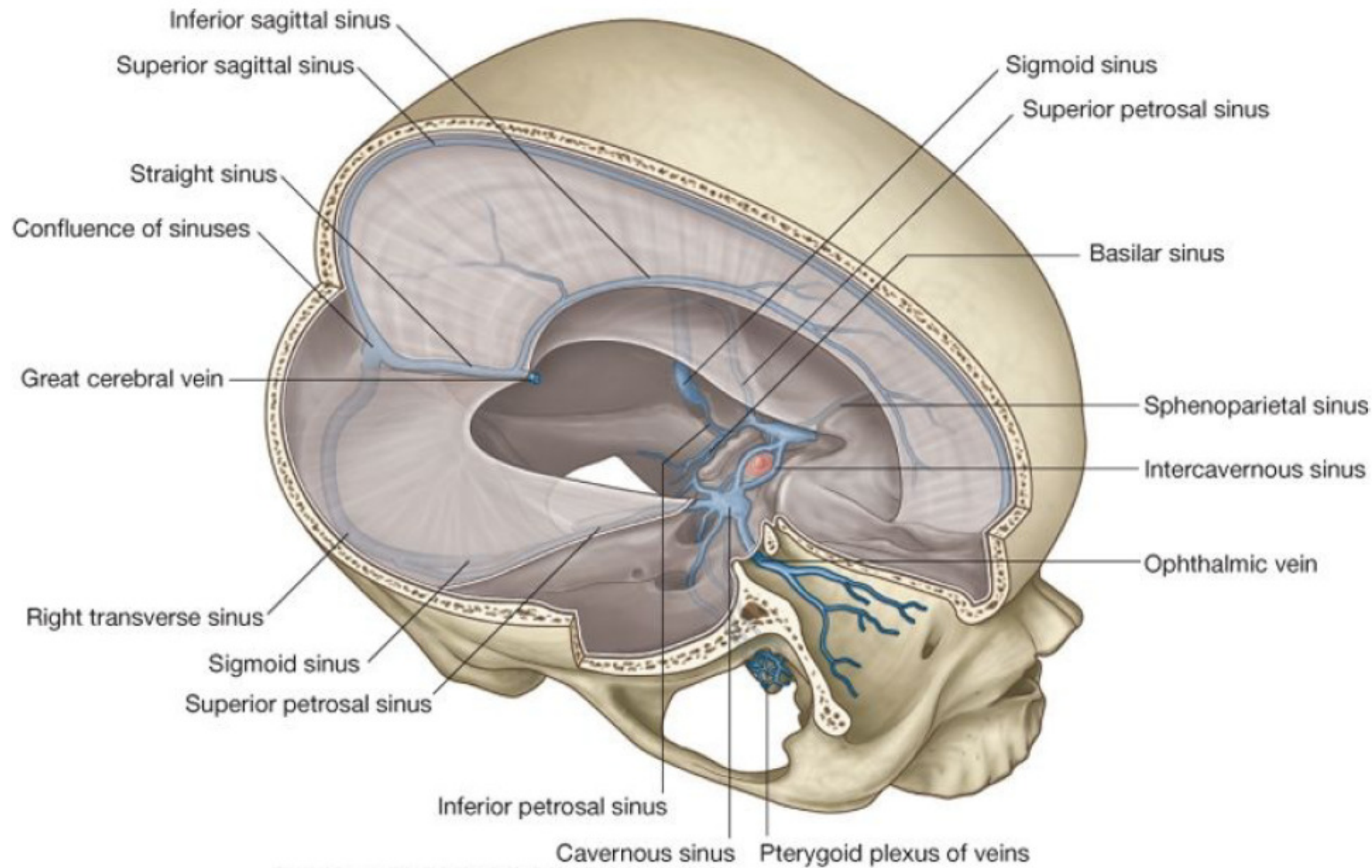
* posterior to sella turcica ⇒ basilar sinus and plexus



➤ Basilar sinus

- **Location:** posterior to sella turcica of sphenoid
- communicate with vertebral plexus of veins

descending in foramen magnum



EPIDURAL HEMATOMA

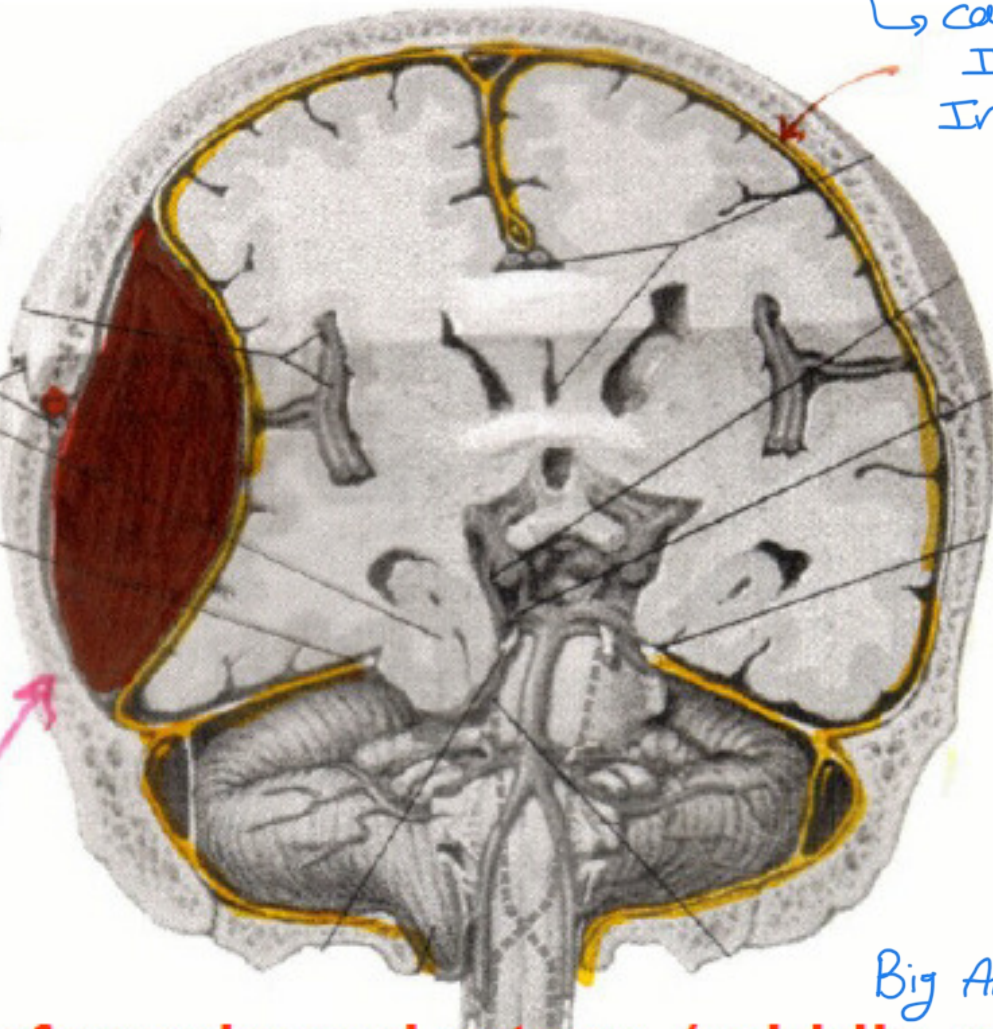
Hematoma in general
↳ caused by Increased Intracranial pressure

Symptoms depend on the severity of each case
(How much pressure)

Skull fracture crossing middle meningeal artery
Herniation of temporal lobe under tentorium cerebelli

Near Pterion

Weakest point of the skull, where 4 bones meet together midway just above zygomatic arch



Big Artery

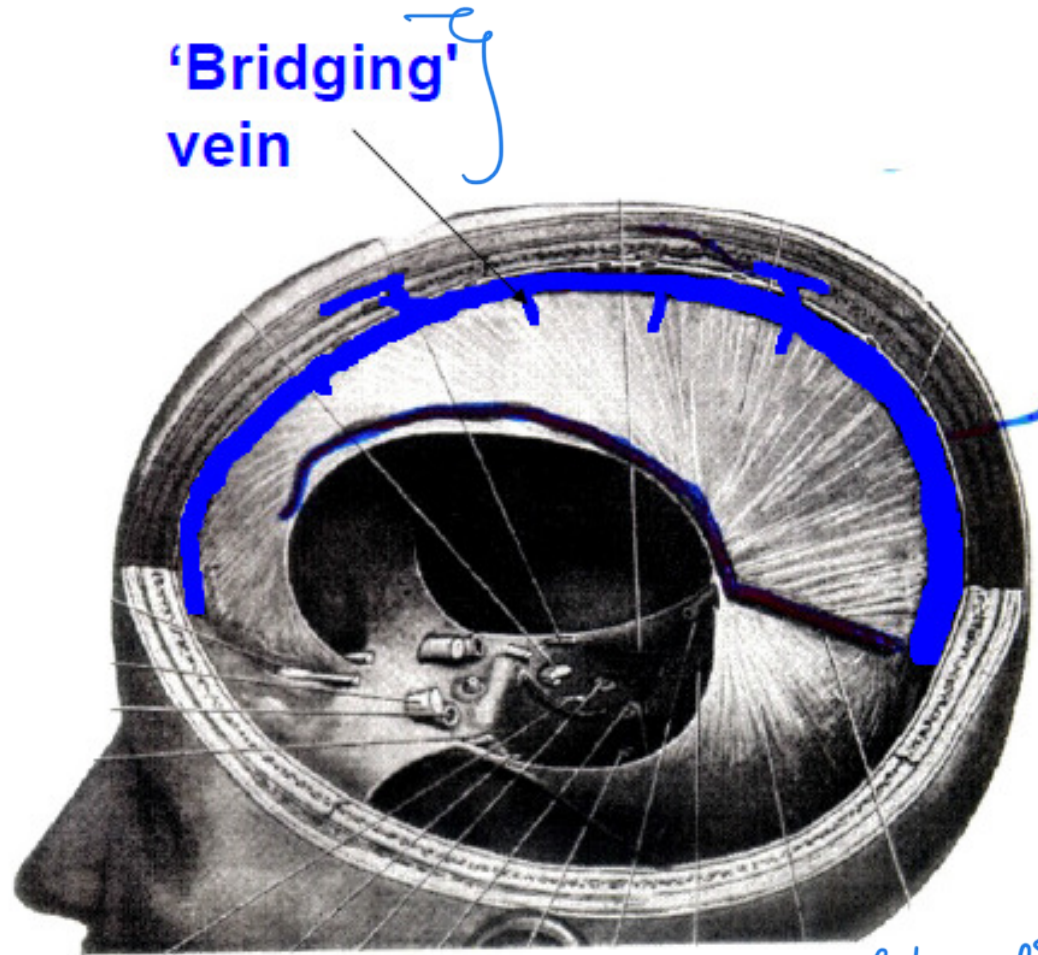
often tearing of meningeal artery (middle meningeal torn in fracture of skull at pterion); bleeding is arterial – can be profuse & rapid; - ex, car accident – patient lucid at first - can be fatal within hours

Acute (arterial pressure > venous pressure) more dangerous

+ trauma on the pterion

improvement in early hours

B. SUBDURAL HEMATOMA



'Bridging'
vein

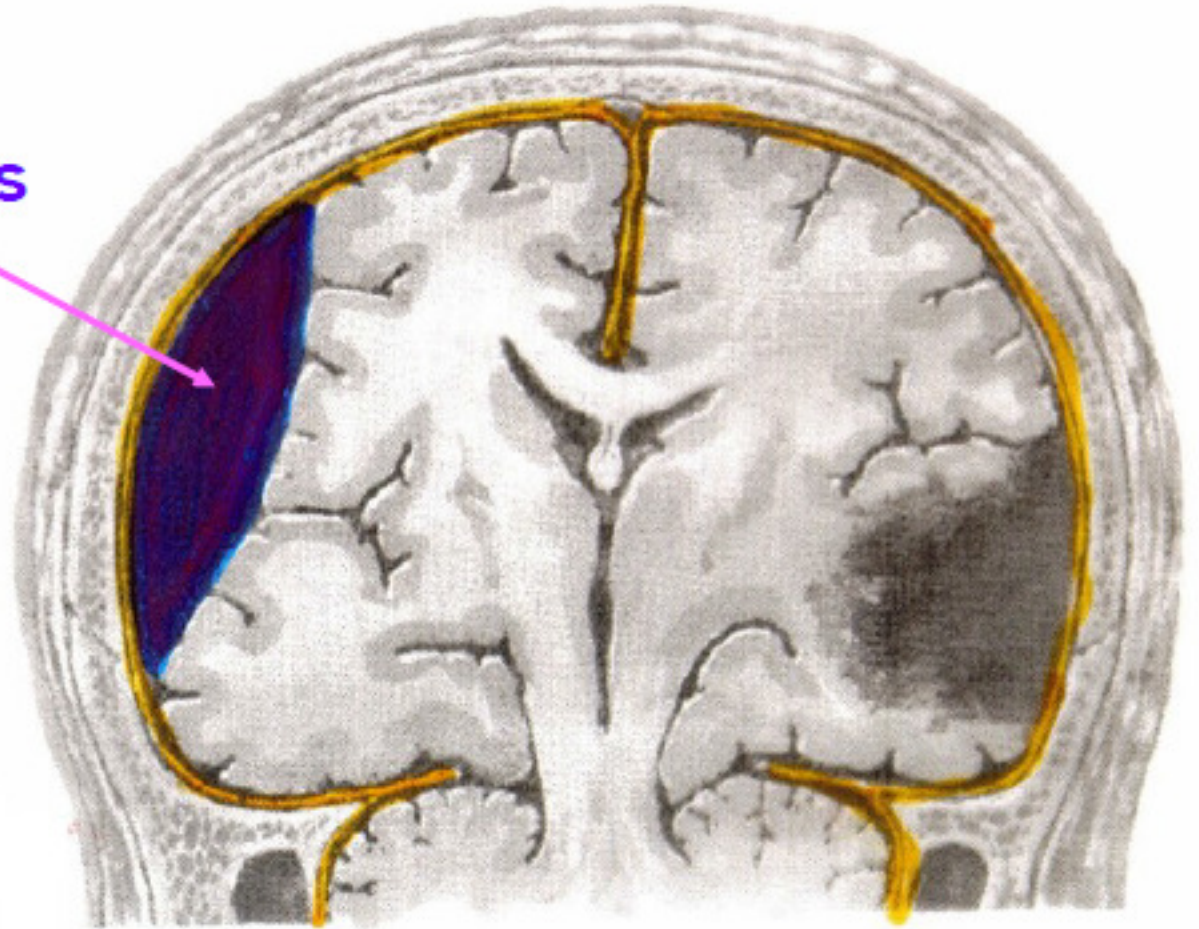
- bleed into potential space between Dura & Arachnoid
- from tear 'Bridging' vein or sinus
- bleeding often slow
- chronic subdural hematomas can remain undetected

delayed
symptoms

Tearing of the **superior cerebral veins** at their point of entrance into the superior sagittal sinus

SUBDURAL HEMATOMA

- Subdural Hematomas
- bleeding slow (venous)
- Chronic Subdural Hematomas can remain undetected



Epidural Hematoma

(Does Not Cross Suture Line)

Meningeal arteries are found in periosteal layer which is attached to the suture line

Arterial Blood
very rapid

Skull Fracture

Middle Meningeal Artery

Subdural Hematoma

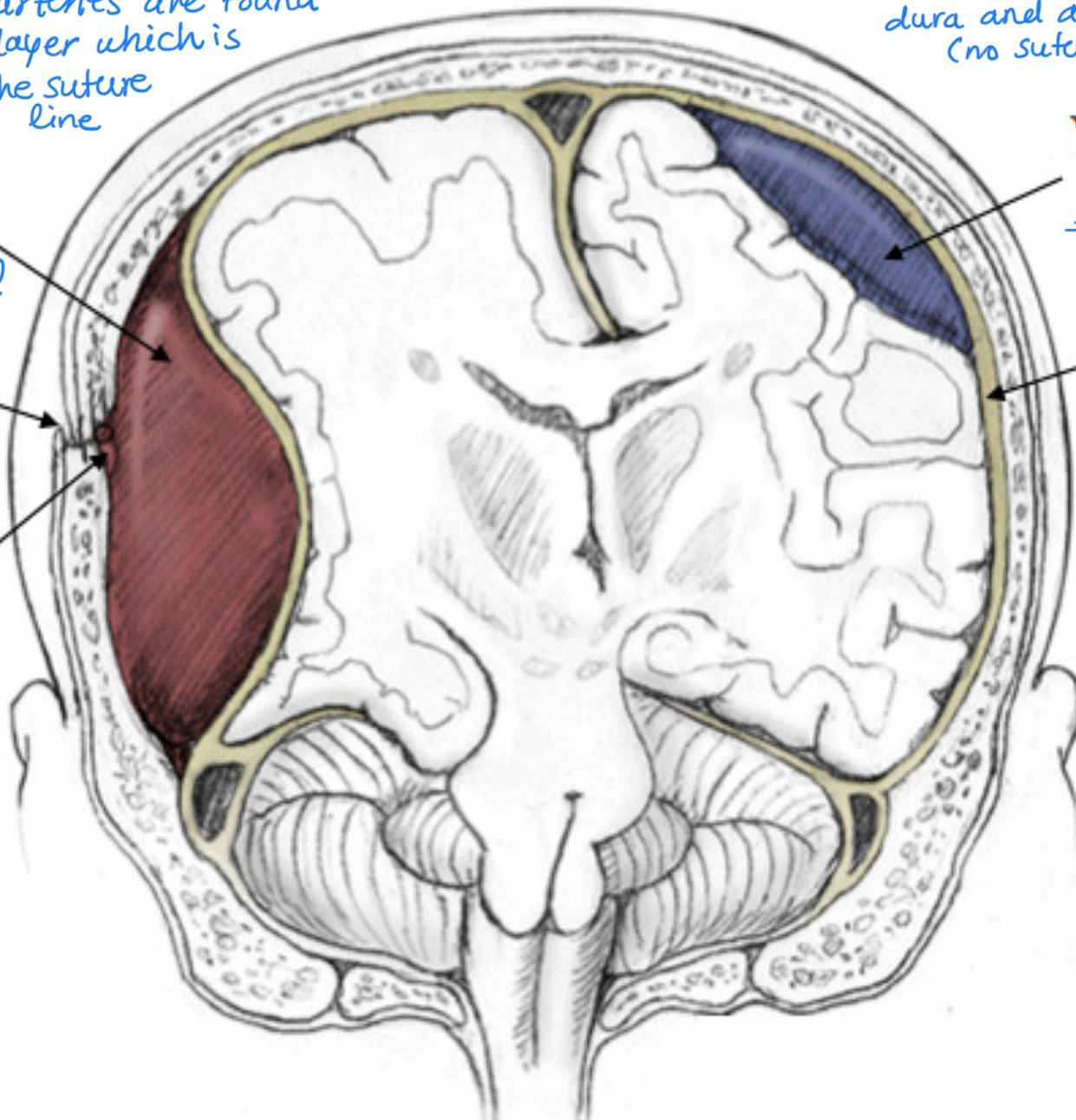
(Crosses Suture Line)

found between the dura and arachnoid (no suture line)

Venous Blood
slow

Dura

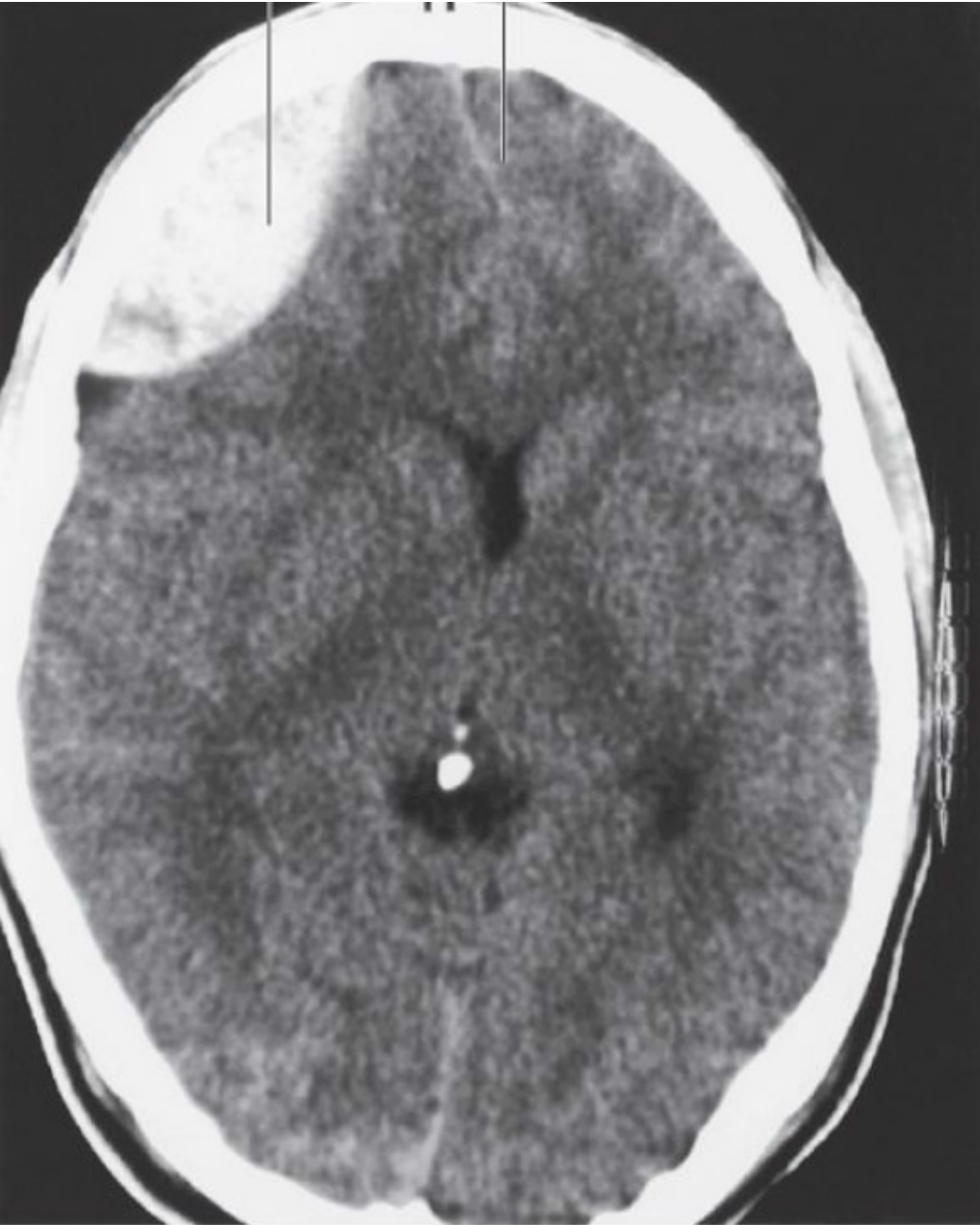
**Can be chronic and undetectal*



Epidural

biconvex disc
(lens-like)

Extradural hematoma



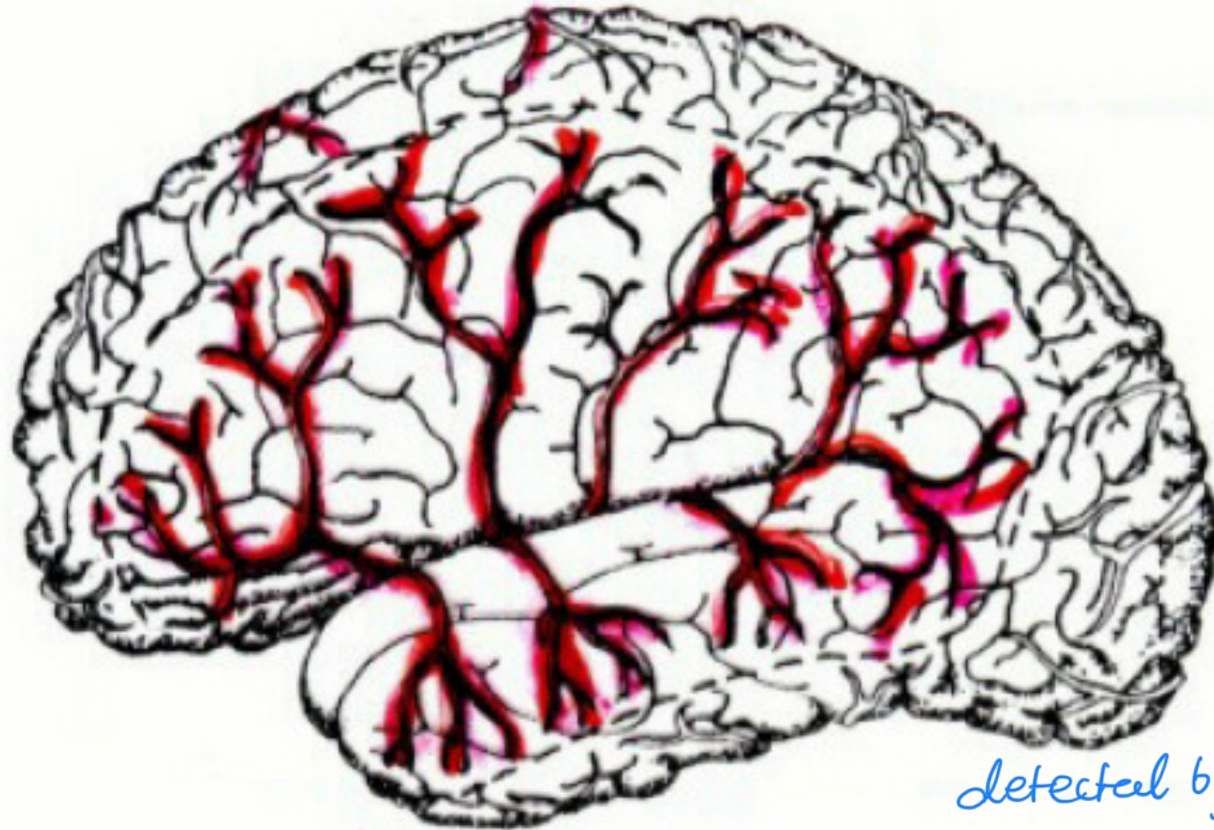
crosses
suture line \Rightarrow crescent
shaped

Subdural hematoma



C. SUBARACHNOID HEMATOMA

most big arteries are
found in subarachnoid
space



tearing
cerebral artery
or aneurysm
(swelling of
vessel wall)

detected by lumbar puncture
you find
(Blood within CSF)

If arterial can be rapid and fatal

اللهم نج المستضعفين من المؤمنين في مشارق الأرض و مغاربها
اللهم نصرك الذي وعدت لعبادك الصابرين المجاهدين

 موفقين

ما تنسوننا و المسلمين من صالح دعواتكم