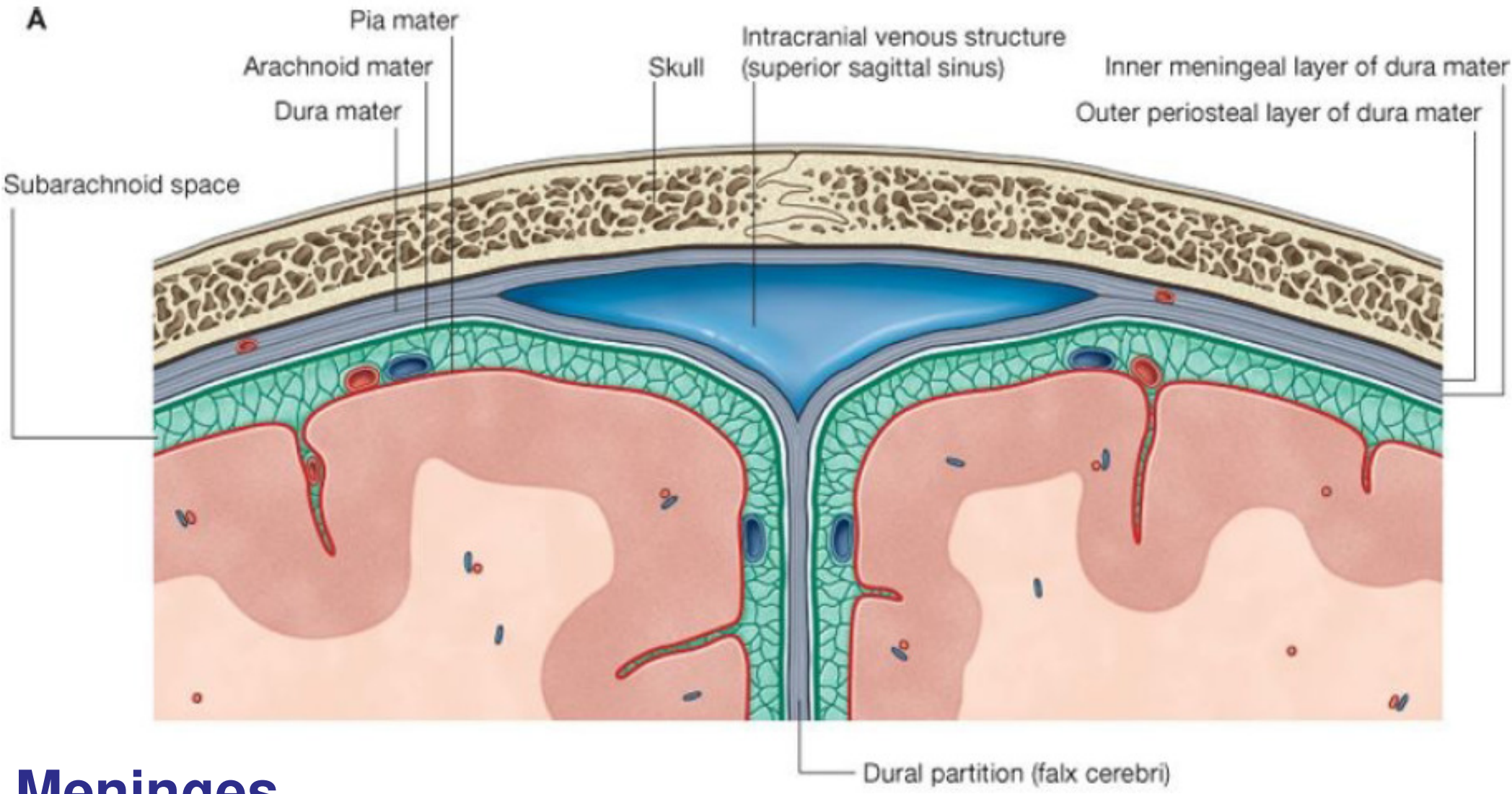
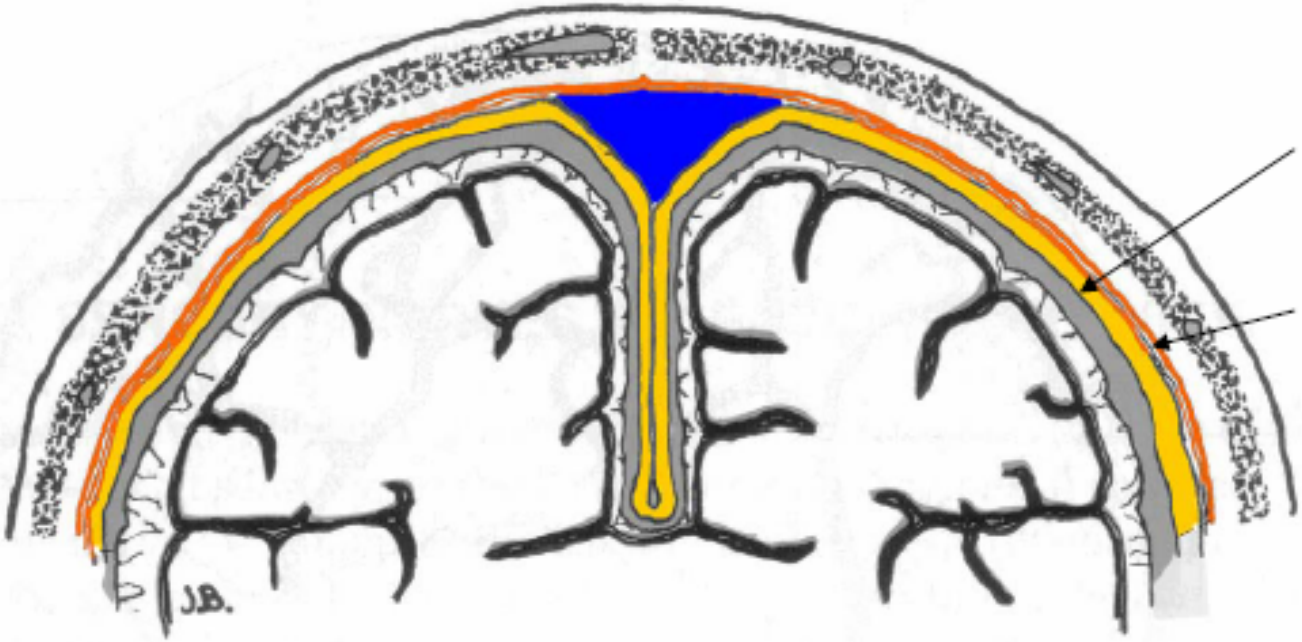


Meninges

- **Dura mater**:
  - **Endosteal layer:** attached to the skull **+** meningeal arteries
  - **Meningeal layer:** continuous with spinal dura
- **Arachnoid mater**:
- **Pia mater**

II. MENINGES OF BRAIN

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



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

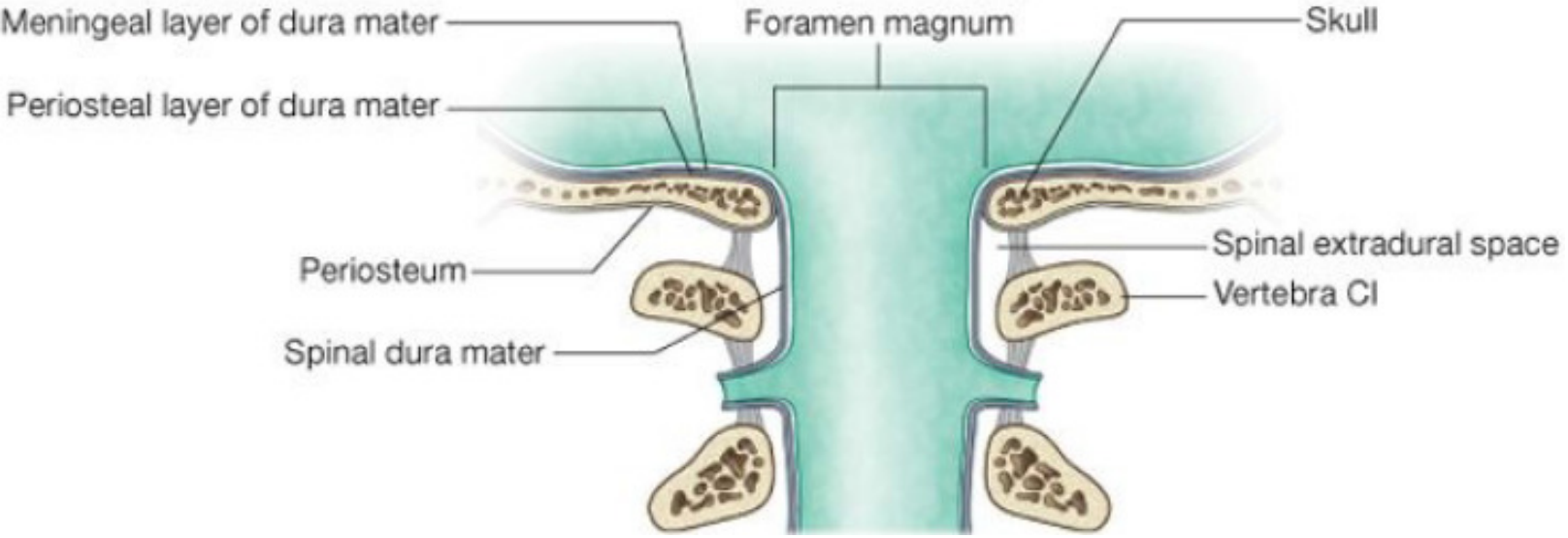
DURA - 2 LAYERS ARE FUSED IN MOST PLACES

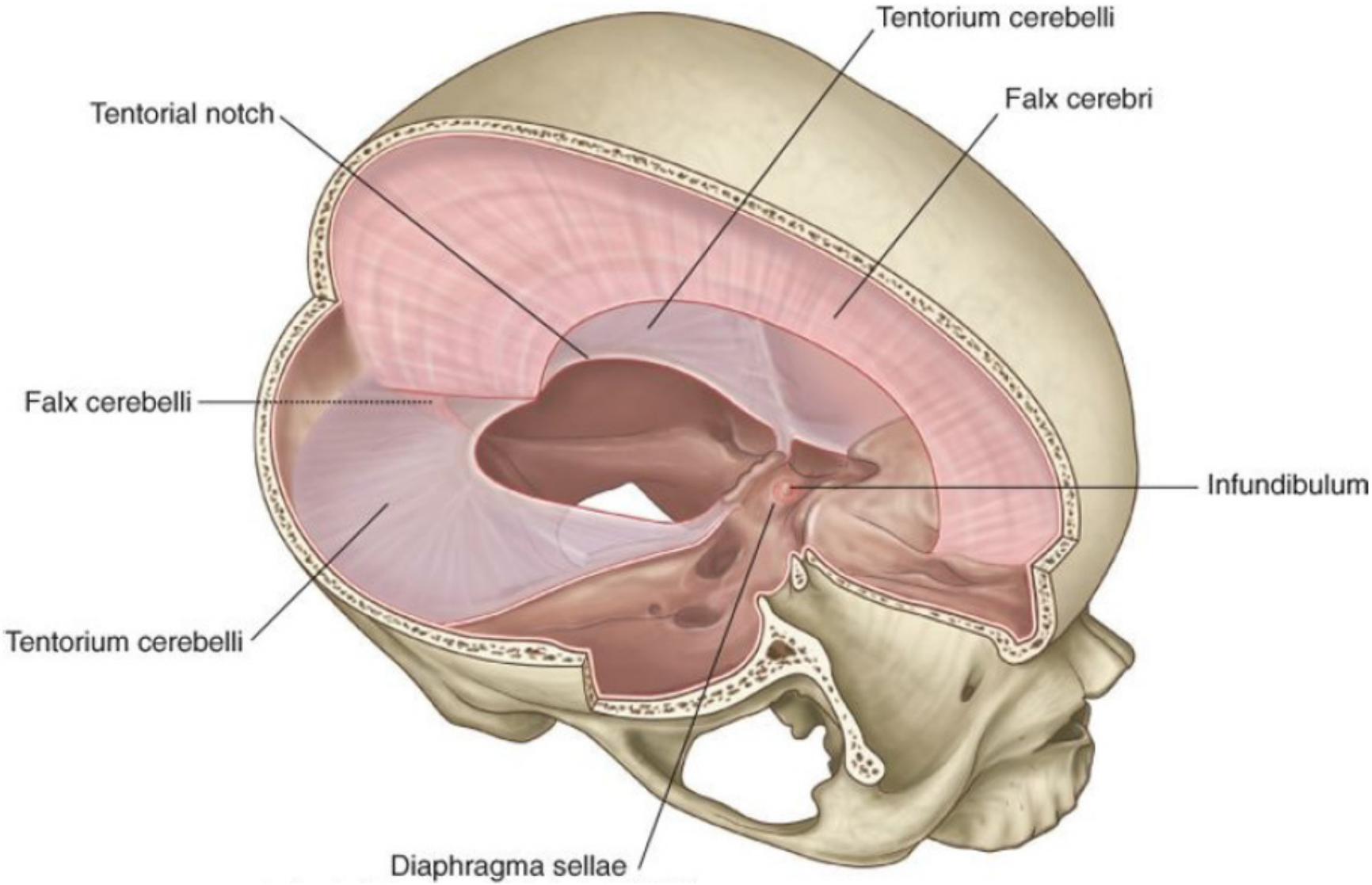
- Dura is tightly attached to inner side of calvarium

- Normally No Epidural Space (unlike spinal cord)

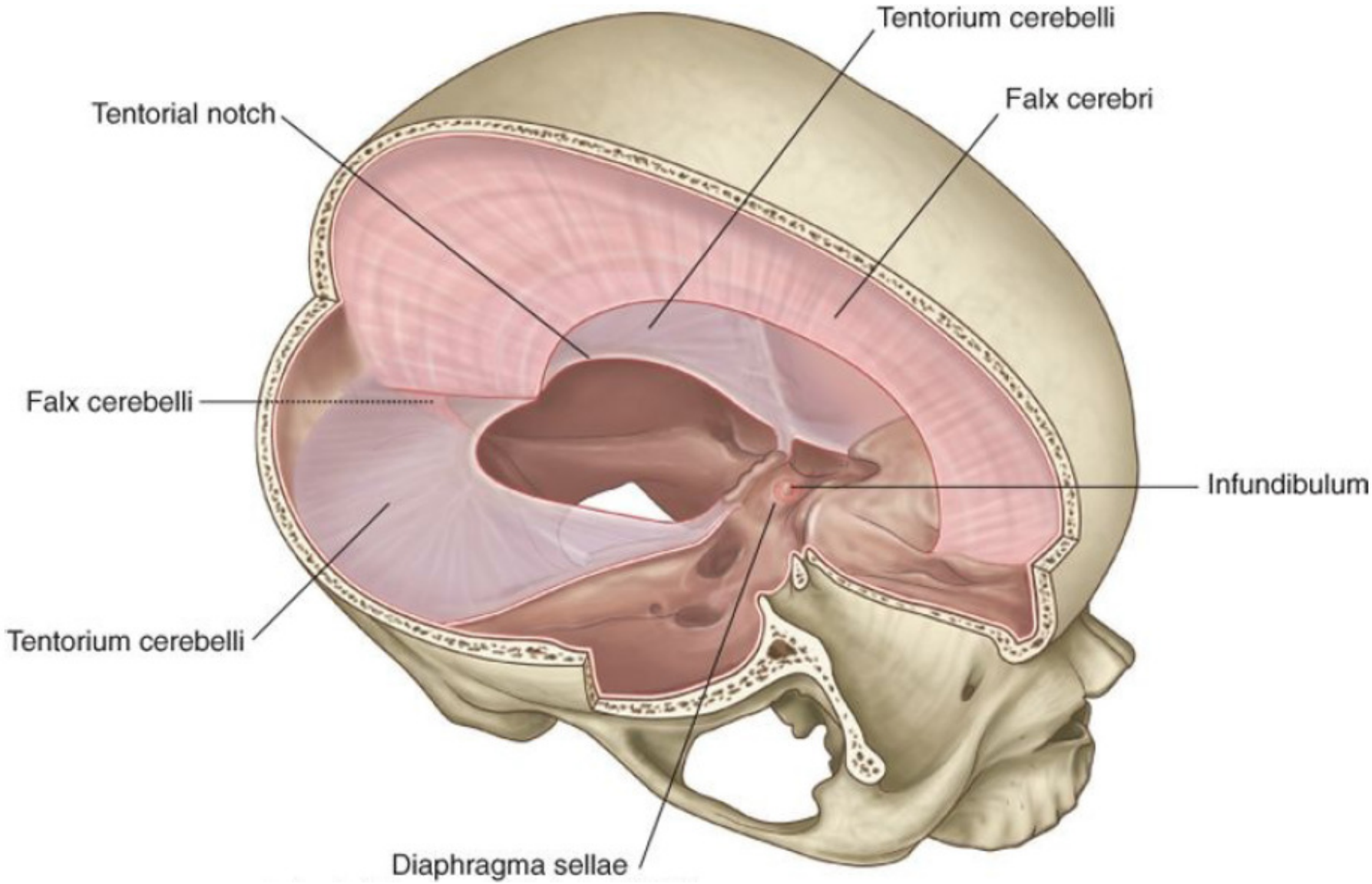
Calvarium removed by pulling away bone from dura

➢ *The two layers of dura separate to from folds, dural partitions*





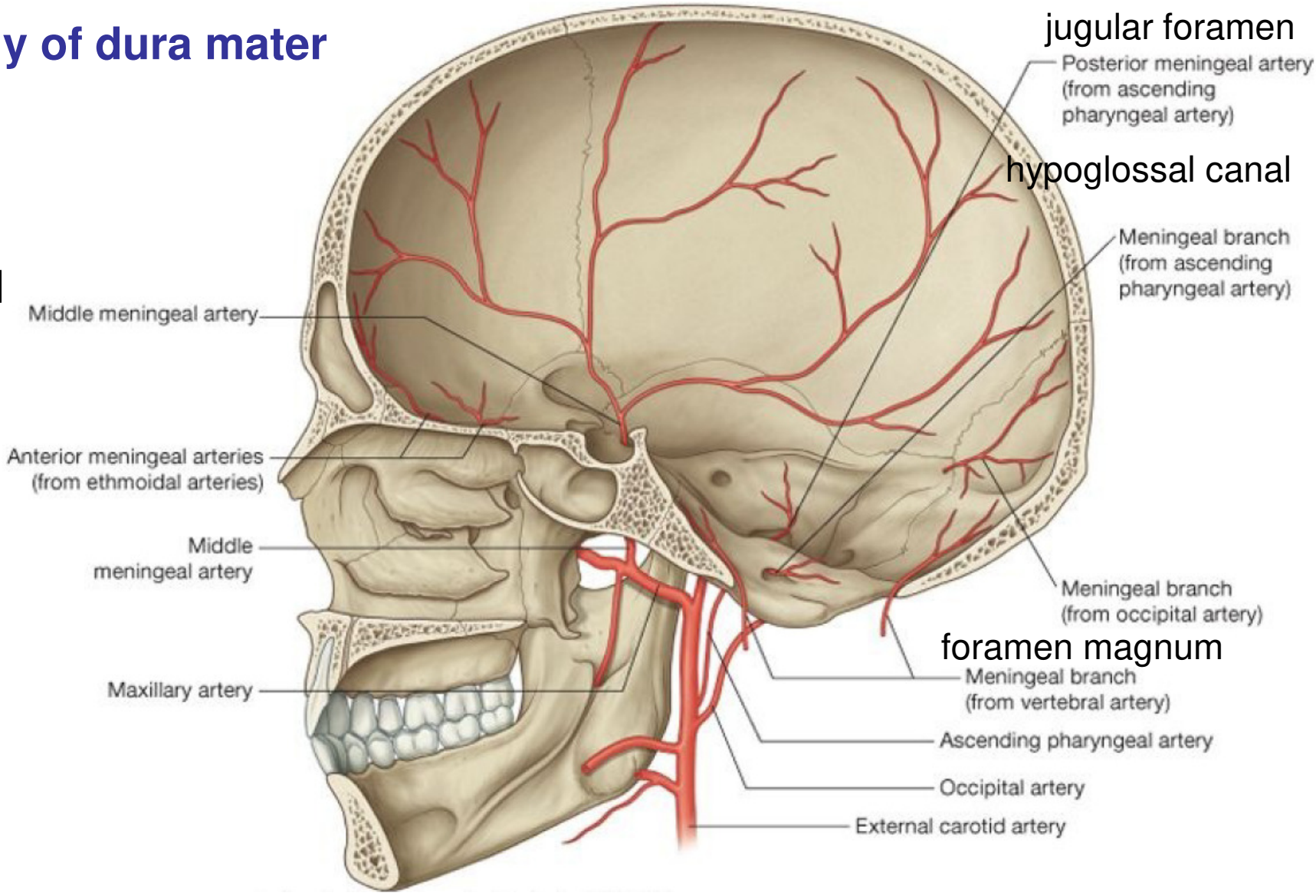
- **Falx cerebri:** crescent-shaped, Attachments:
  - **Anterior**: crista galli **Posterior**: tentorium cerebelli
- **Tentorium cerebelli:** horizontal, Attachments:
  - **Anteriolateral**: superior border of the petrous. **Posterior**: occipital bone, **AnteriolmedIal:** free, tentorial notch



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

Arterial supply of dura mater

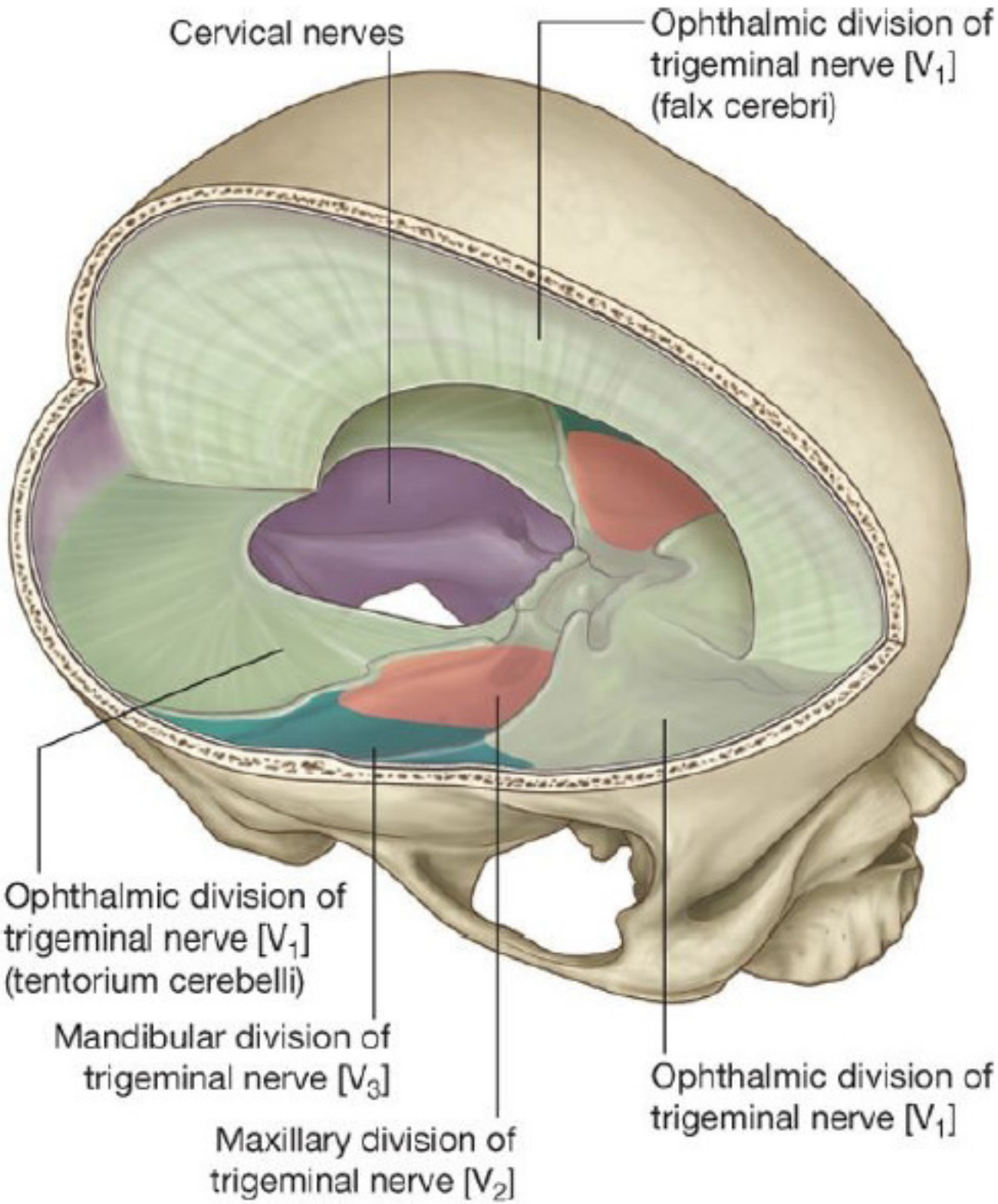
- **Anterior meningeal arteries**
- **Middle** and **accessory meningeal arteries**
- **posterior meningeal artery**

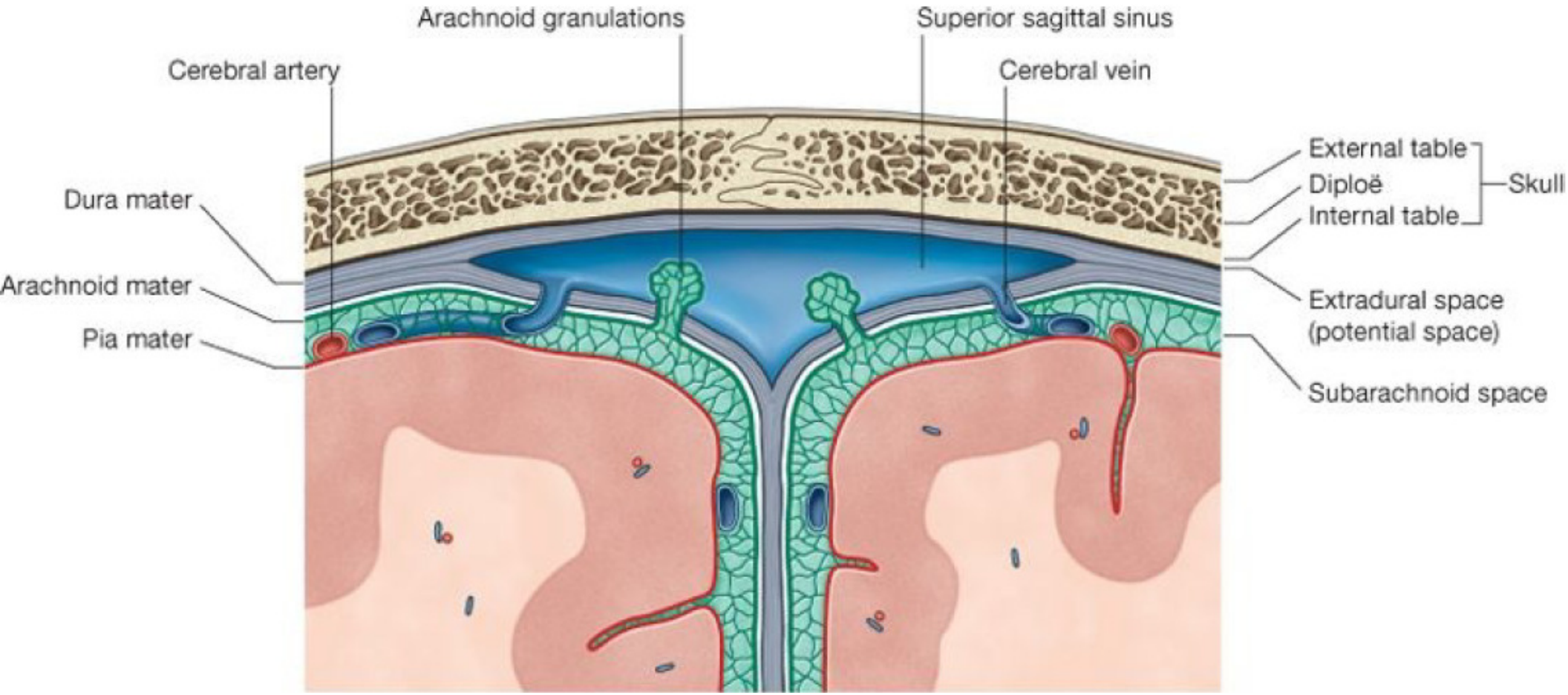


- Middle meningeal artery (branch of maxillary artery), enters through the foramen spinosum
- Accessory meningeal artery (branch of maxillary artery), enters through the foramen ovale

❖ ***All in the outer periosteal layer of the dura***

Nerve supply of dura mater

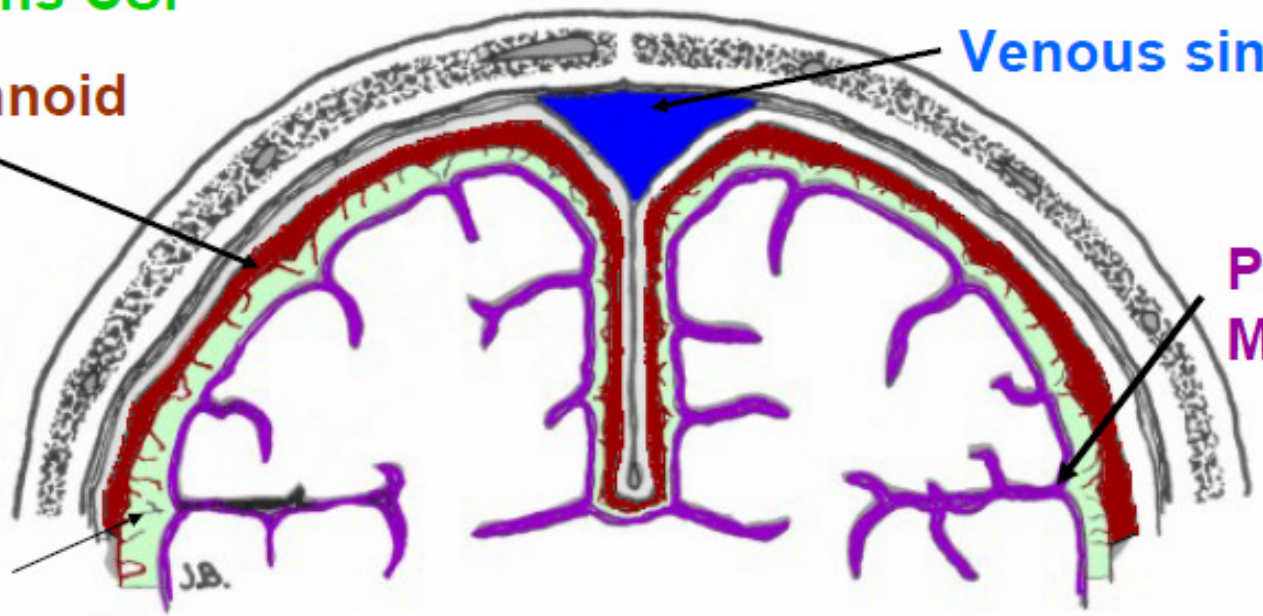




- **Arachnoid:** does not enter the grooves or fissures of the brain, except for the longitudinal fissure
- **Pia:** follows the contours of the brain
- Spaces
  - Epidural:
  - Subdural
  - Subarachnoid

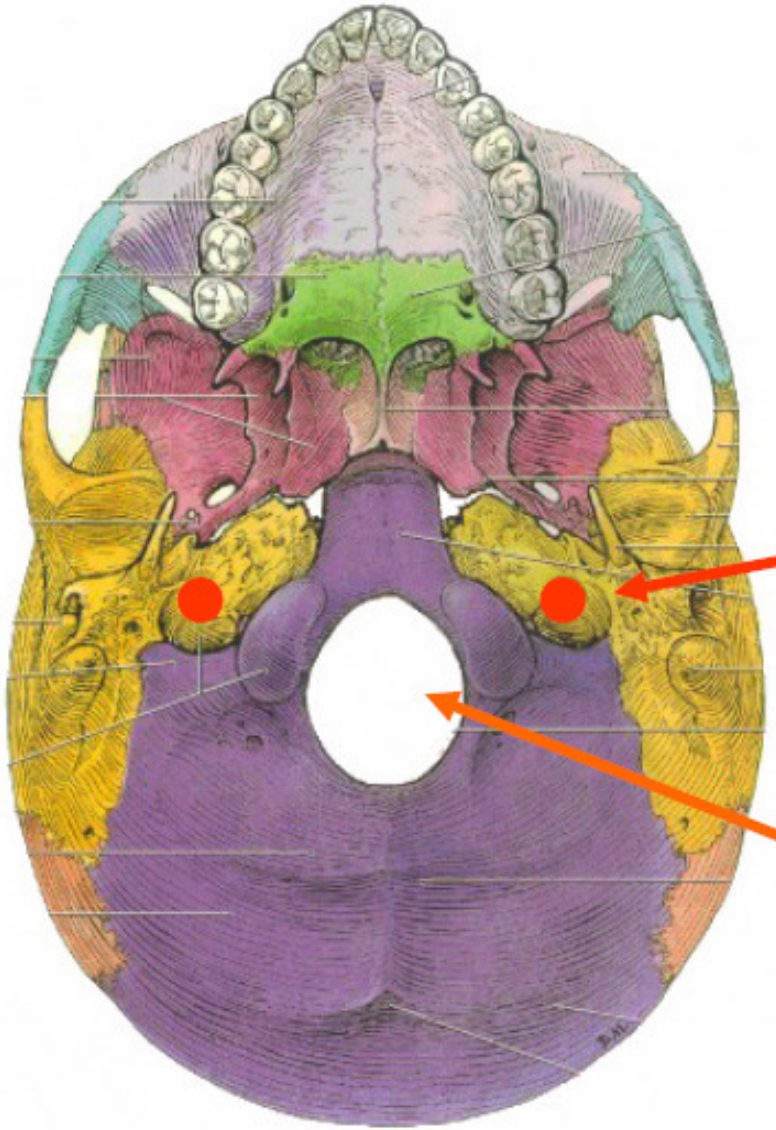
MENINGES OF BRAIN

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



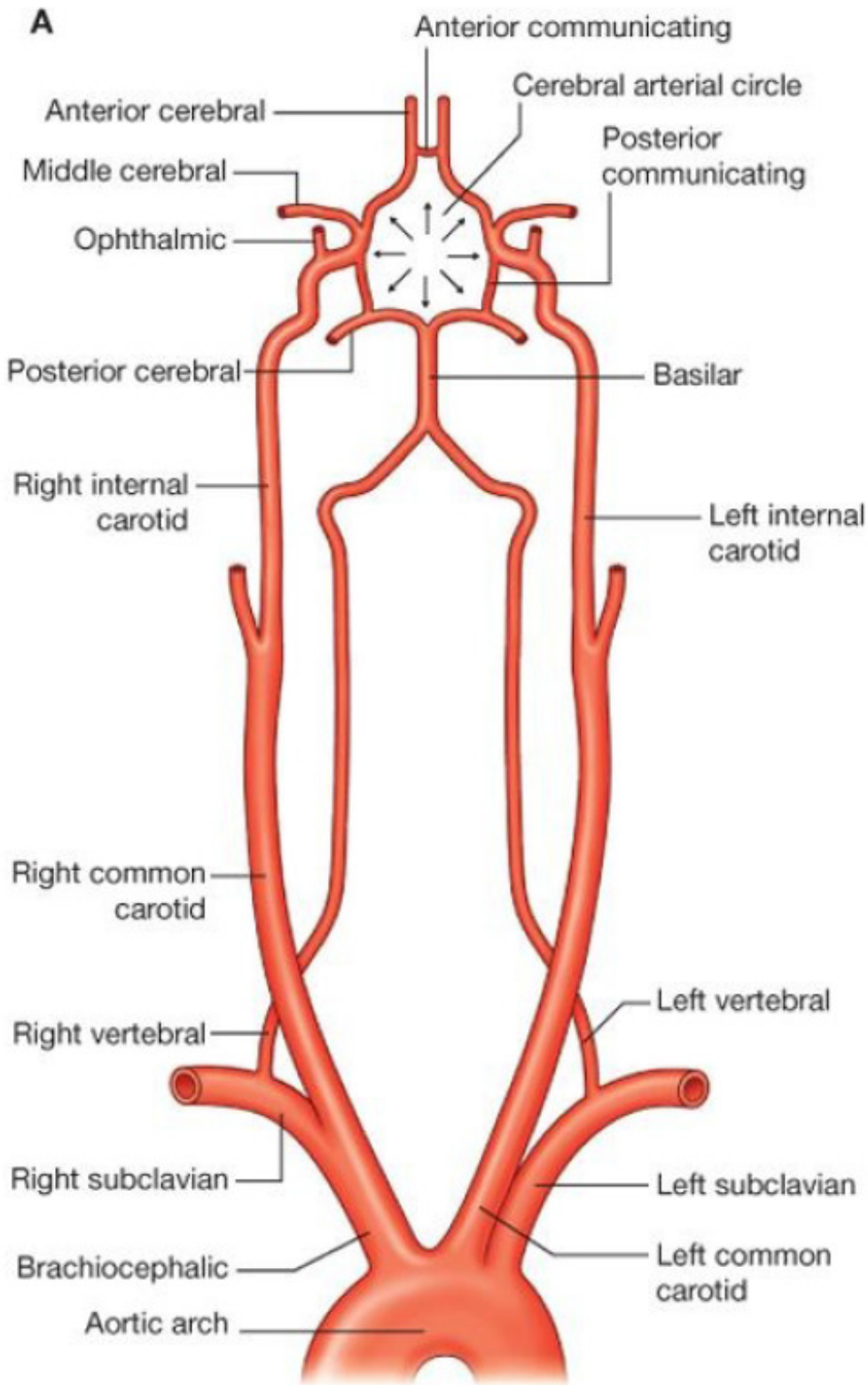
Arterial Blood Supply

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

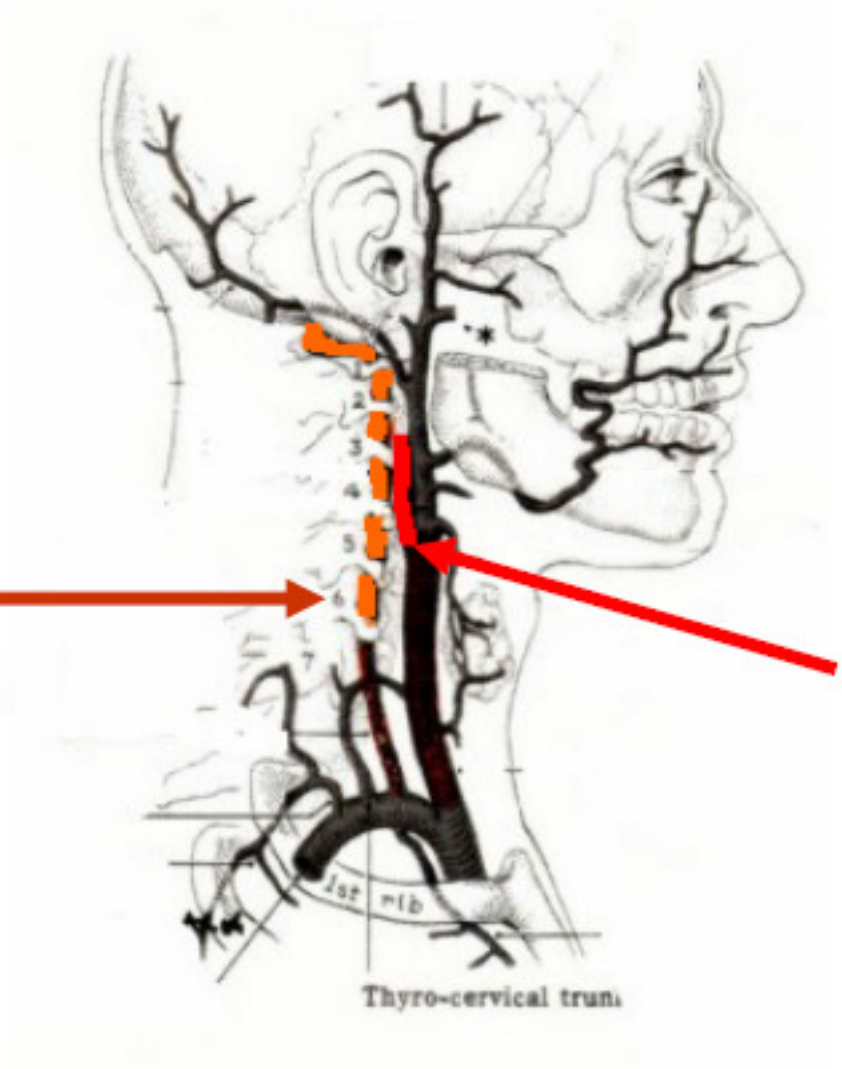


A. Internal Carotid Artery- enters skull via Carotid Canal And Foramen Lacerum

B. Vertebral artery- enters skull via Foramen Magnum


A
Anterior communicating
Cerebral arterial circle
Anterior cerebral
Posterior communicating
Middle cerebral
Ophthalmic
Posterior cerebral
Basilar
Right internal carotid
Left internal carotid
Right common carotid
Left vertebral
Right vertebral
Right subclavian
Left subclavian
Brachiocephalic
Left common carotid
Aortic arch

Vertebral A. Courses Through Foramina Transversaria C1-C6



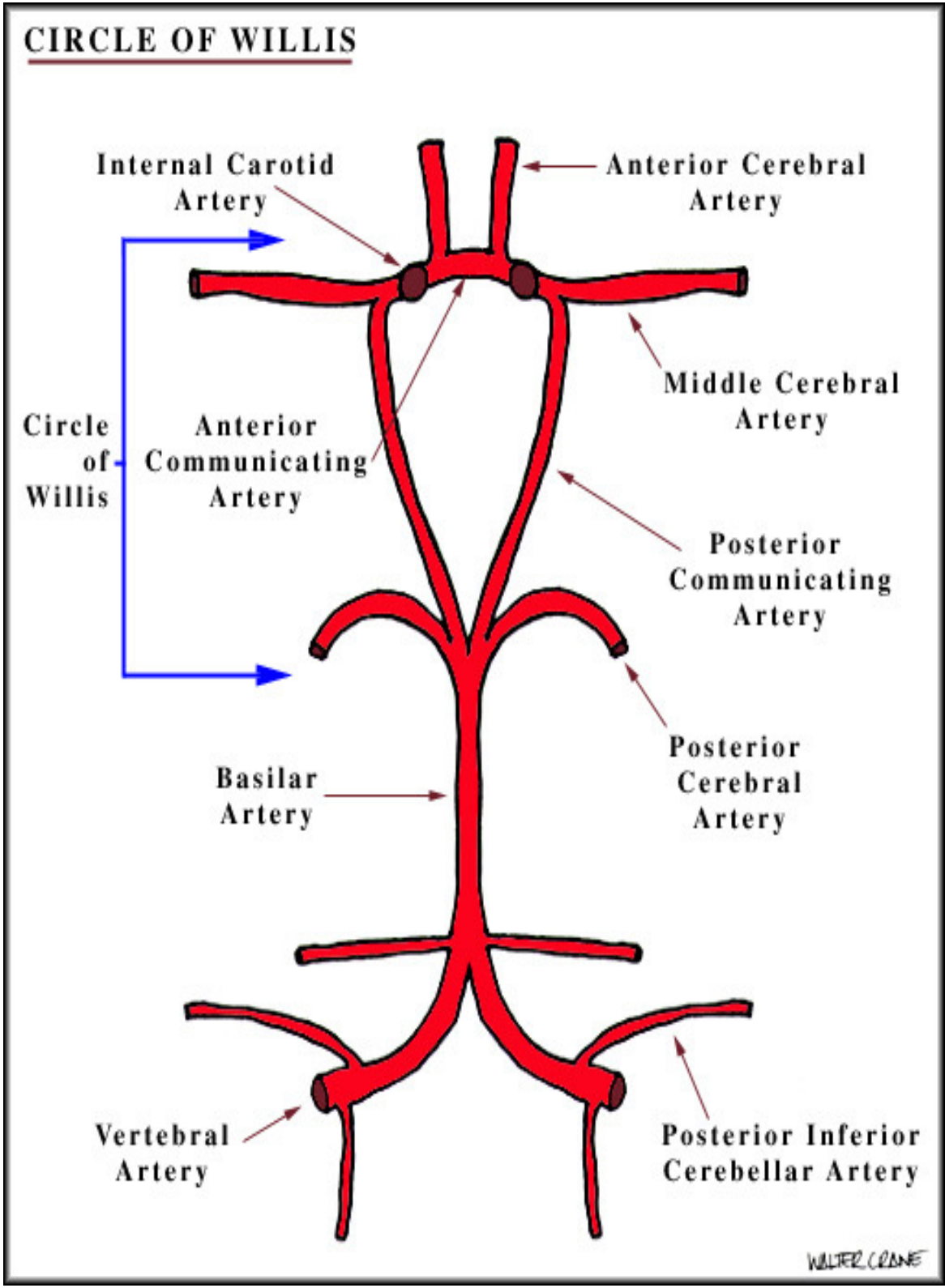
Int. Carotid A. Ascends without Branching into Skull (via Carotid Canal)

Internal Carotid Artery

- Terminal branch of common carotid artery

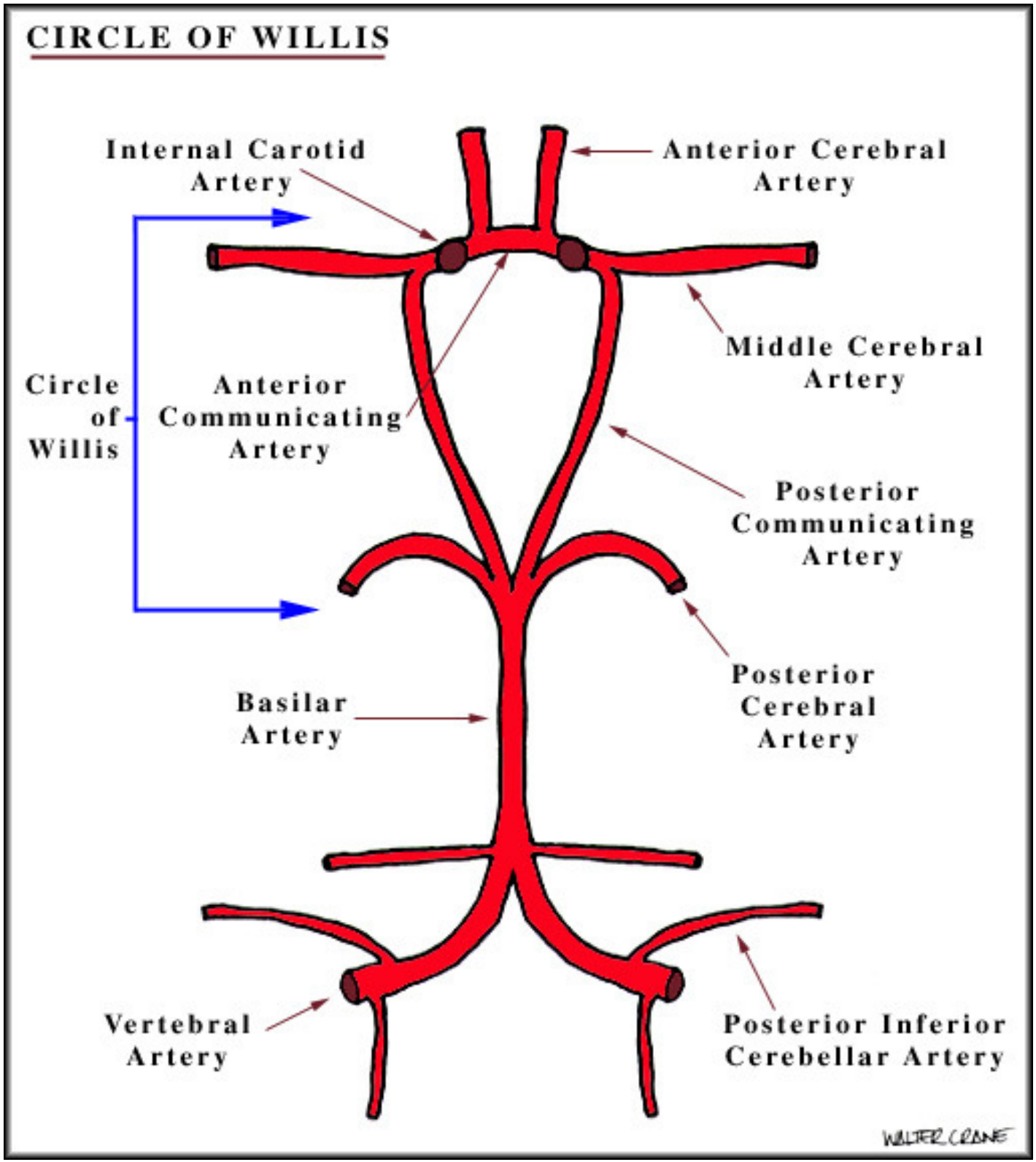
➢ Branches
  - **Ophthalmic artery**: supply eyes, paranasal sinuses and parts of the nose
  - **Posterior communicating** artery: runs backward to join the posterior cerebral artery
  - **choroidal artery**: supply choroid plexus of lateral ventricles and other areas including optic tract, lateral geniculate nucleus, etc.

➢ Terminal branches:
  - **Middle cerebral artery**
  - **Anterior cerebral artery**



Vertebral Artery

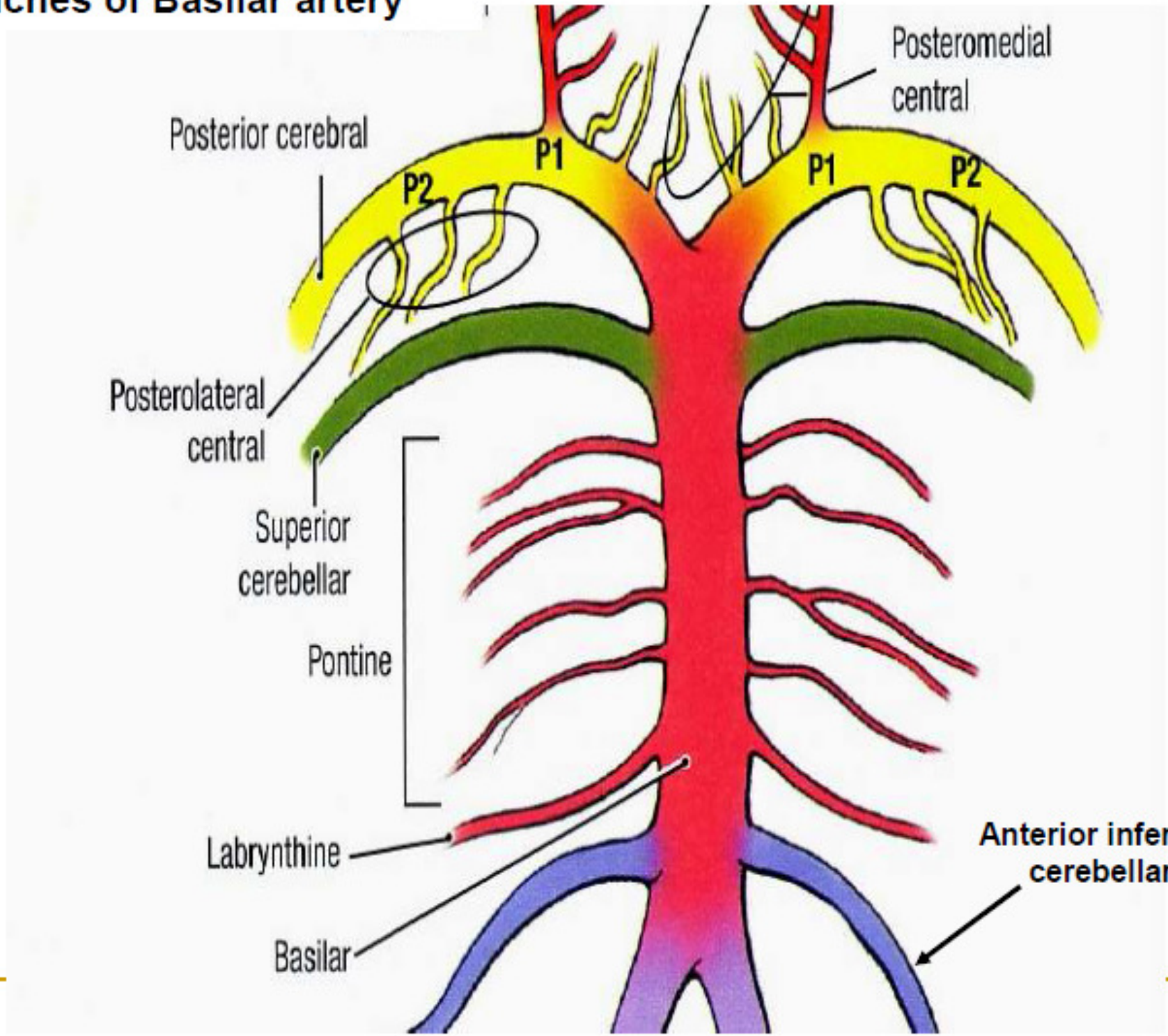
- Branch of first part of subclavian A
- Passes – foramen transvesarium C6 – C1
- Enters through foramen magnum – perforates dura & arachnoid mater – enters subarachnoid space
- Turns upward, forward, medially – medulla oblongata
- Lower border of pons – joins opposite side to form
  - ***BASILAR***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


CIRCLE OF WILLIS
Internal Carotid Artery
Anterior Cerebral Artery
Middle Cerebral Artery
Circle of Willis
Anterior Communicating Artery
Posterior Communicating Artery
Posterior Cerebral Artery
Basilar Artery
Vertebral Artery
Posterior Inferior Cerebellar Artery
WALTER CRANE

Basilar artery

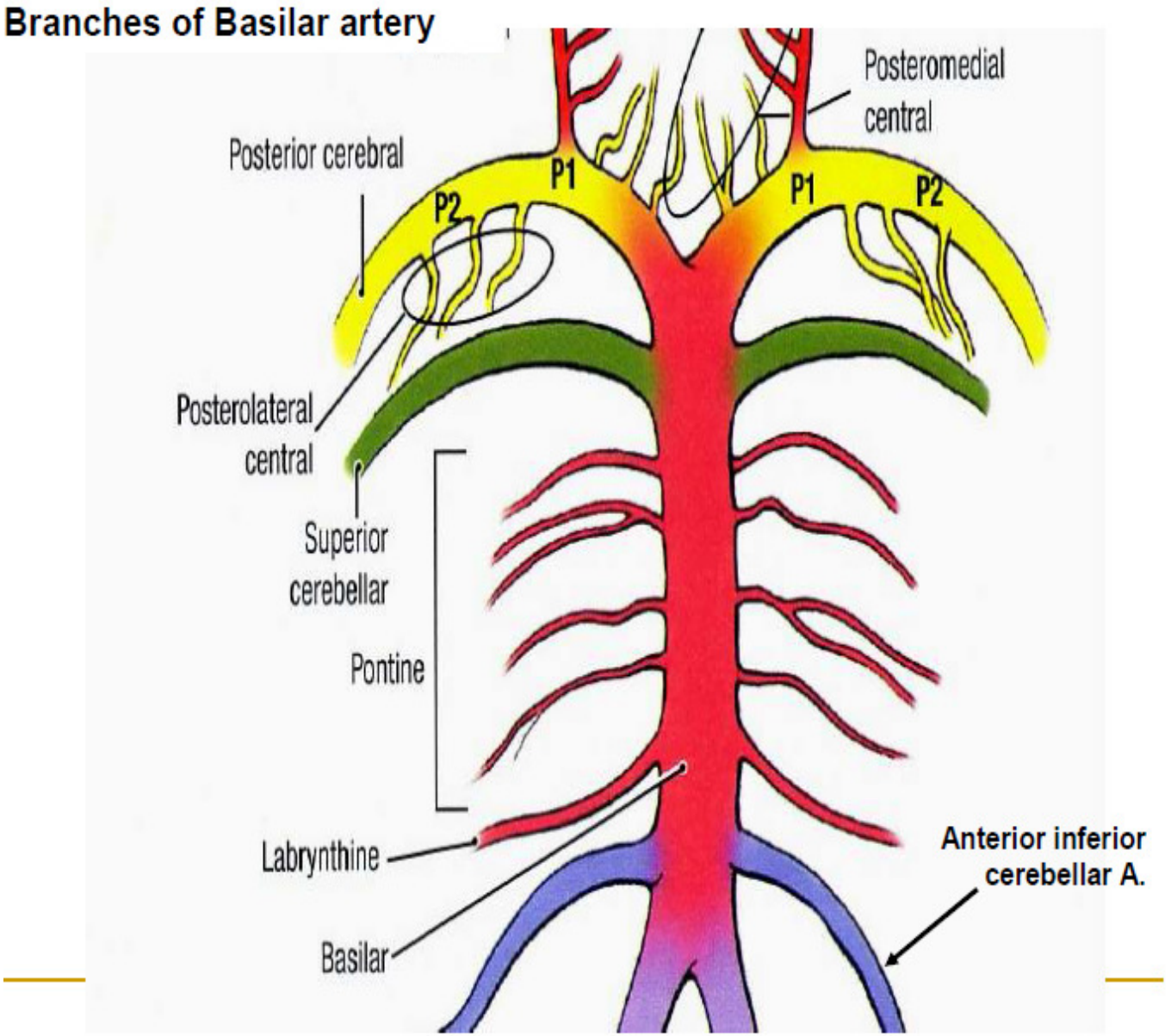
- Formed by the **union** of the two vertebral arteries at the **lower border** of the **pons**
- Ascends on the front of the pons lodged in the **basilar groove**
- Ends at the **upper border** of the pons by dividing into 2 **Posterior cerebral arteries (PCA)**

Branches of Basilar artery



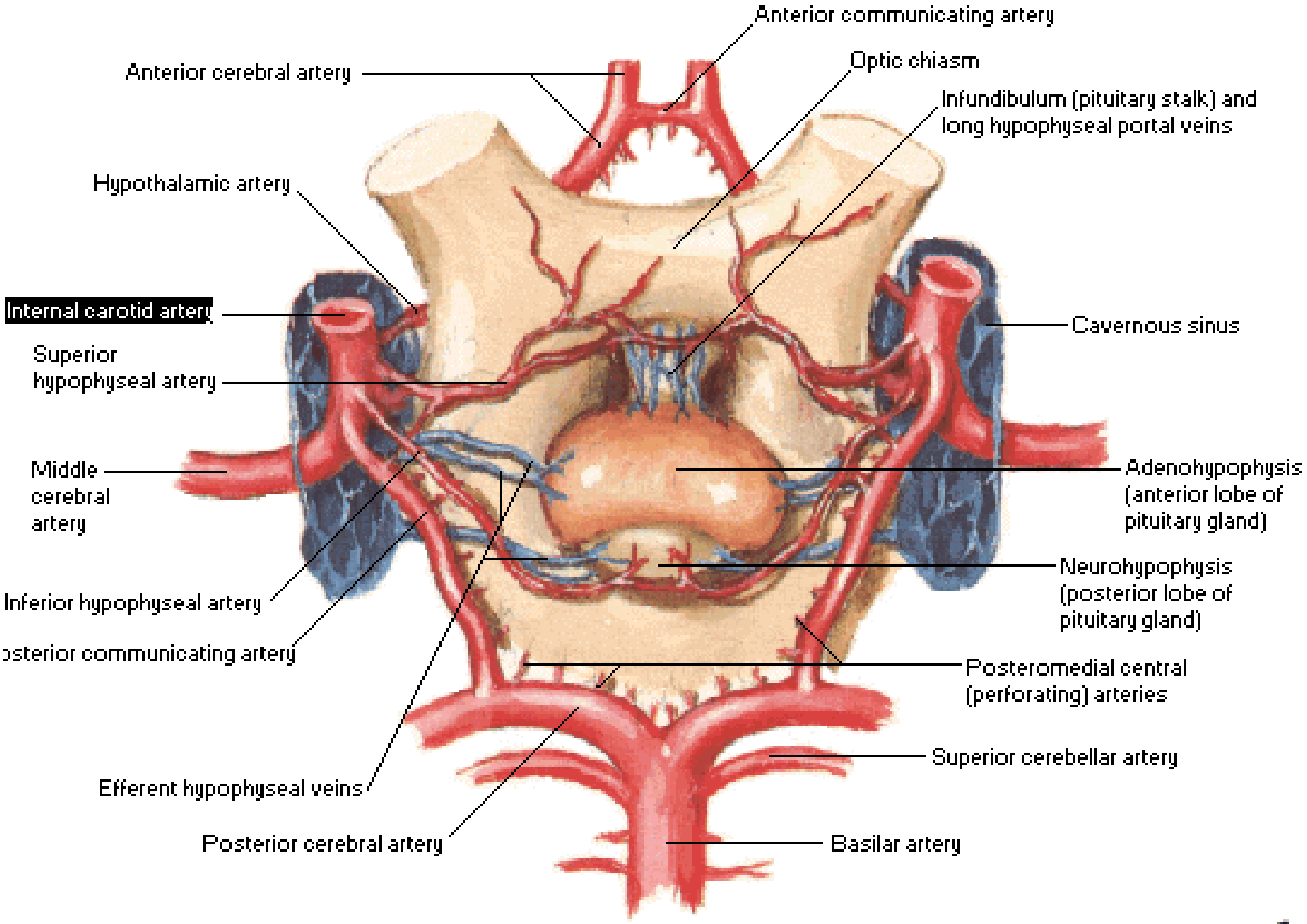
Basilar artery

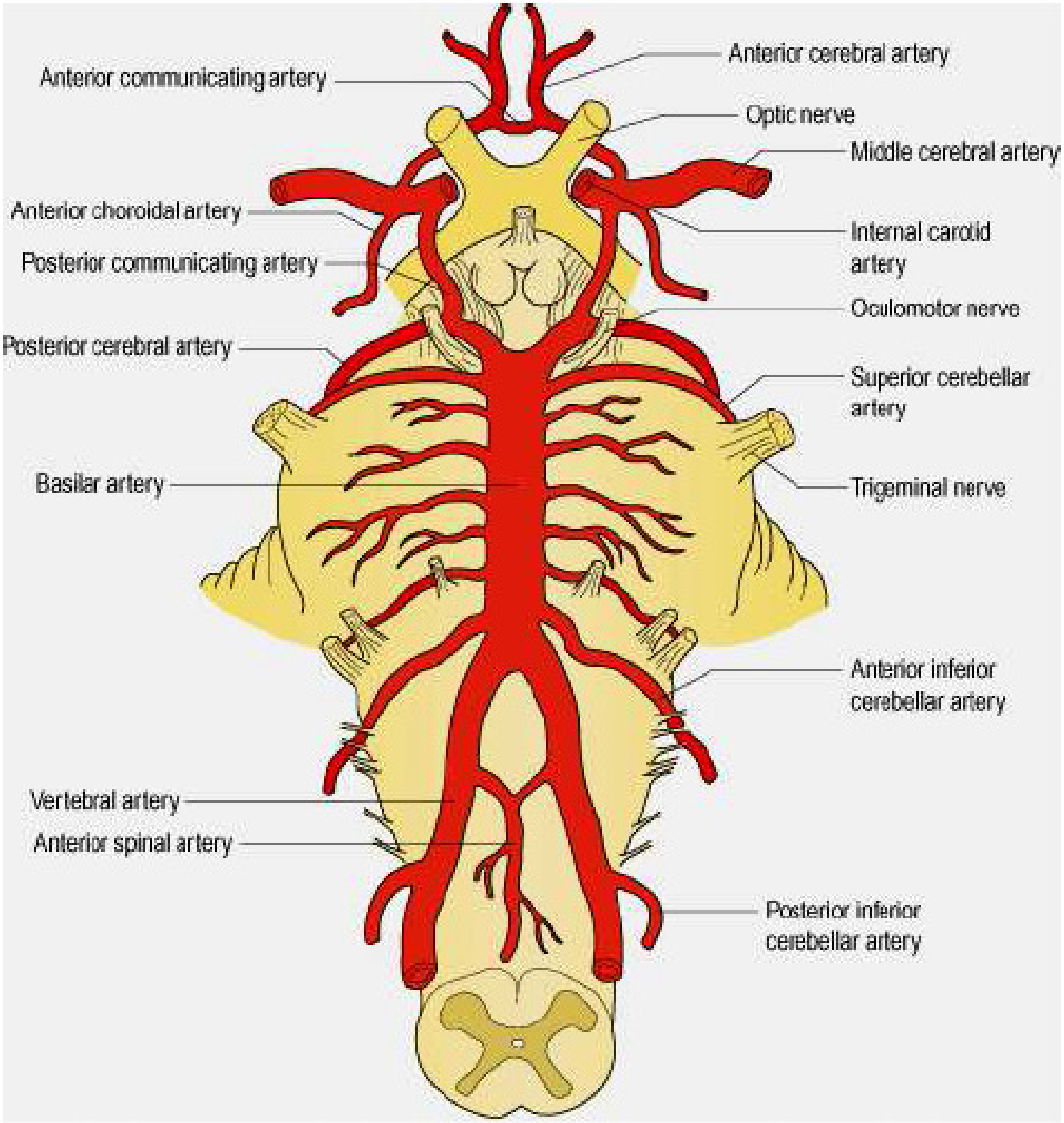
- Branches of basilar artery
- ➢ anterior inferior cerebellar artery (AICA) supplies inferior surface of the cerebellum
- ➢ labyrinthine artery supplies the membranous labyrinth of the internal ear
- ➢ Pontine arteries supply pons
- ➢ superior cerebellar artery supplies superior surface of cerebellum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

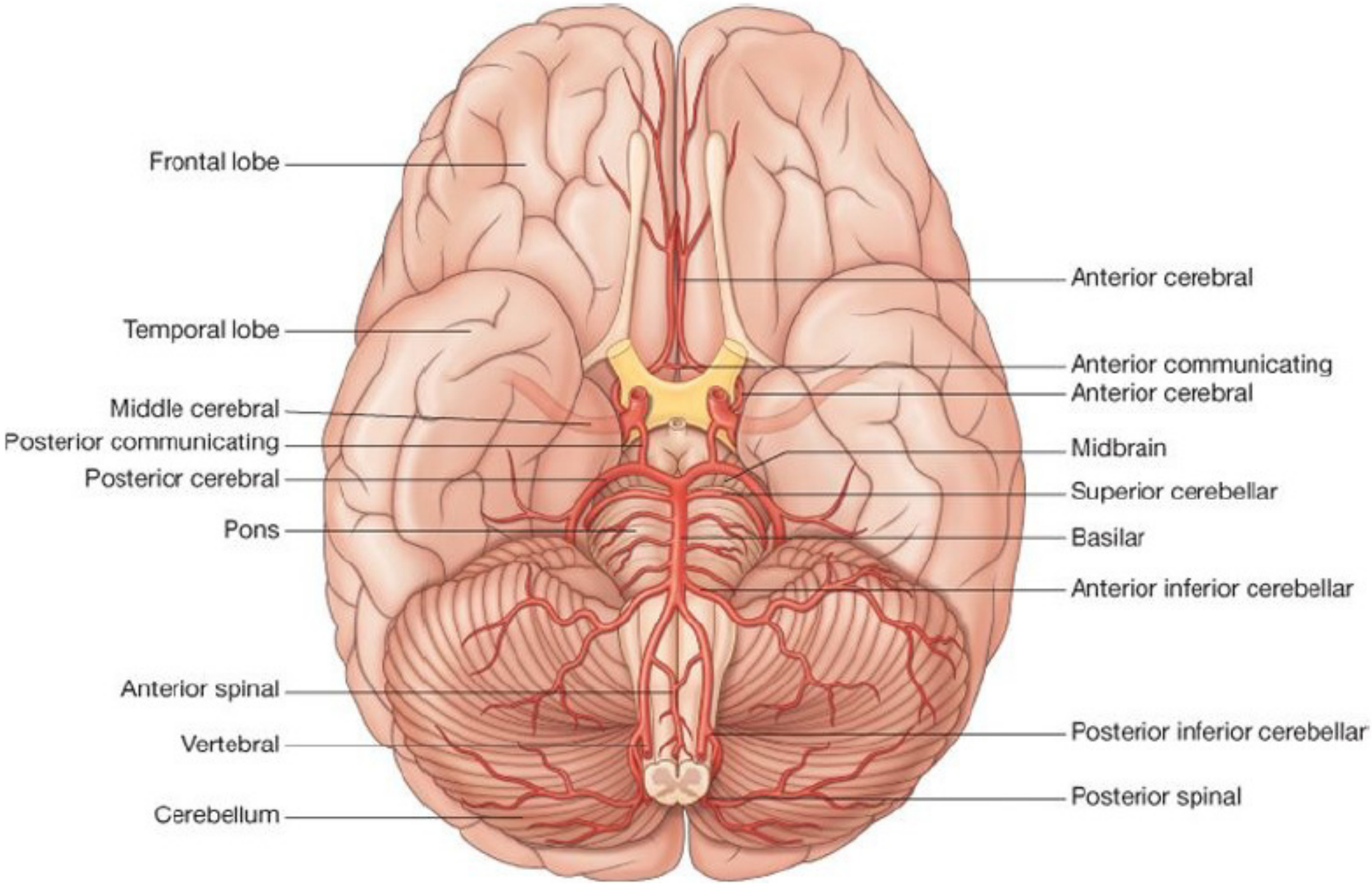


Cerebral Arterial Circle [Willis] - Vessels in Situ

Inferior View

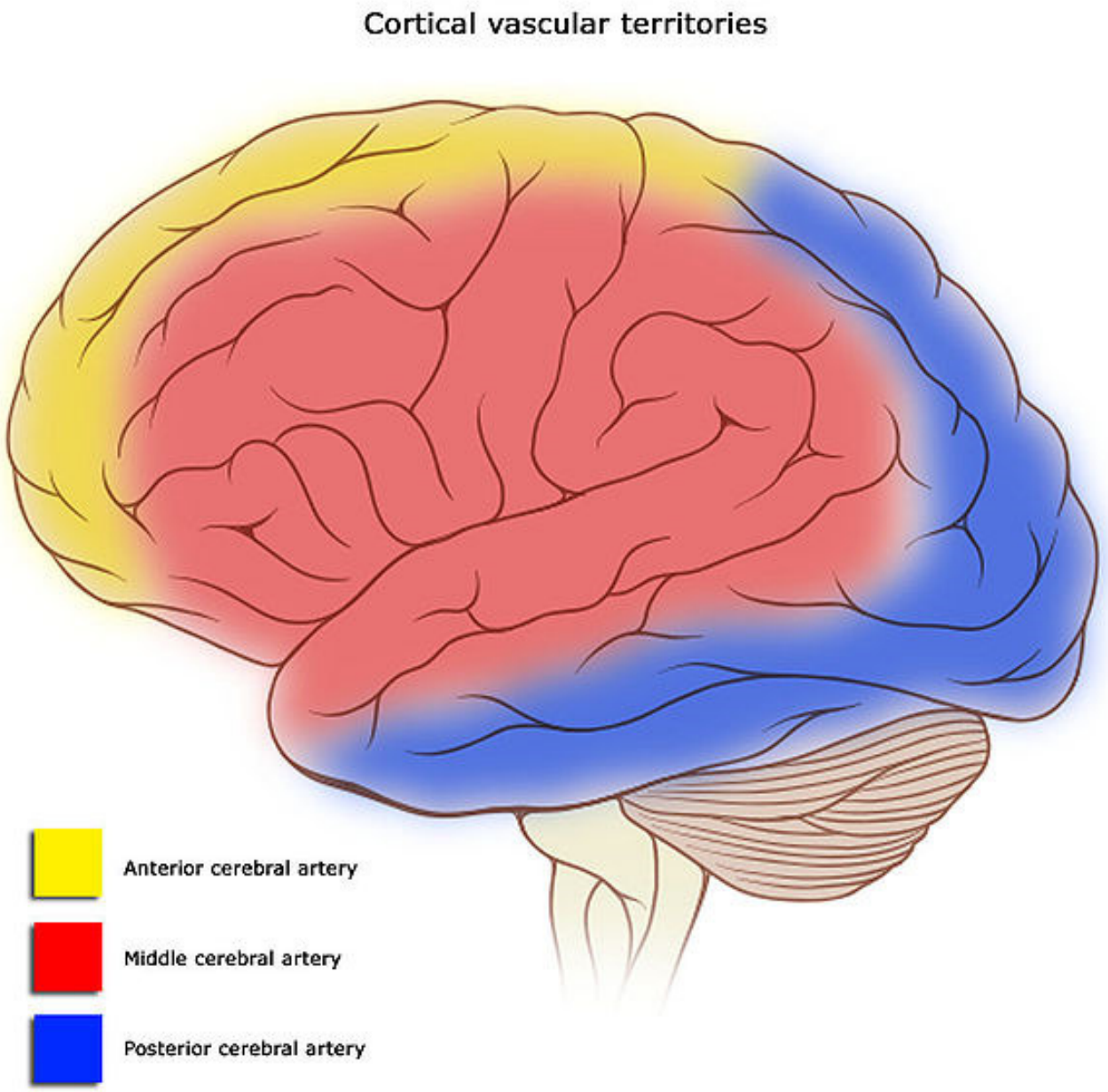



Anterior communicating artery
Anterior cerebral artery
Optic nerve
Middle cerebral artery
Anterior choroidal artery
Internal carotid artery
Posterior communicating artery
Oculomotor nerve
Posterior cerebral artery
Superior cerebellar artery
Basilar artery
Trigeminal nerve
Anterior inferior cerebellar artery
Vertebral artery
Anterior spinal artery
Posterior inferior cerebellar artery


Frontal lobe
Temporal lobe
Middle cerebral
Posterior communicating
Posterior cerebral
Pons
Anterior spinal
Vertebral
Cerebellum
Anterior cerebral
Anterior communicating
Anterior cerebral
Midbrain
Superior cerebellar
Basilar
Anterior inferior cerebellar
Posterior inferior cerebellar
Posterior spinal

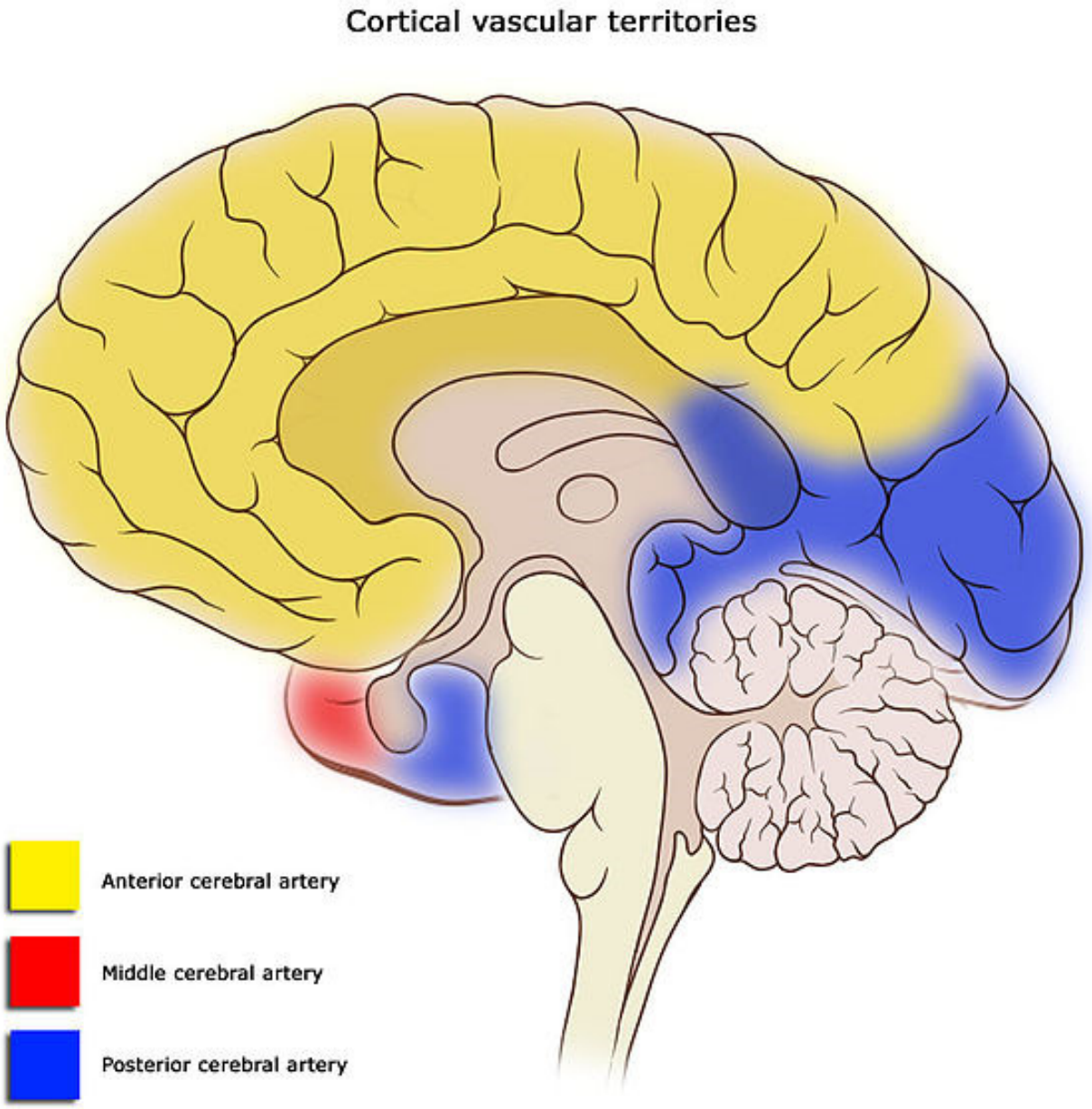
Middle Cerebral Artery

- 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)



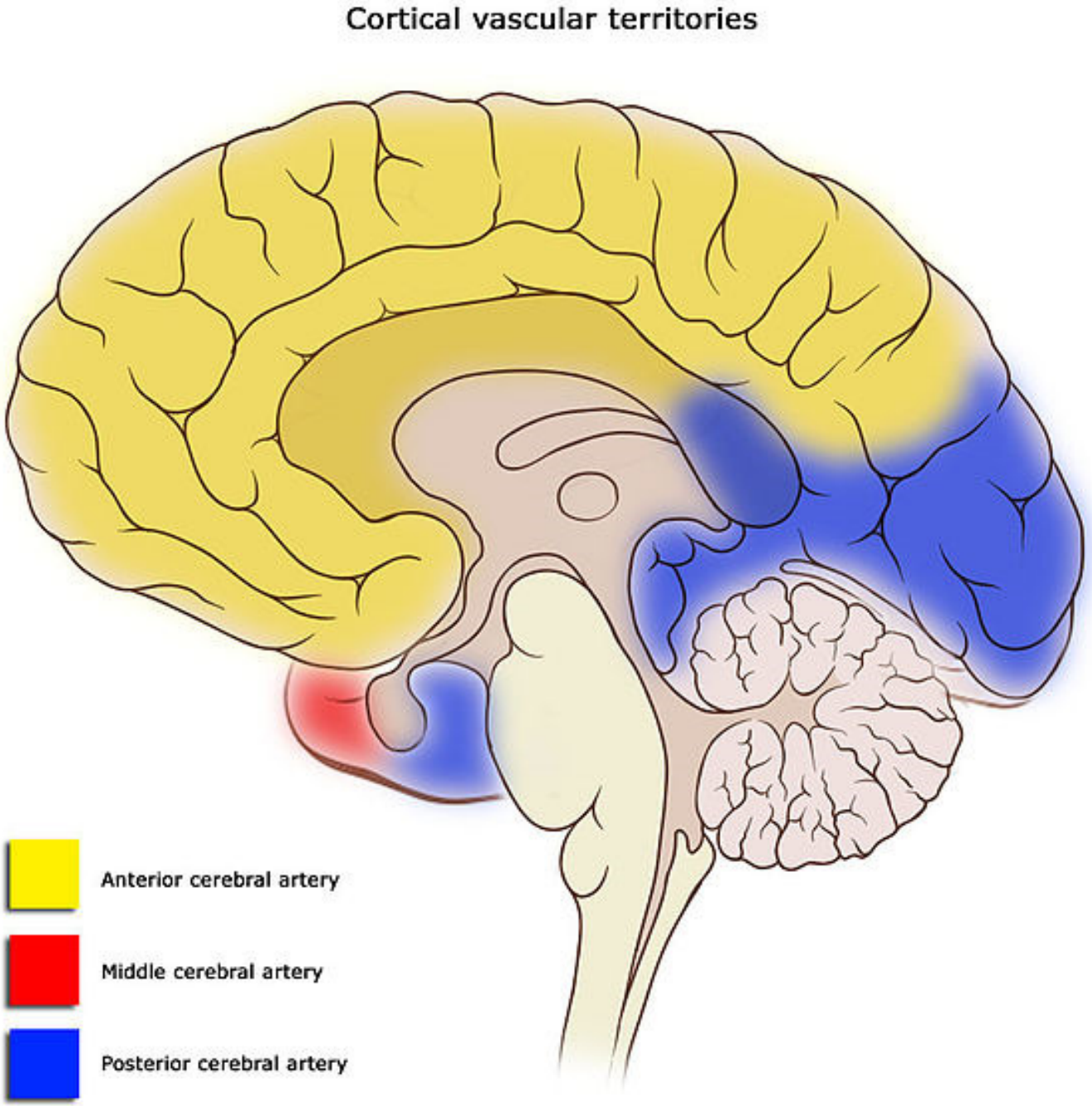
Anterior Cerebral Artery

- 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

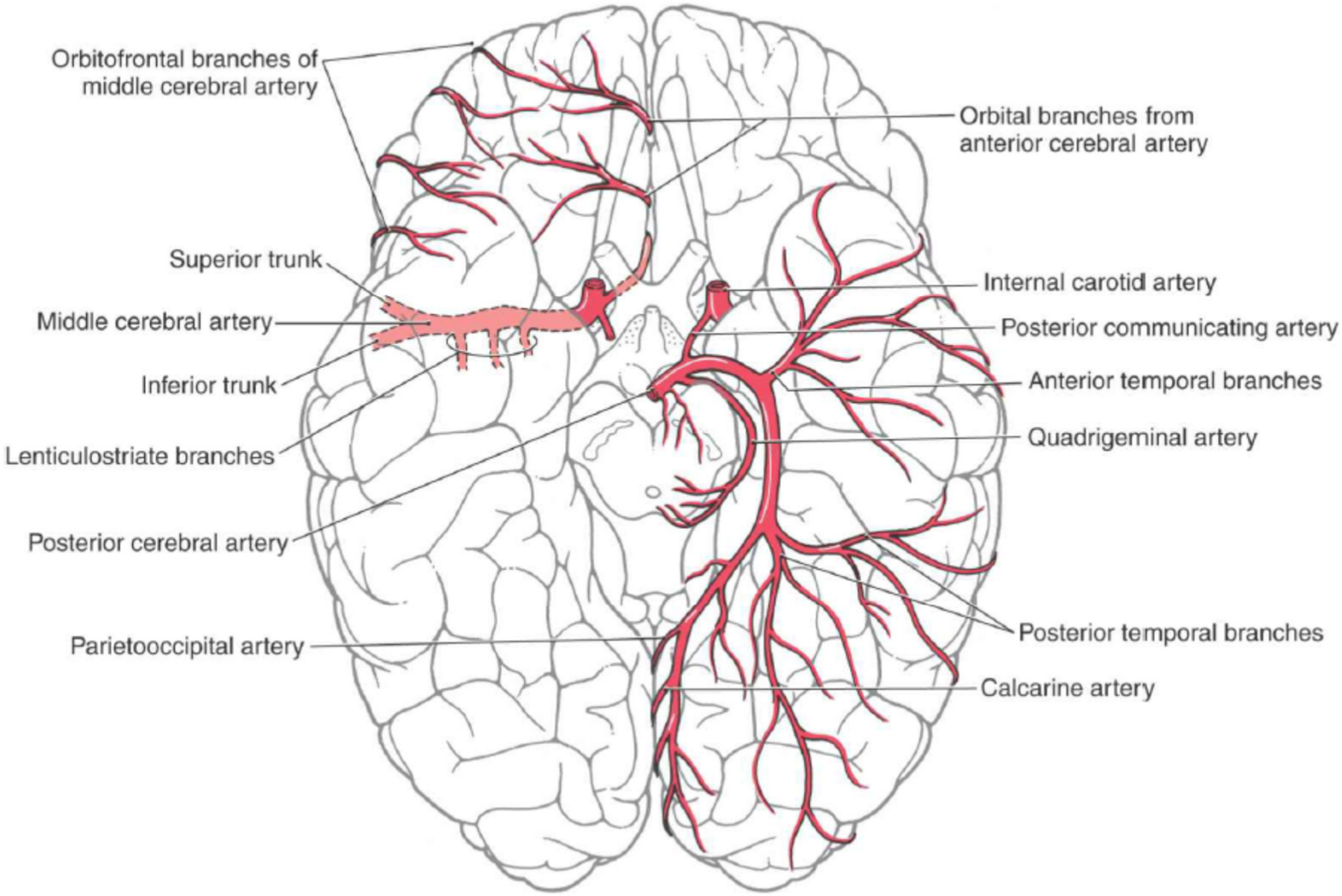


Posterior Cerebral Artery

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



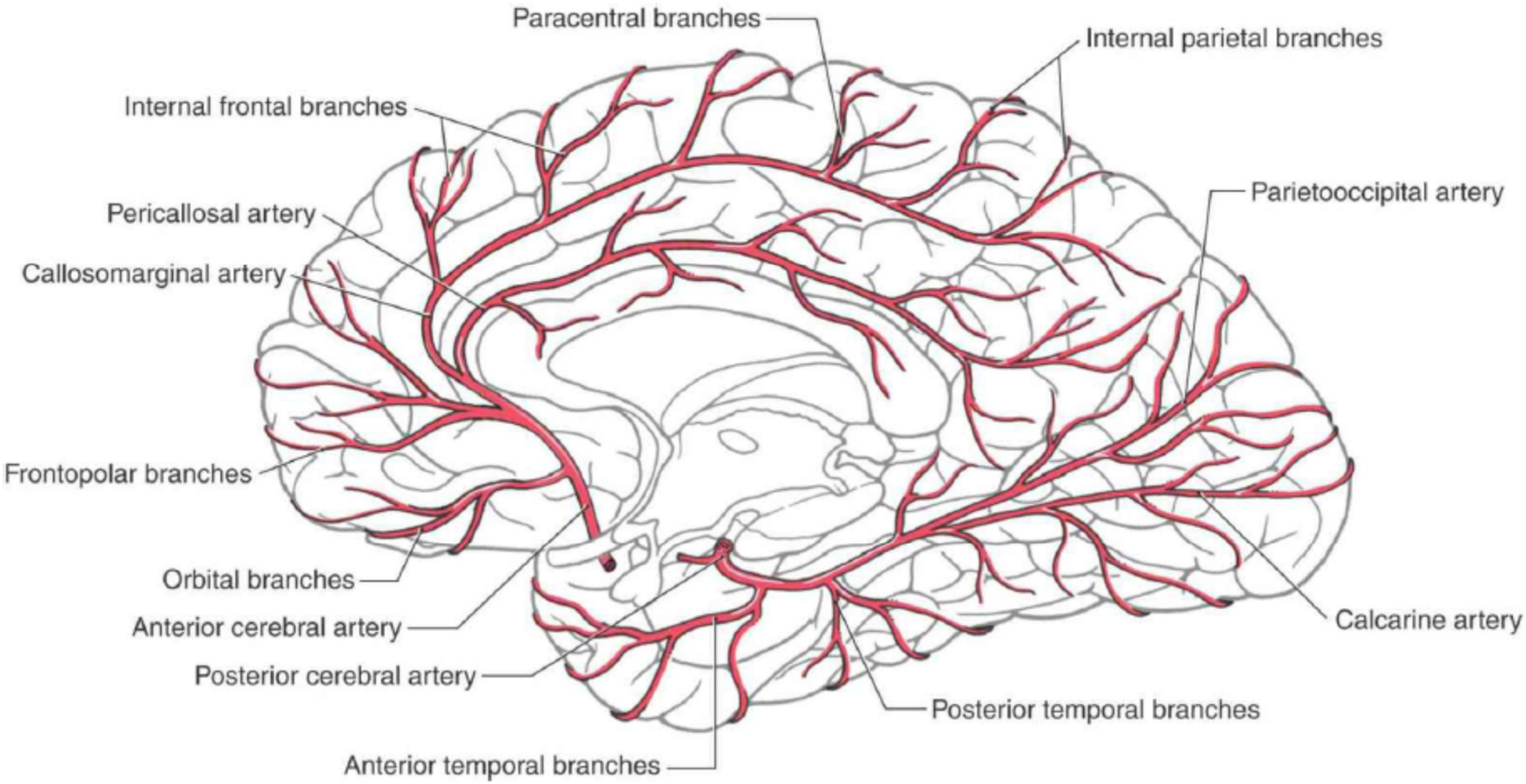
Posterior Cerebral Artery



- **Cortical branches**
- **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.

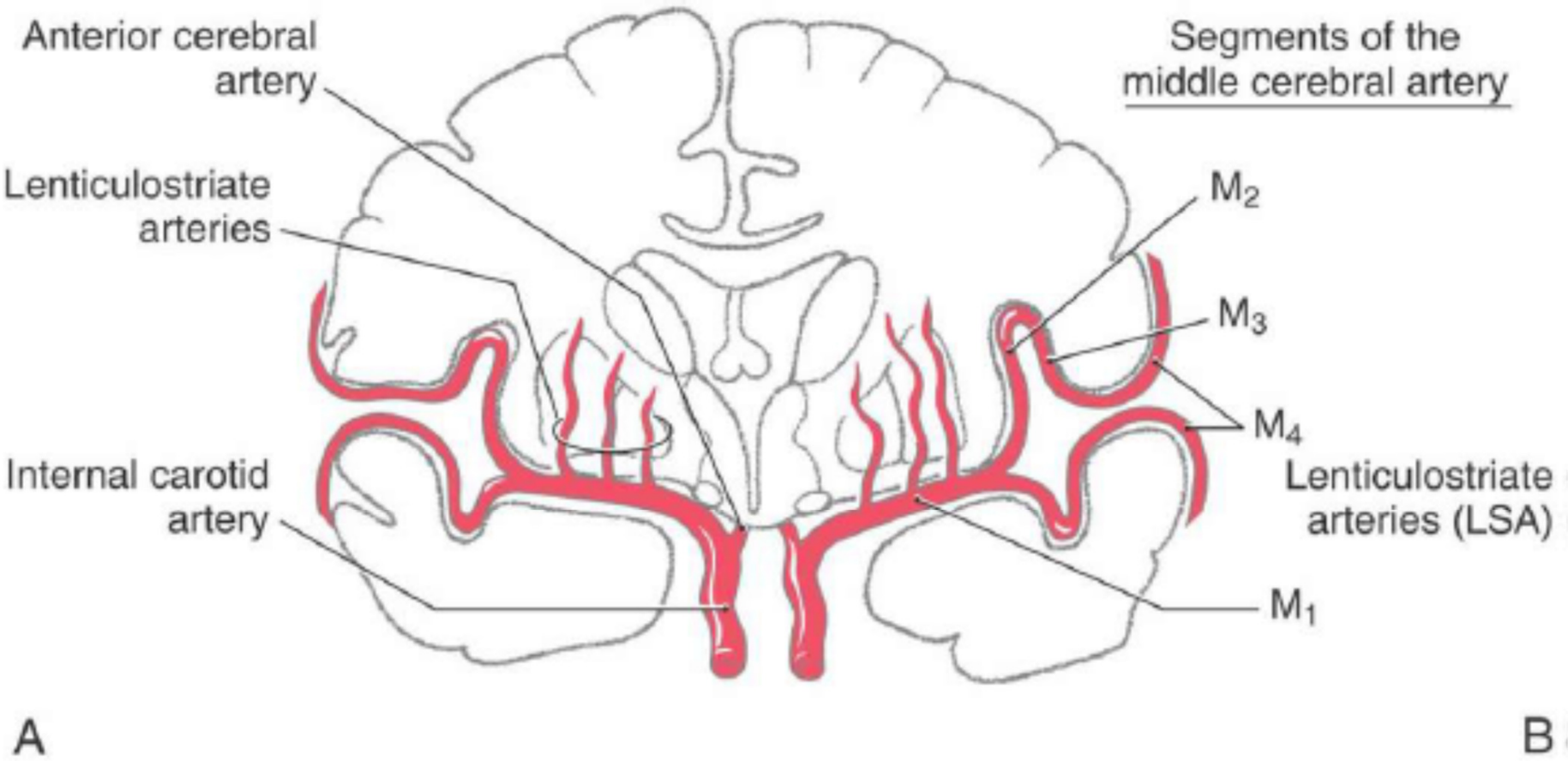
Anterior Cerebral Artery

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



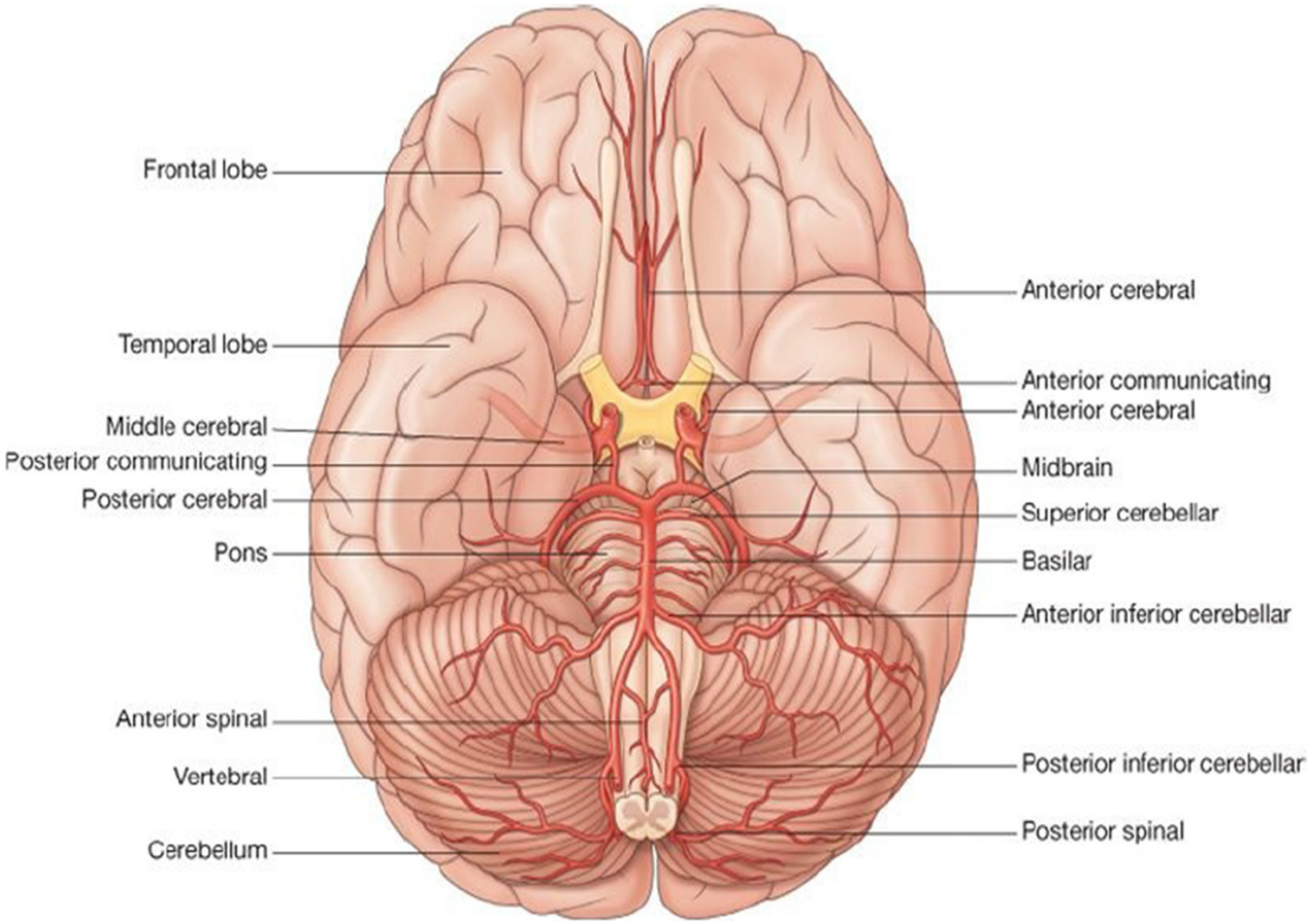
Middle Cerebral Artery

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

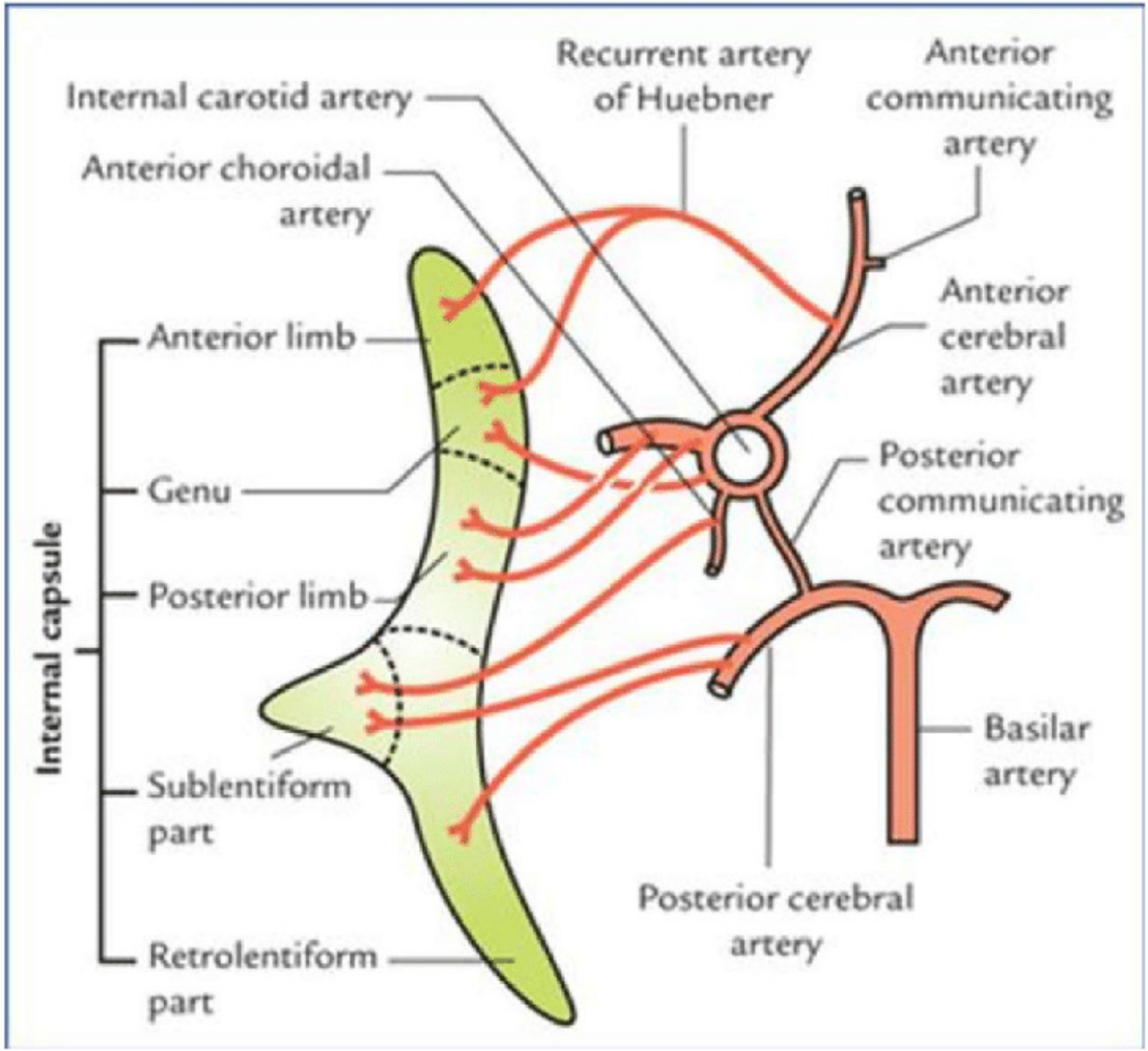


Arteries to Specific Brain Areas

- **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



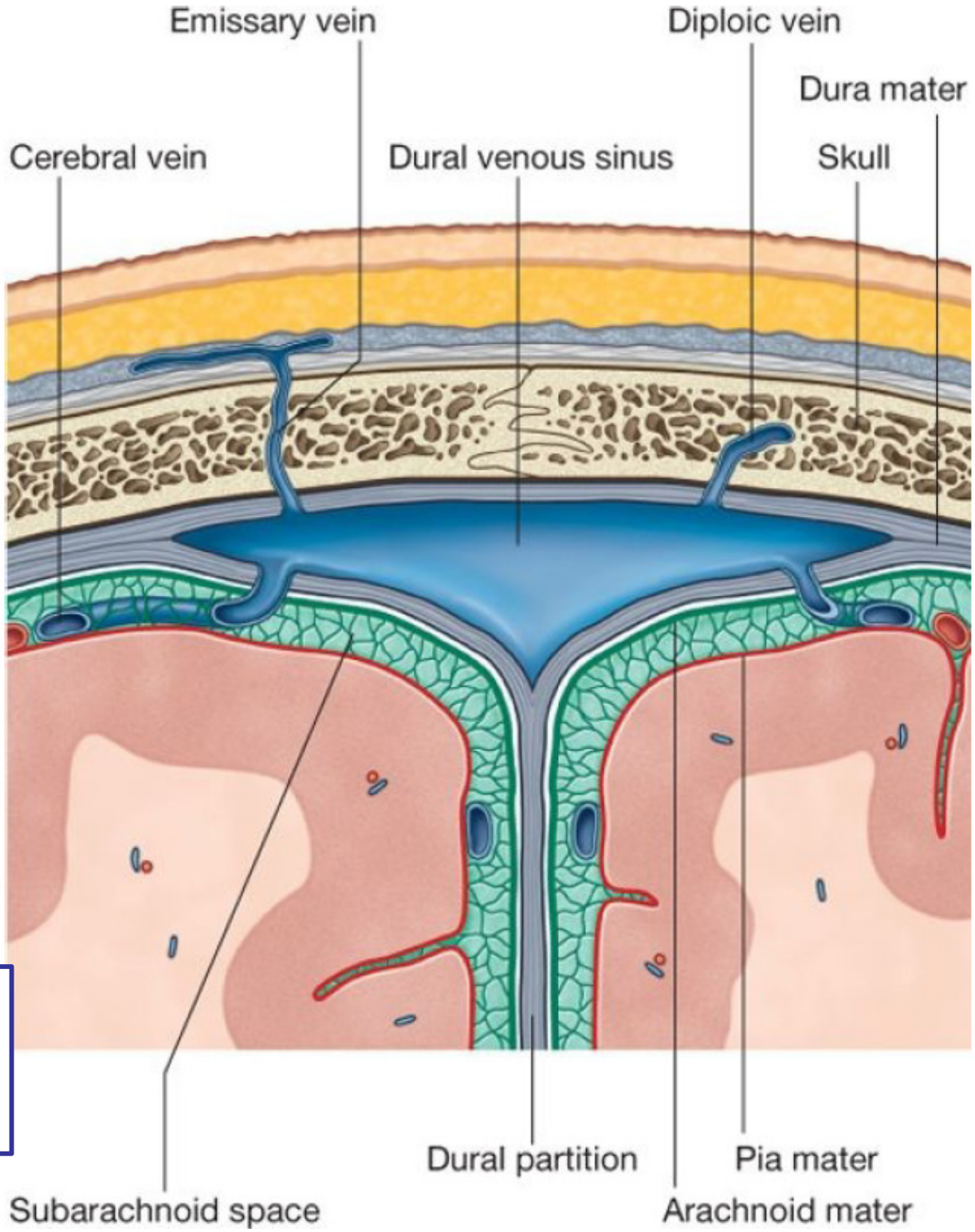
Veinous drainage of the brain

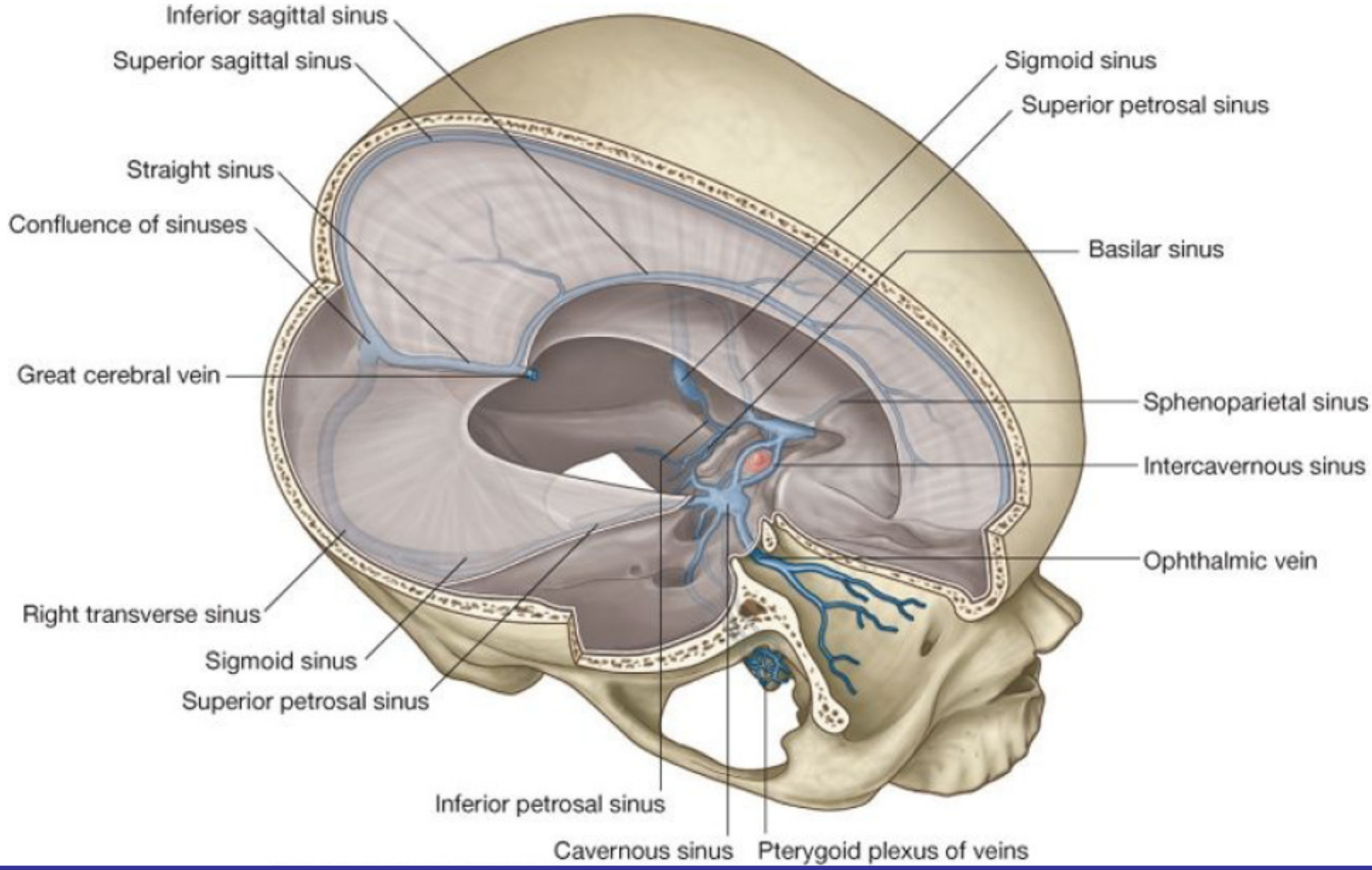
- Veins of the brain have no muscular tissue in their wall
- No valves
- Lie in subarachnoid space
- Pierce the arachnoid mater and the meningeal layer of the dura and drain into the cranial venous sinuses

❖ Veins of the brain

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

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

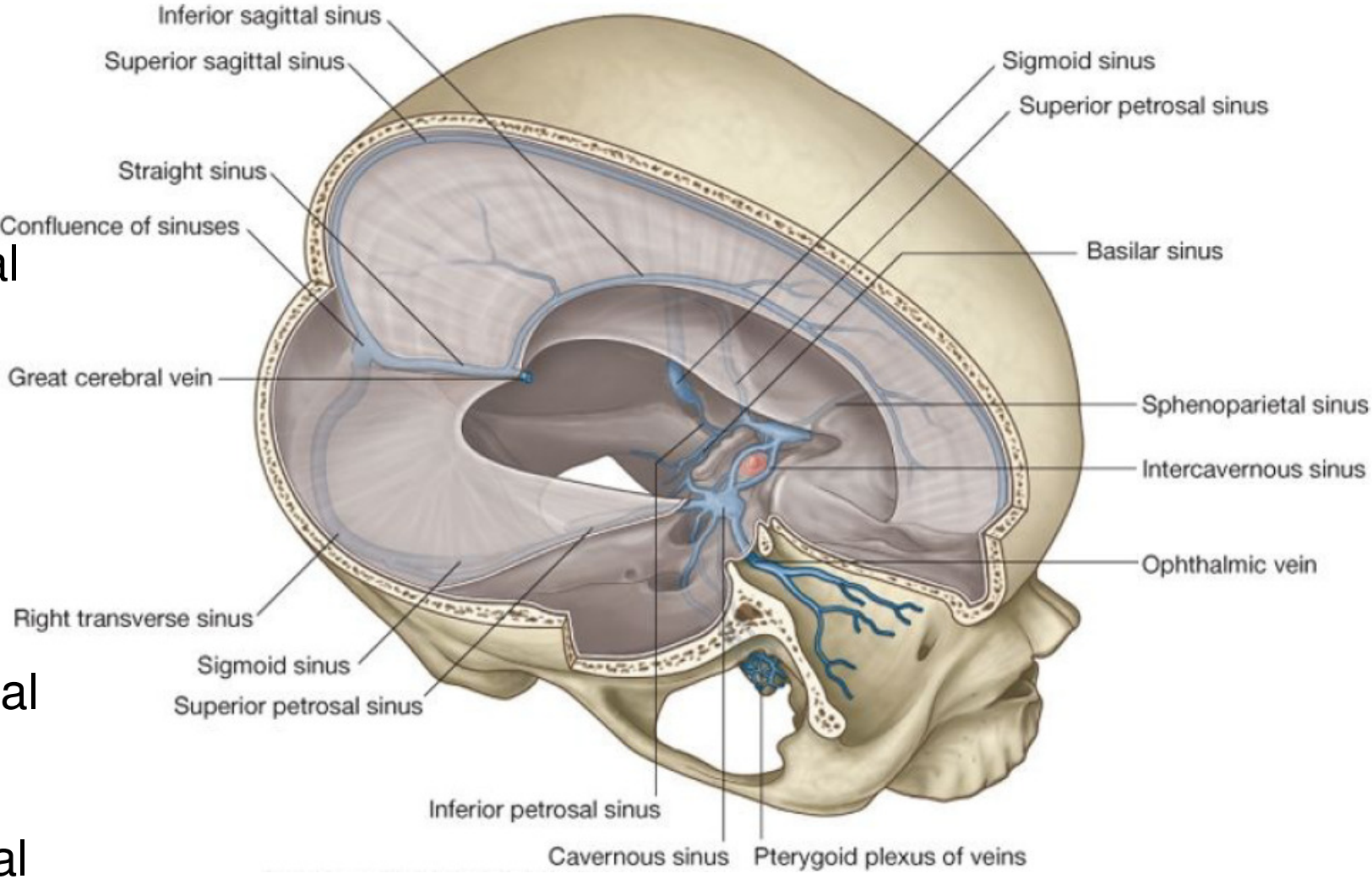




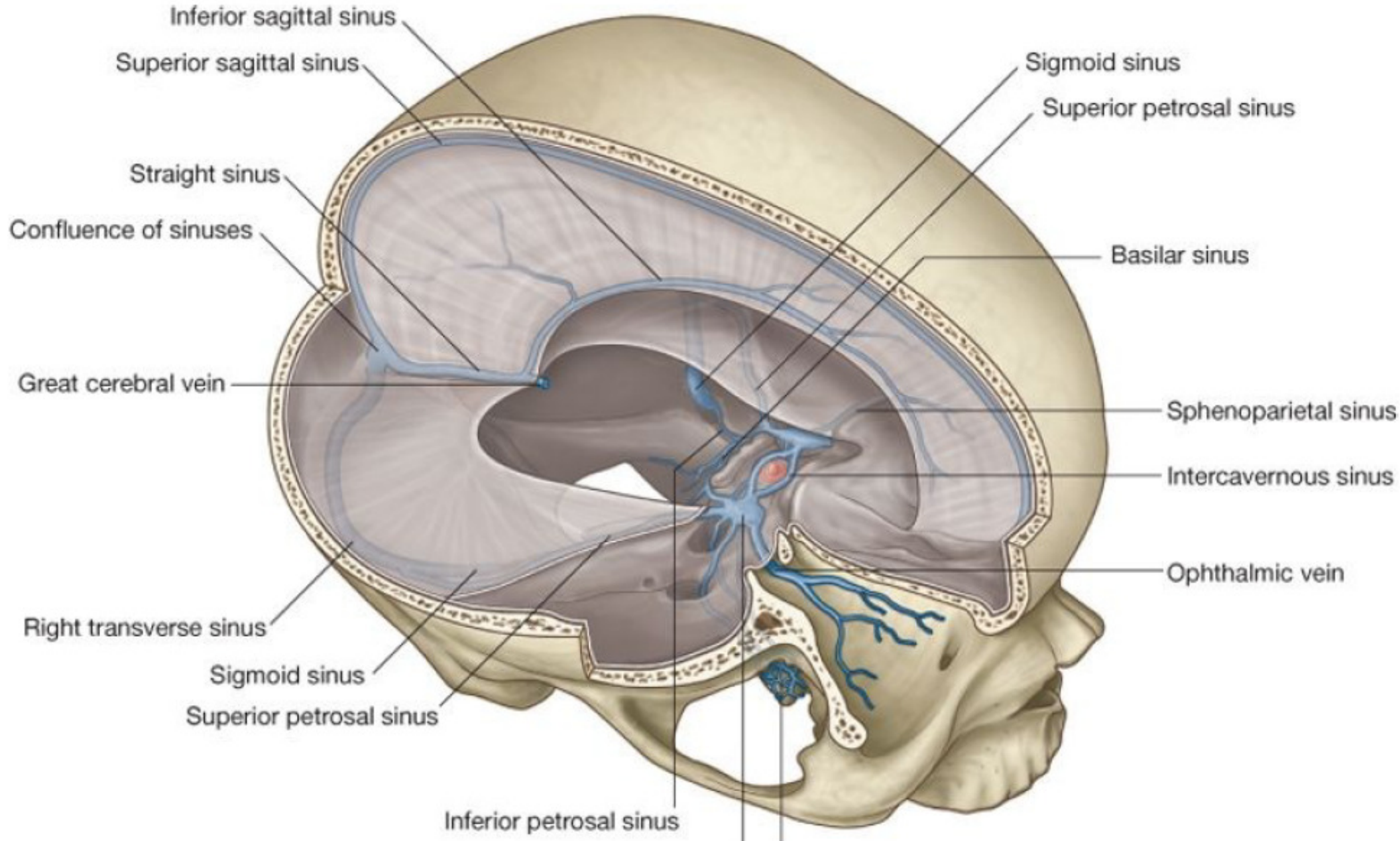
The **deep** venous drainage is primarily composed of traditional veins inside the deep structures of the brain, which join behind the midbrain to form the vein of Galen (**great cerebral vein**). This vein merges with the inferior sagittal sinus to form the straight sinus which then joins the superficial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

Dural venous sinuses

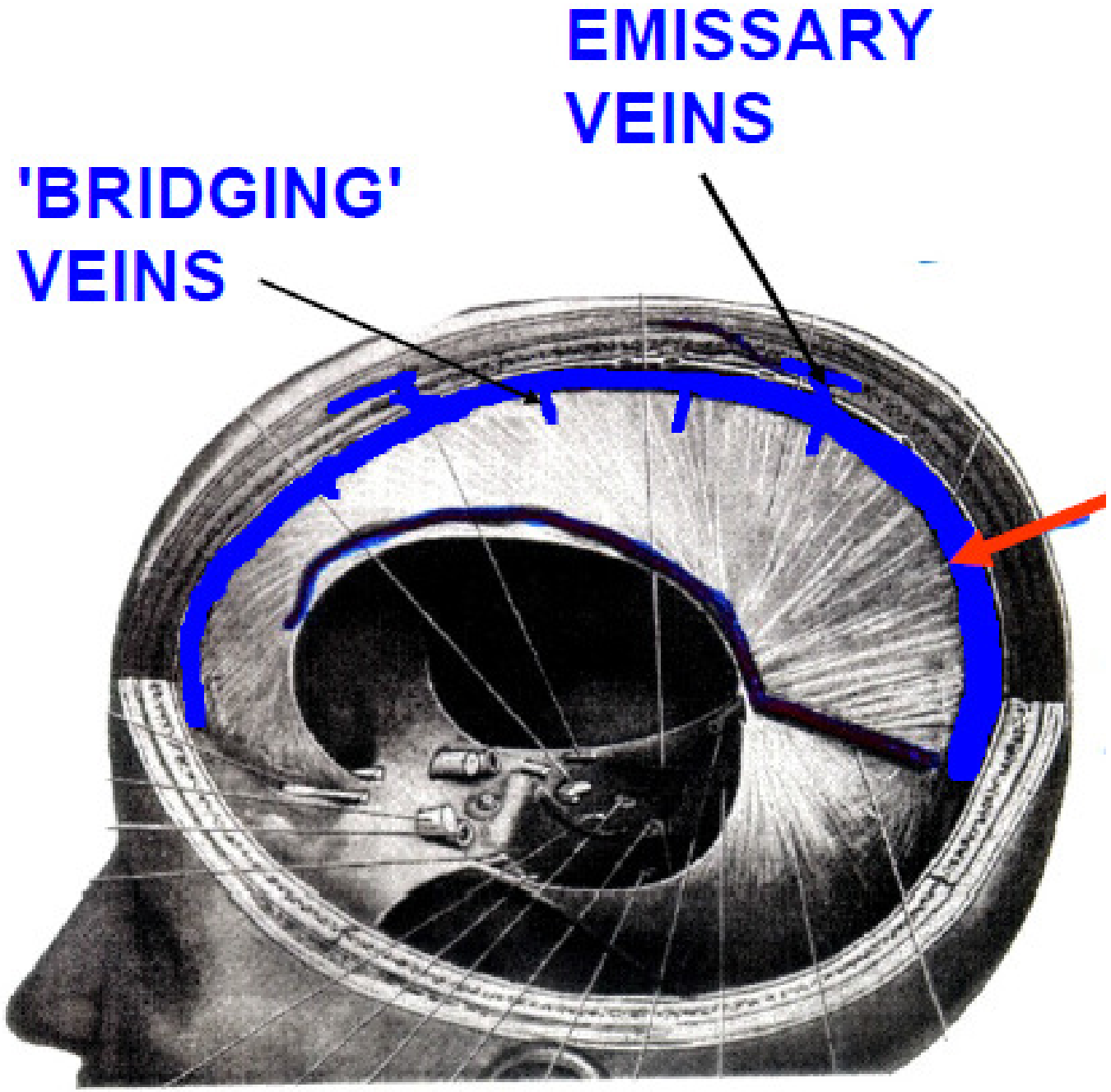
1) Superior sagittal
2) Inferior sagittal
3) Straight
4) Transverse
5) Sigmoid
6) Occipital sinuses
7) Cavernous
8) Superior and Inferior petrosal
9) Confluence of sinuses
10) Sphenoparietal
11) Basilar sinus



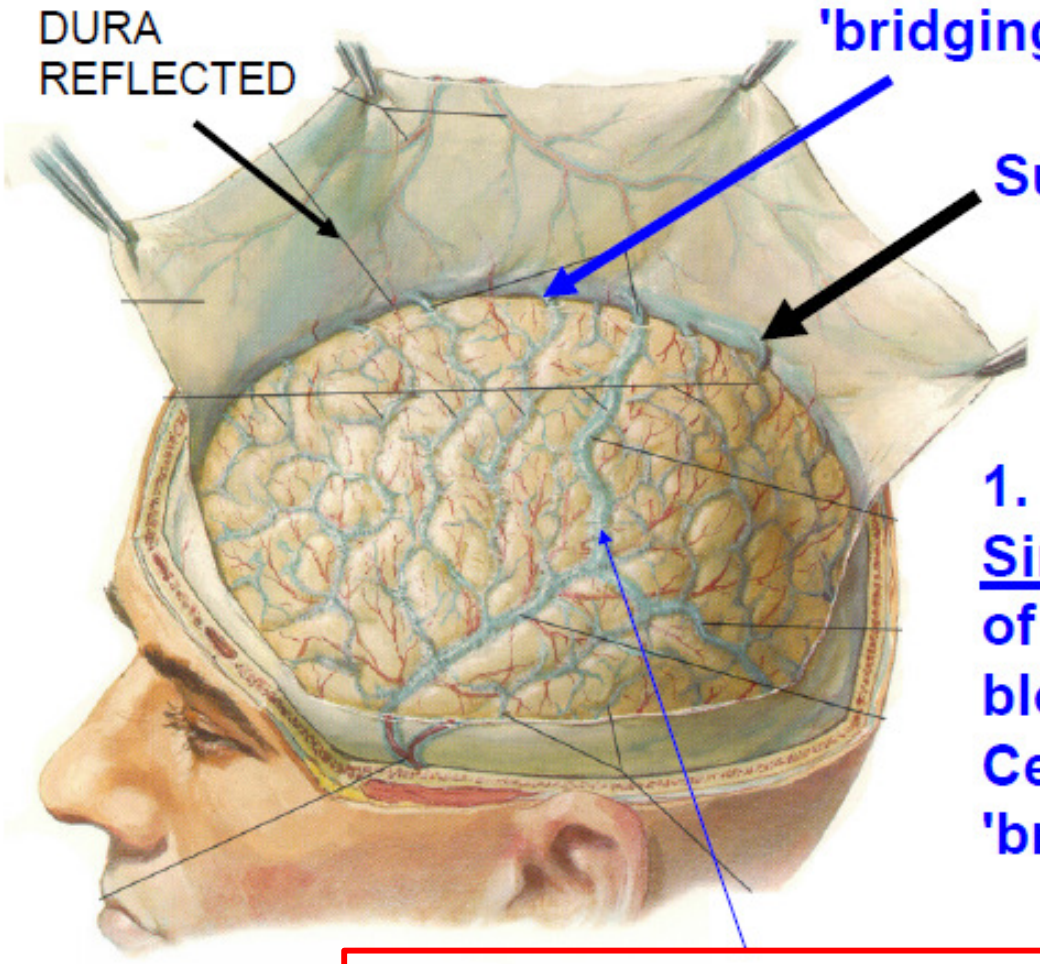
- Endothelial-lined spaces
- **Location**: between the outer periosteal and the inner meningeal layers of the dura mater
- **Empty into**: internal jugular veins.



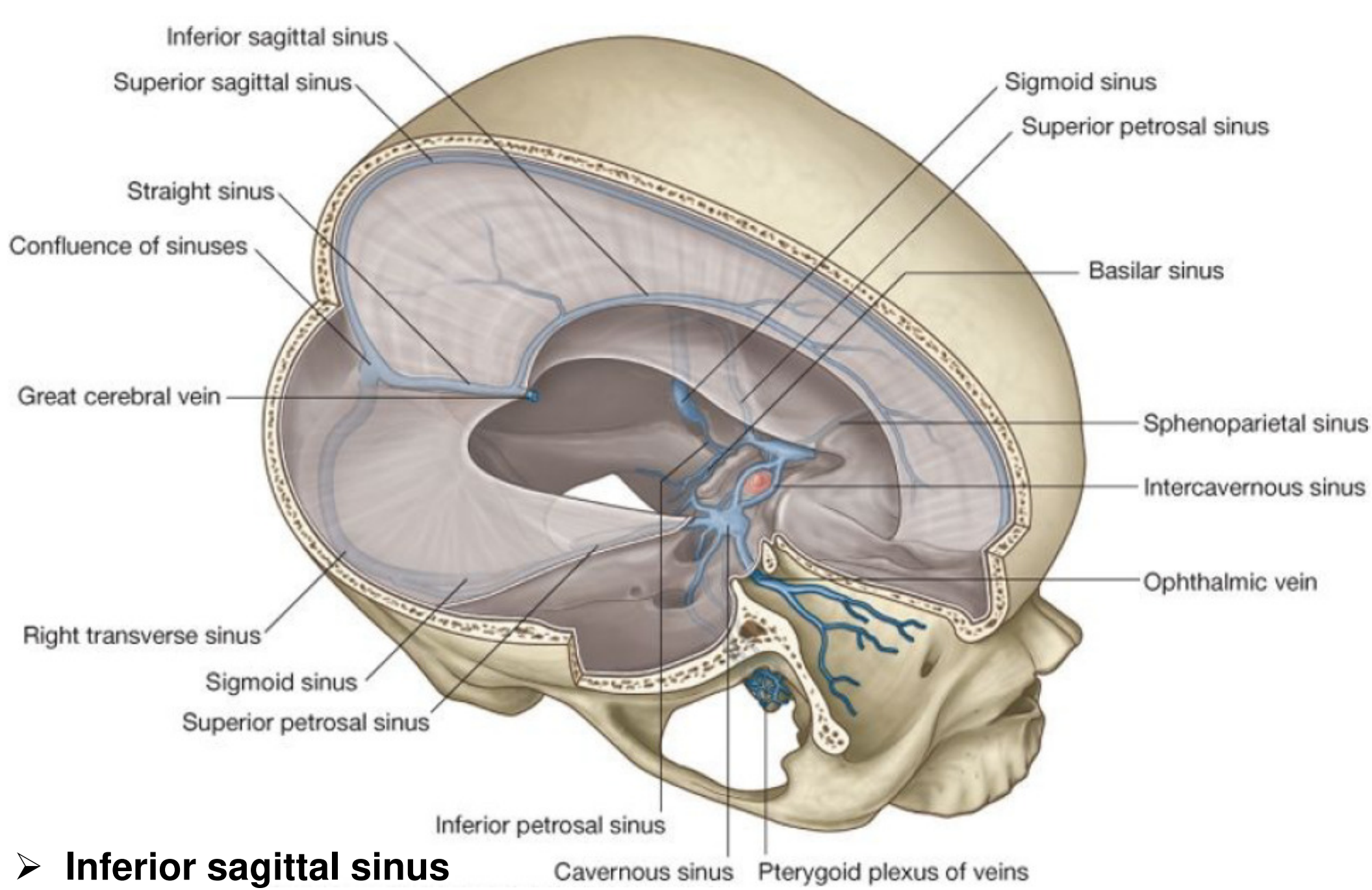
- **Superior sagittal sinus**
- **Location:** Superior border of falx cerebri
- **Receives from**: Superior cerebral, diploic, and emissary veins and CSF


EMISSARY VEINS
'BRIDGING' VEINS
Brain removed

Brain not removed

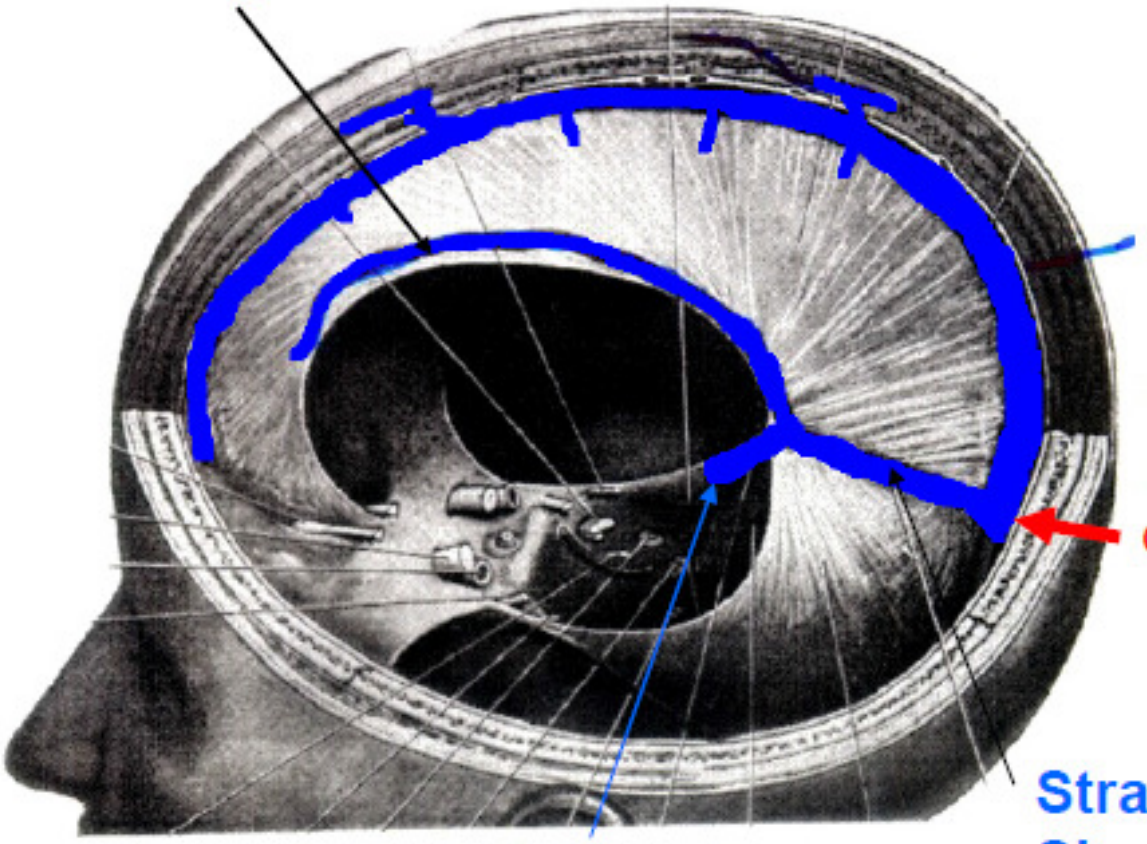


1. Superior Sagittal Sinus – in upper border of falx cerebri; receives blood from Superior Cerebral veins through 'bridging veins'



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

VENOUS SINUSES

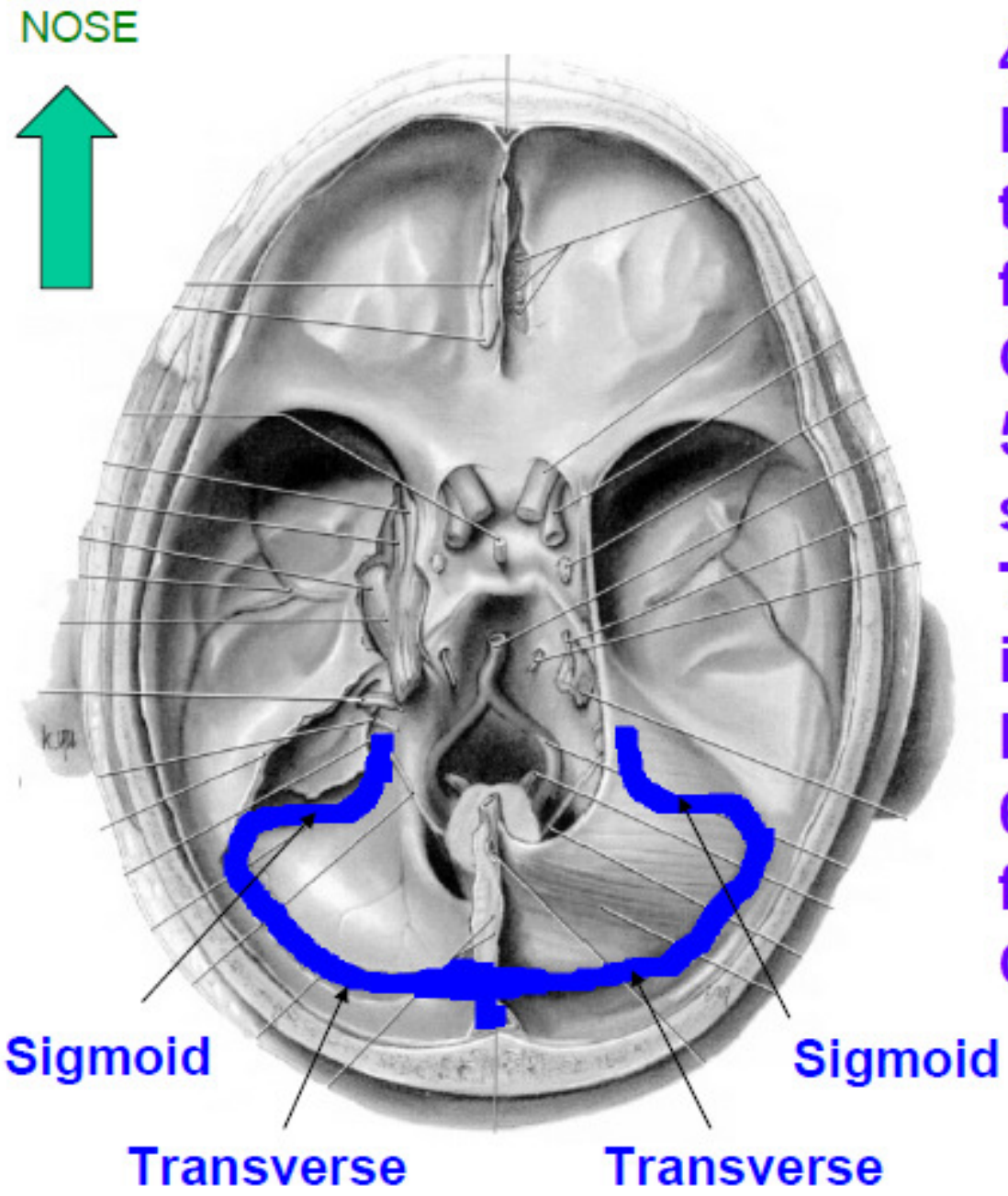


2. Inferior Sagittal Sinus - in lower (free) border of falx cerebri; - joins Great Cerebral V. form Straight Sinus

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

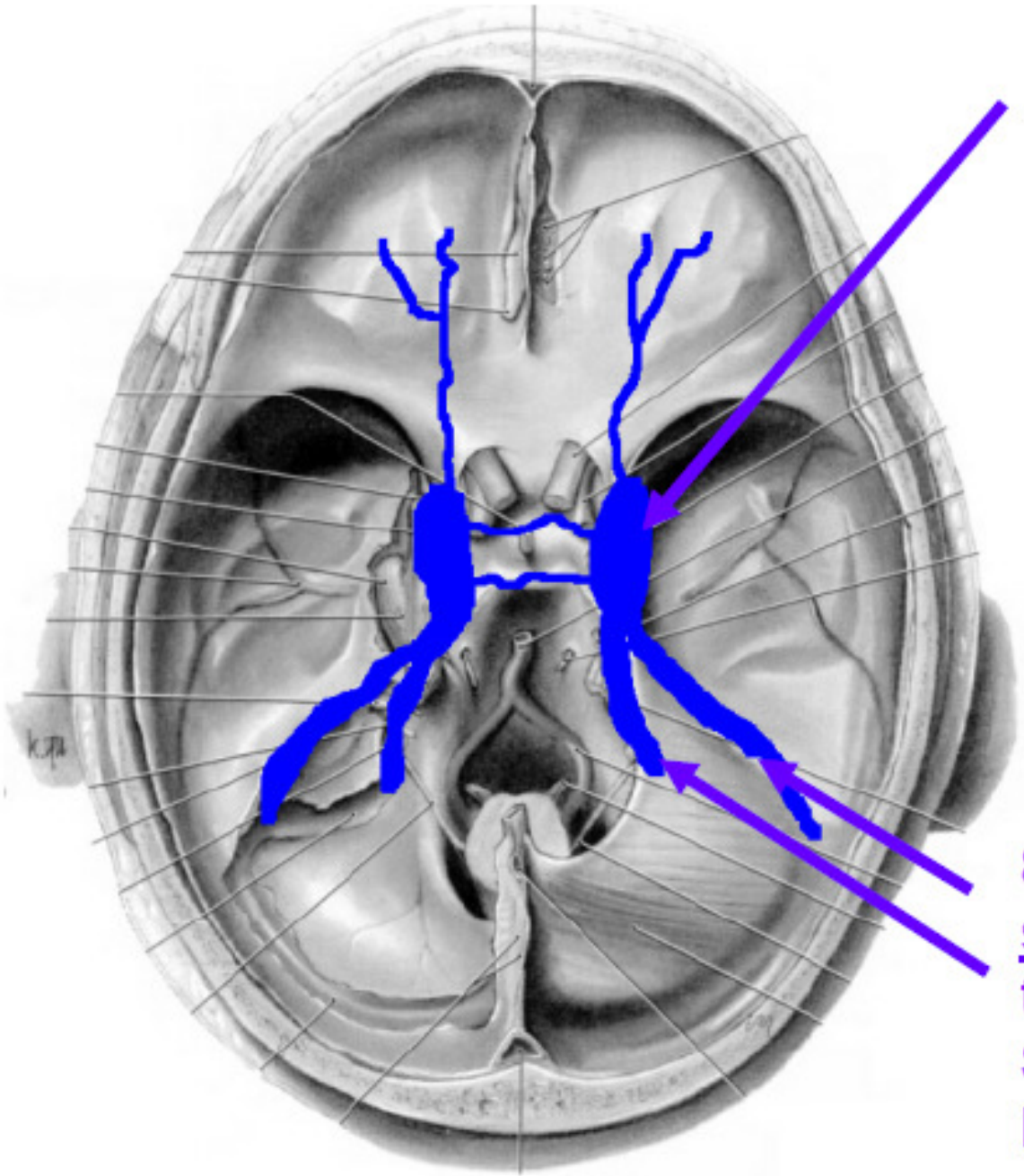
Straight Sinus can join Superior Sagittal Sinus at Confluens of Sinuses or turn left

VENOUS SINUSES



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

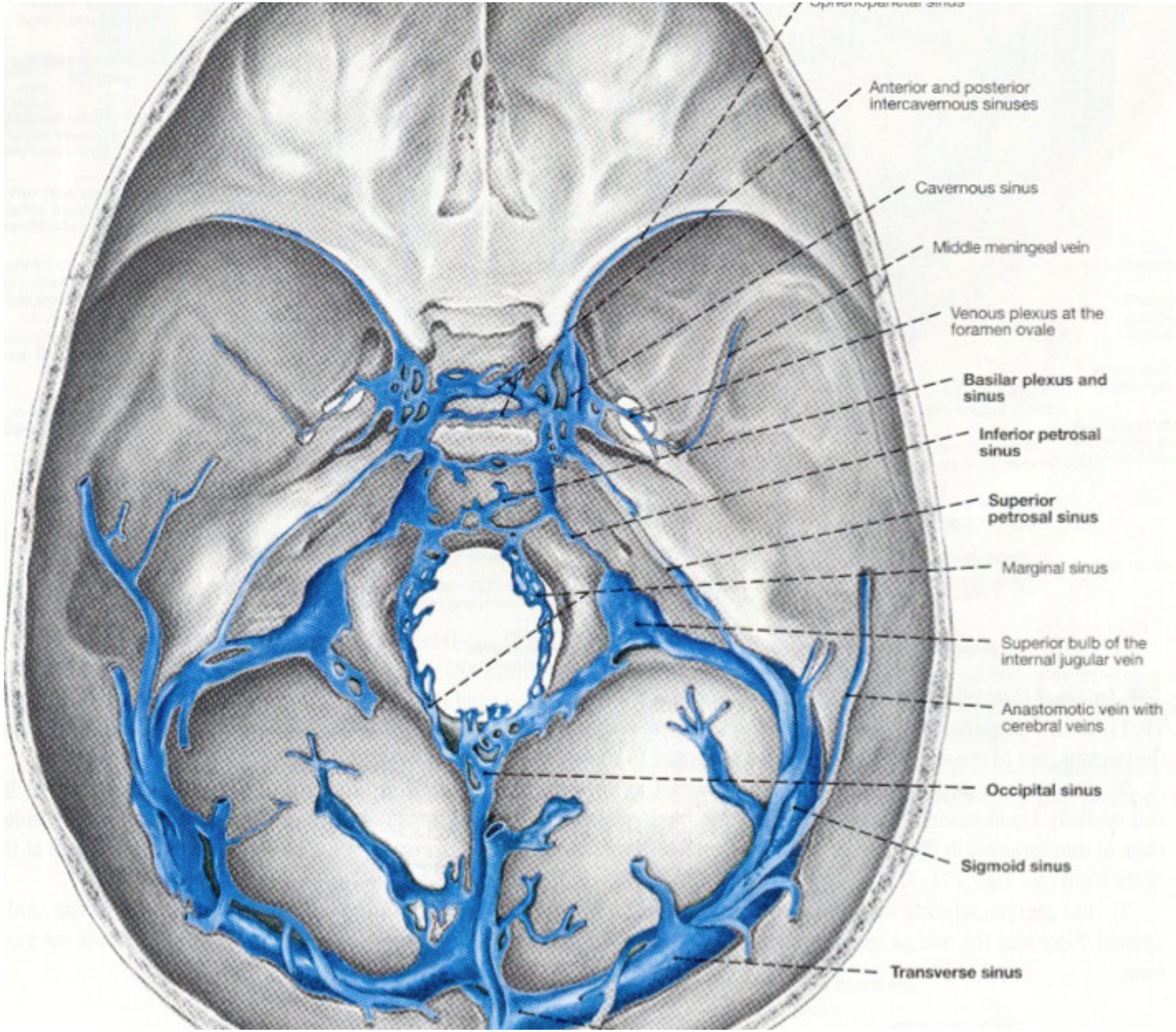
VENOUS SINUSES



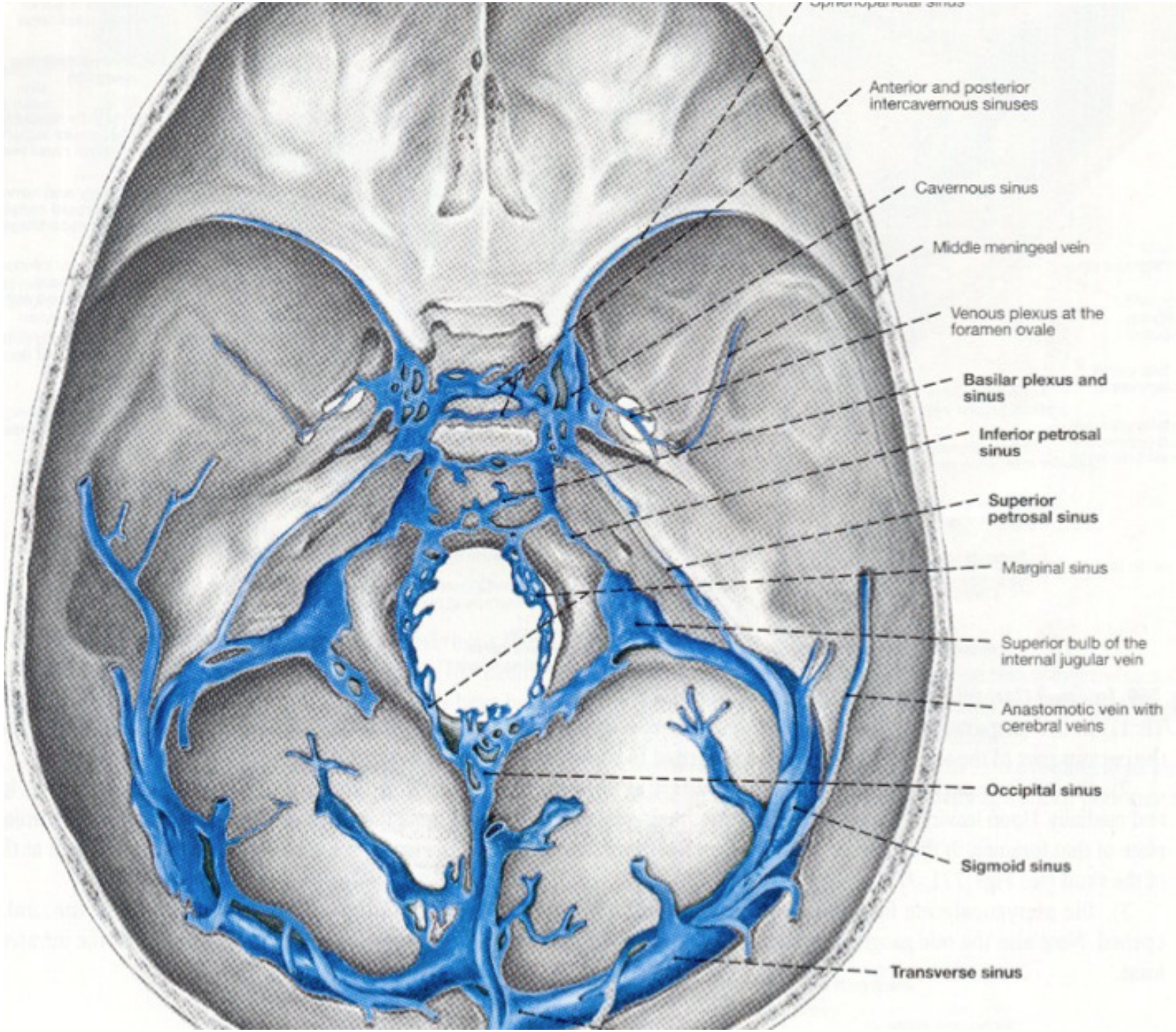
7. Cavernous sinuses - in middle cranial fossa; on side of the body of the sphenoid bone; connected by Intercavernous sinus; receive blood from Sup. and Inf. Ophthalmic veins, Cerebral veins; drain to Sup. and Inf. Petrosal sinuses

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

➢ **Confluence of sinuses**

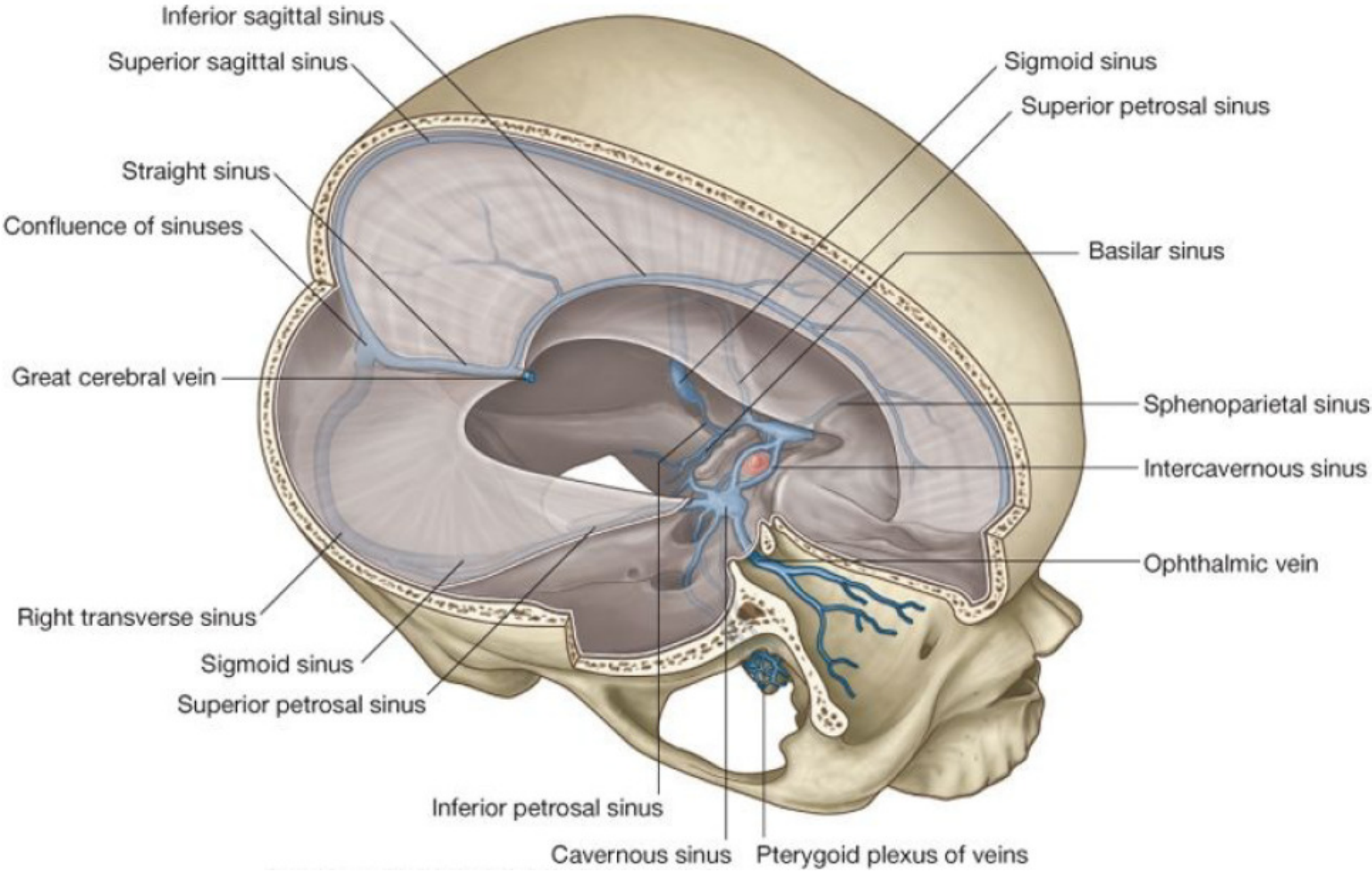


- **Location:** internal occipital protuberance
- **Receives from**: Superior sagittal, straight, and occipital sinuses

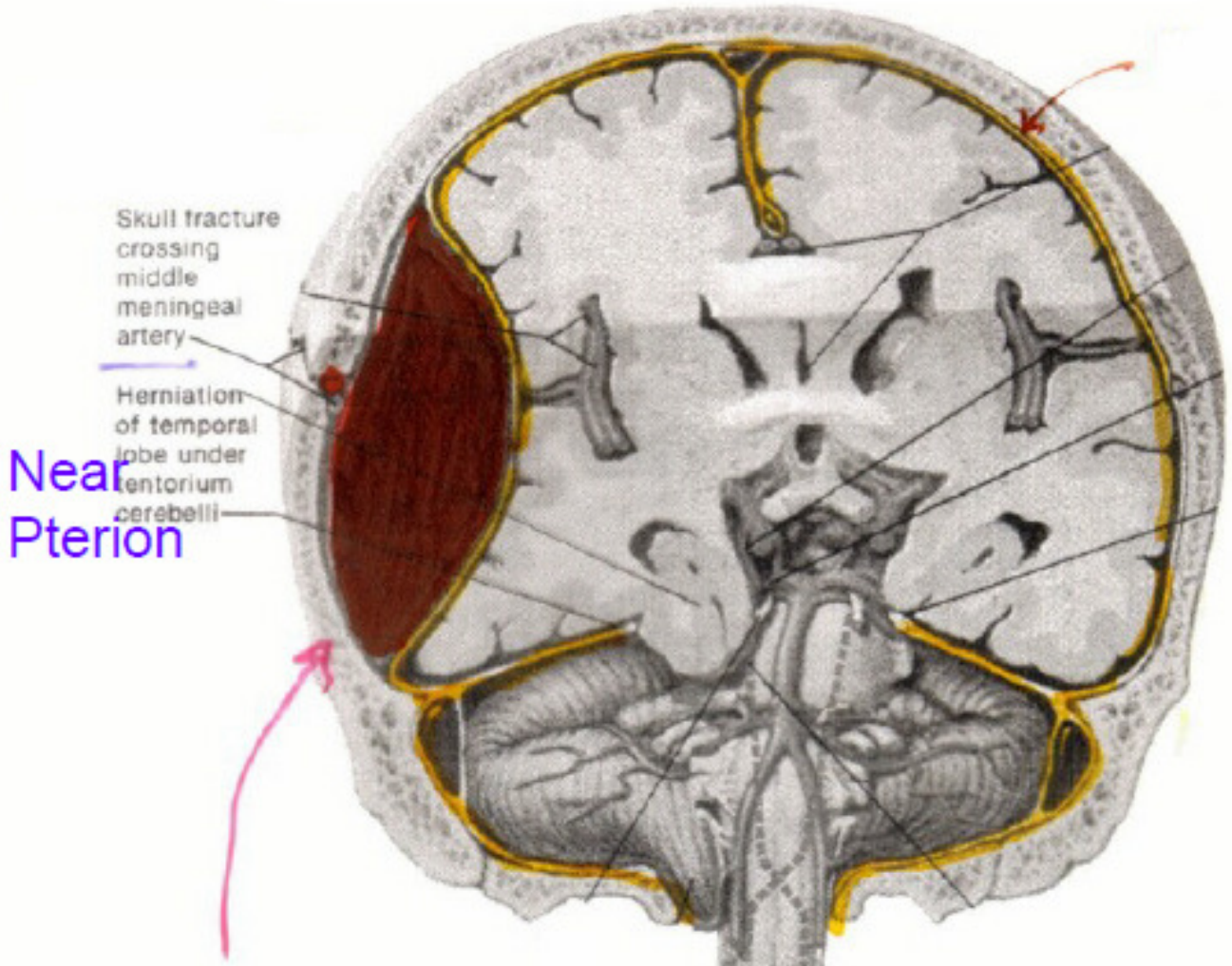


- **Basilar sinus**

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

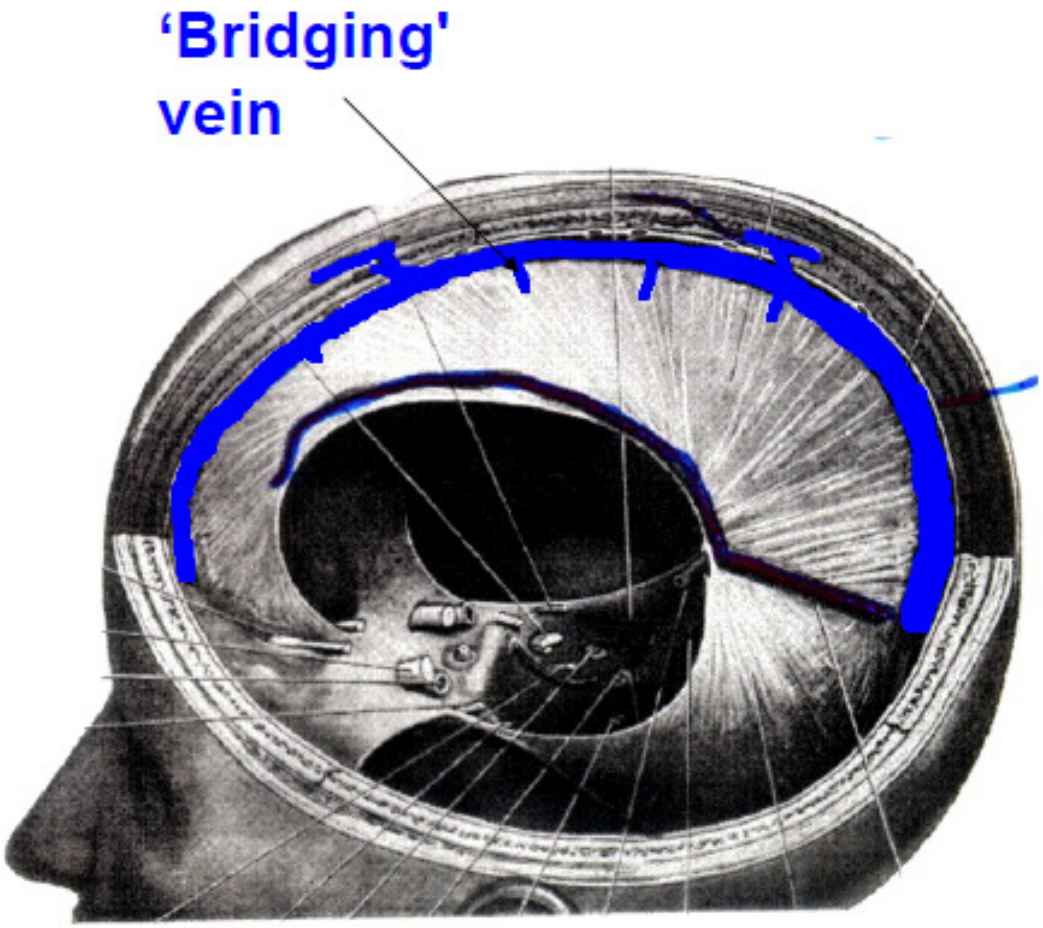

Inferior sagittal sinus
Superior sagittal sinus
Straight sinus
Confluence of sinuses
Great cerebral vein
Right transverse sinus
Sigmoid sinus
Superior petrosal sinus
Inferior petrosal sinus
Cavernous sinus
Pterygoid plexus of veins
Sigmoid sinus
Superior petrosal sinus
Basilar sinus
Sphenoparietal sinus
Intercavernous sinus
Ophthalmic vein

EPIDURAL HEMATOMA



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

B. SUBDURAL HEMATOMA

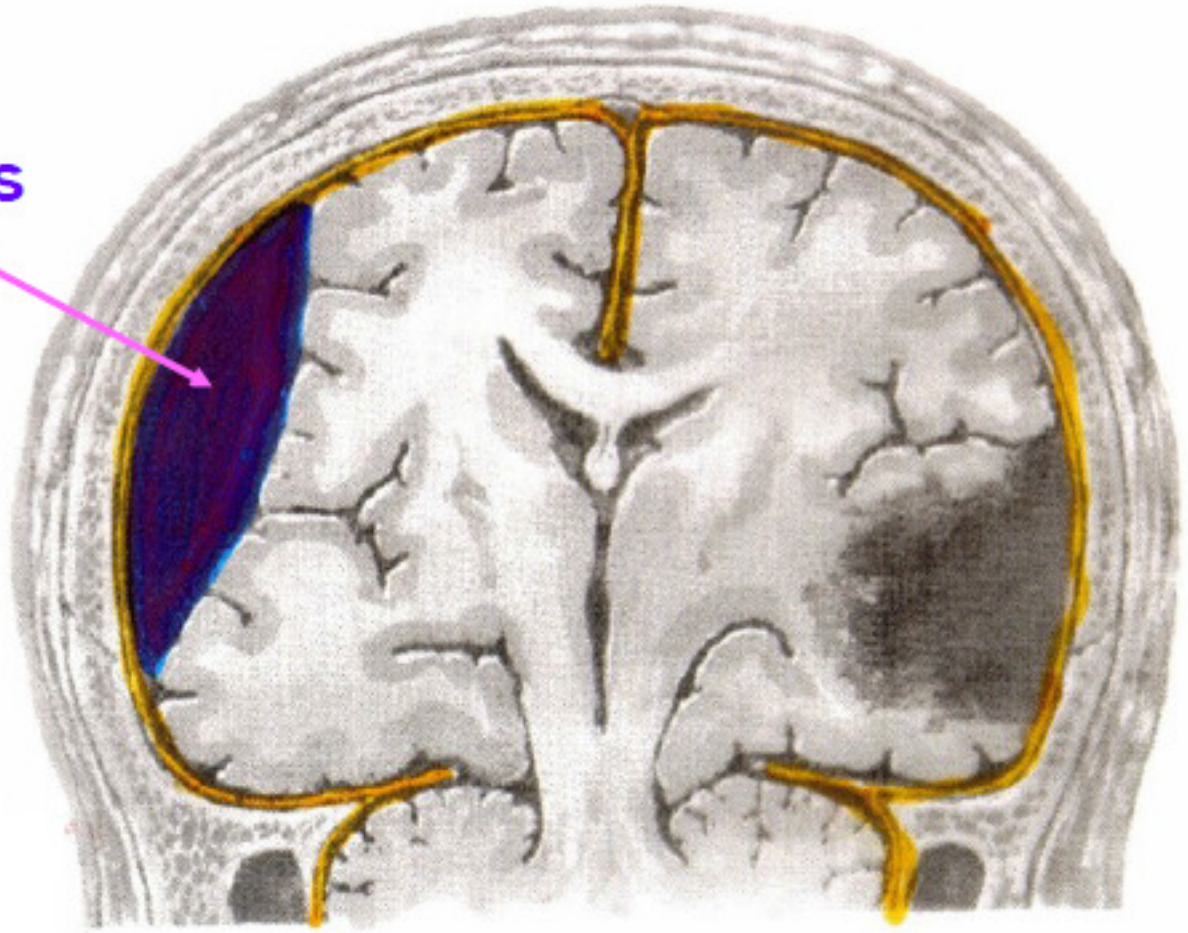


- bleed into potential space between Dura & Arachnoid
- from tear 'Bridging' vein or sinus
- bleeding often slow
- chronic subdural hematomas can remain undetected

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

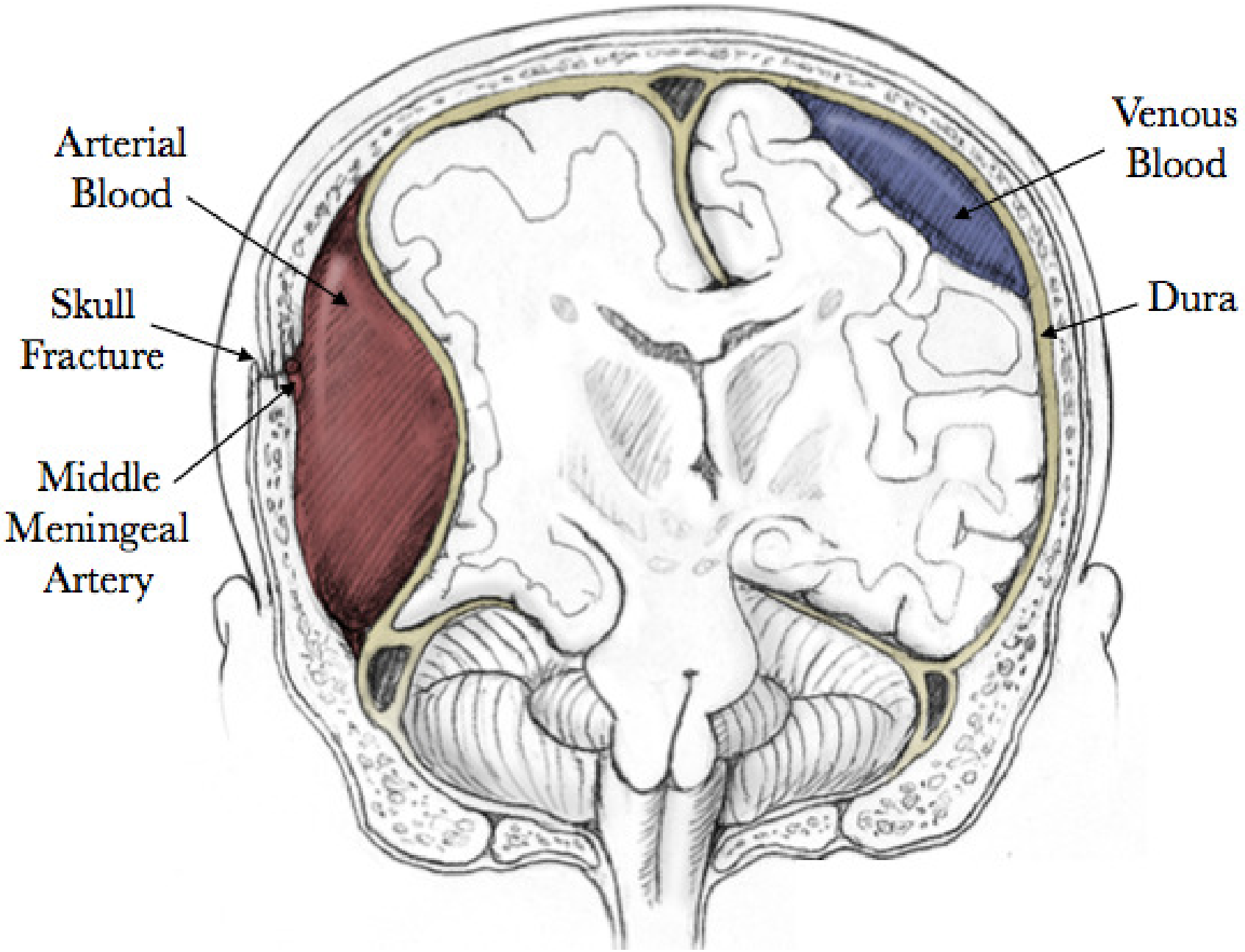
SUBDURAL HEMATOMA

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



Epidural Hematoma
(Does Not Cross Suture Line)

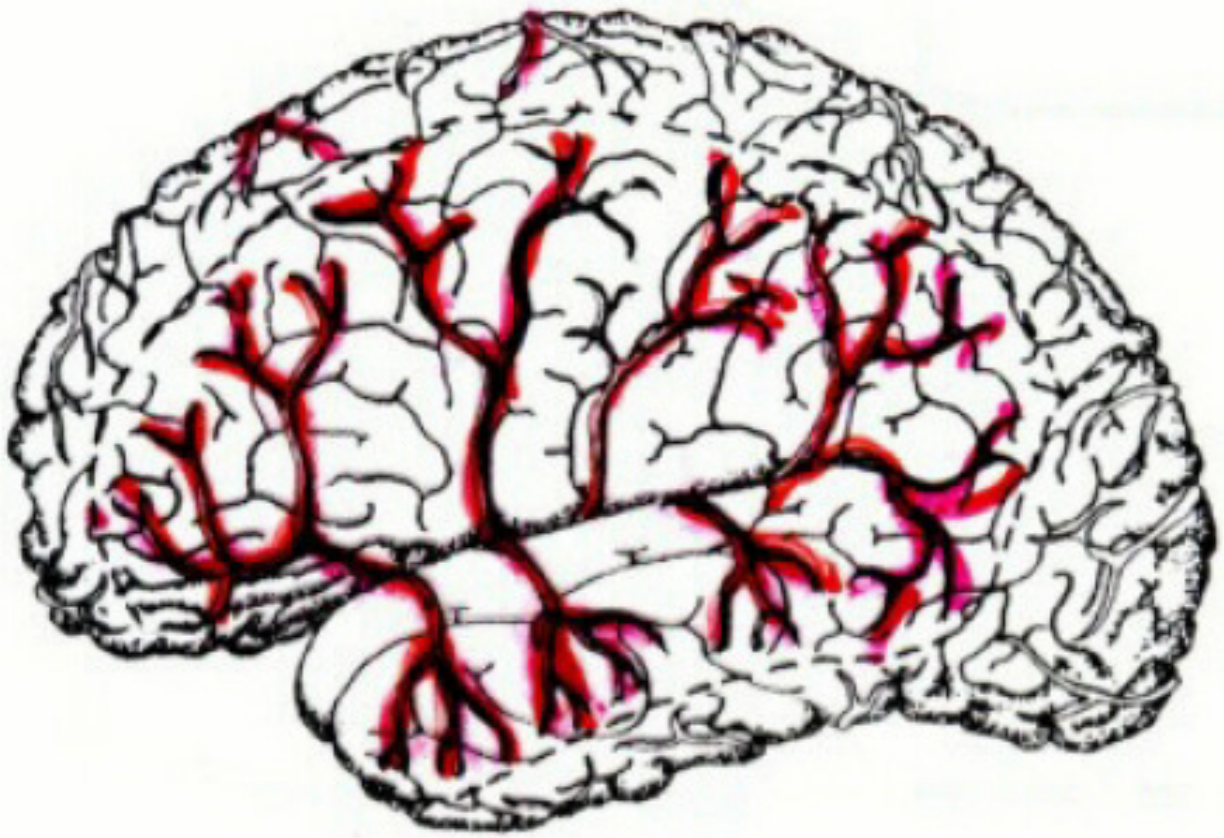
Subdural Hematoma
(Crosses Suture Line)



Extradural hematoma

Subdural hematoma

C. SUBARACHNOID HEMATOMA



tearing cerebral artery or aneurysm (swelling of vessel wall)

If arterial can be rapid and fatal