

Arterial Supply of the Brain

- The brain receives its blood supply from **2 sources**:

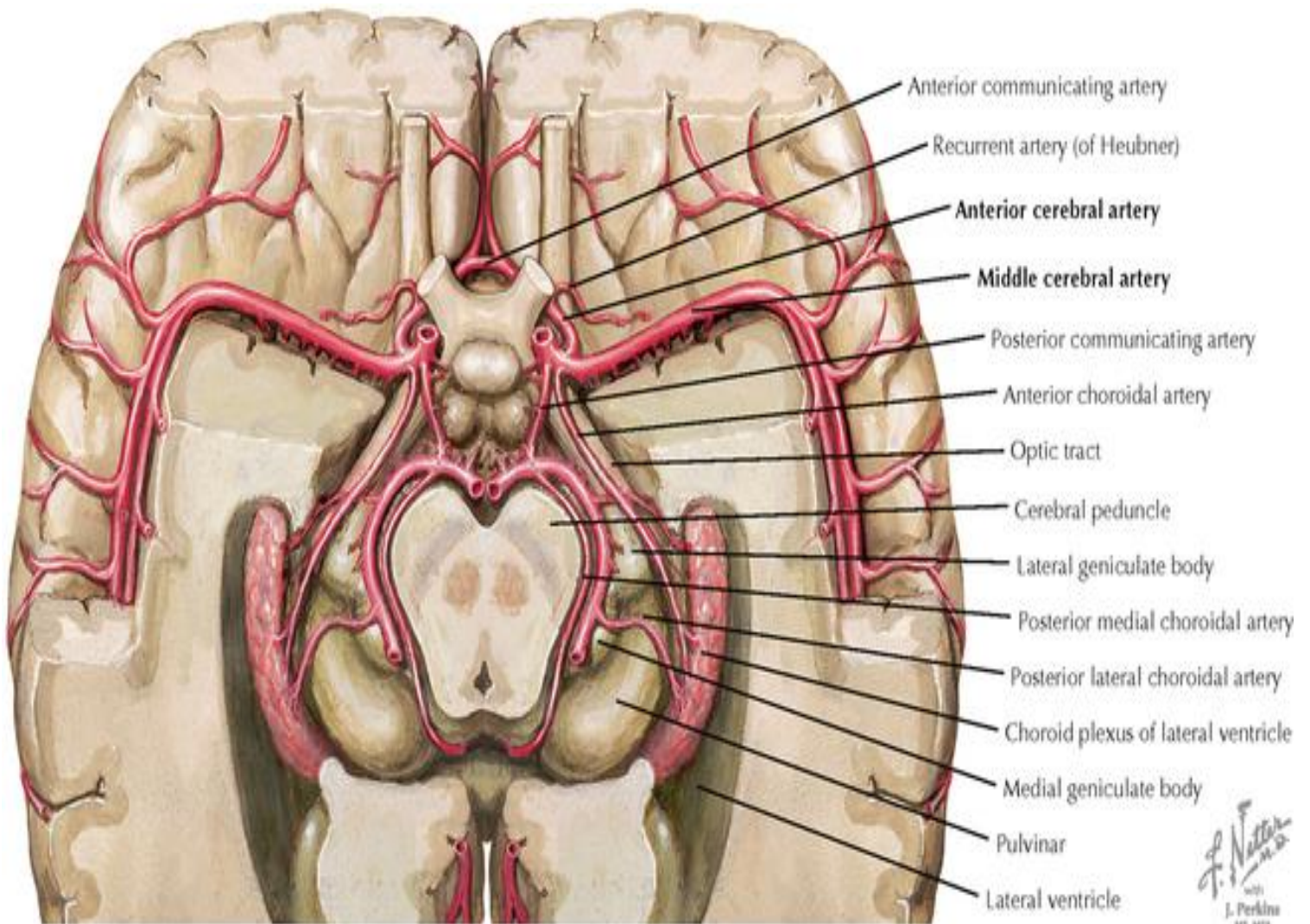
A- **Internal carotid** system .

B- **Vertebro-basilar** system .

A- Internal Carotid System:

- **Origin:** Each internal carotid artery (ICA) **arises** in the neck as one of the 2 terminal branches of the common carotid artery (CCA).
- **Course:**
 - Each ICA **enters the skull** through the **carotid canal** to reach the **cavernous sinus** .
 - It **leaves** the cavernous sinus by **piercing** the **dura** mater and then pierces the **arachnoid** mater to reach the **subarachnoid space** in the **interpeduncular cistern**.
 - In the subarachnoid space each ICA **gives** off:
 - 1-The **ophthalmic artery** to supply the orbit.
 - 2-The **posterior communicating artery** to join the posterior cerebral A. sharing in the formation of the arterial circle of Willis.
 - 3-The **anterior choroidal artery**
- **End:** After giving origin to the anterior choroidal artery. the ICA **terminates below the anterior perforated substance** by dividing into 2 terminal branches:
 - a- **Anterior cerebral artery** (small).
 - b- **Middle cerebral artery** (is **larger** and is nearly in **direct line** with the main trunk of ICA).

Neuroanatomy



B- The Vertebro-basilar system: (2 vertebral arteries and basilar artery).

- **Origin:** Each vertebral artery arises at the root of the neck from the **first part of the subclavian artery**.
- **Course:**
 - The vertebral arteries enter the skull through the **foramen magnum**.
 - Inside the skull, the vertebral arteries (**4th parts**) **run** upward, forwards and medially on the **anterior surface of the medulla** oblongata till they reach the **lower border of the pons** where the 2 vertebral arteries **unite** together forming the **basilar artery**.
 - The basilar artery ascends in the **basilar groove** on the anterior surface of the pons .
- **End:** The basilar artery ends at the **upper border** of the pons by dividing into 2 terminal branches ; right and left **posterior cerebral** arteries.

• **Branches of the ICA:**

1. ***The anterior choroidal artery:***
 - It arises from the **ICA**.
 - It passes **backwards** along the **optic tract** around the **cerebral peduncle** as far as the **lateral geniculate** body.
 - It **ends** by entering the **inferior horn** of lateral ventricle to supply the **choroid plexus** of the **inferior horn**.
 - It **supplies** also the **optic tract, lateral geniculate** body, the posterior part of the **posterior limb** of the internal capsule, **retrolentiform** and **sublentiform** parts of the **internal capsule**.
2. ***The posterior communicating artery:*** see the circulus arteriosus.
3. ***The anterior cerebral artery:*** see later.
4. ***The middle cerebral artery:*** see later.

- **Branches of the Vertebro-Basilar System:**

- I. Branches of the vertebral artery:**

- 1- *The posterior inferior cerebellar artery:***

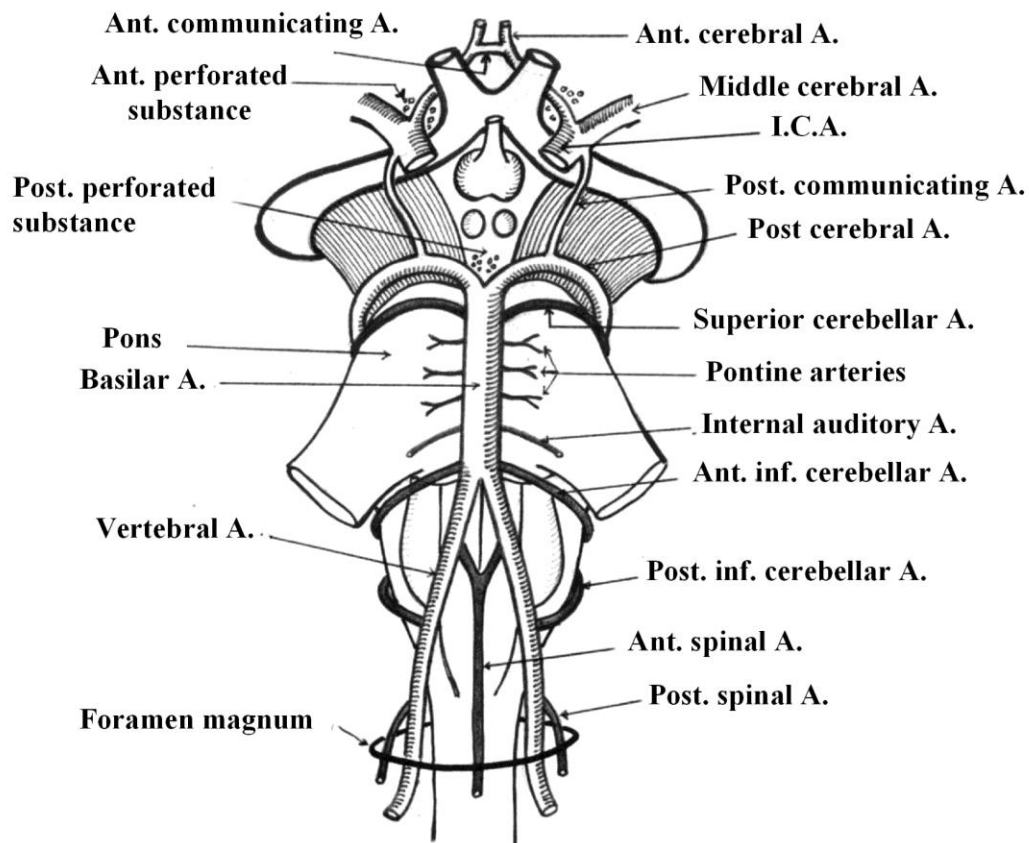
- It is the **largest and the main** branch of the vertebral artery.
- It runs **backwards around the medulla** oblongata to **reach** the inferior surface of the **cerebellum** where:
- It **ends** by dividing into 2 terminal branches to supply:
 - a- The **inferior vermis**.
 - b- The major **posterior part of the inferior surface** of the cerebellar hemisphere.
 - c- Branches to supply the **lateral and dorsal parts of the medulla oblongata** (dorsal to the olivary nucleus) .
- It is an important artery; thrombosis in it results in a well defined syndrome called the **posterior inferior cerebellar artery syndrome**.

- 2- *The posterior spinal artery:***

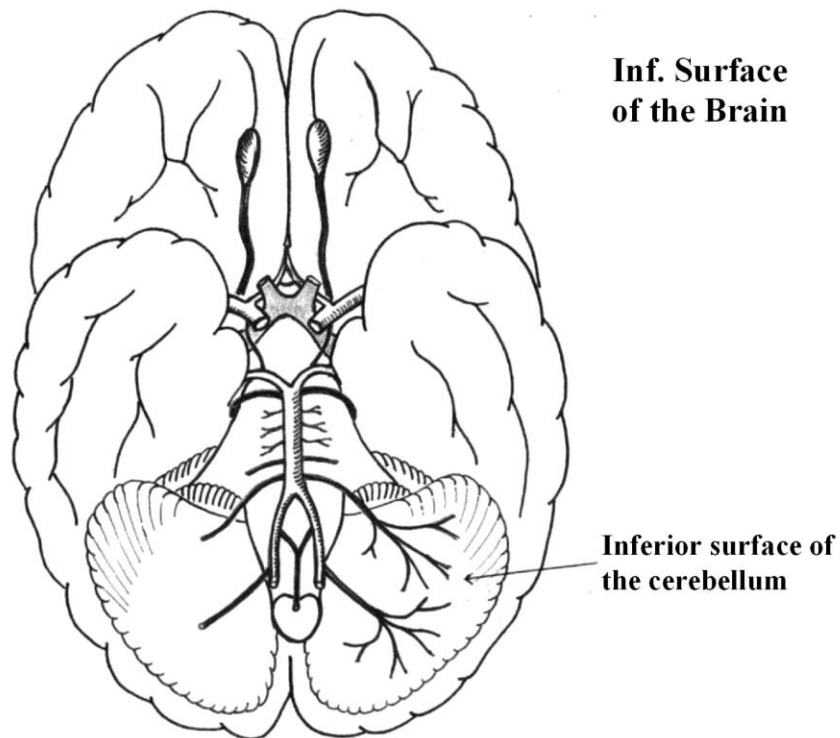
- It is the **first branch** of the vertebral artery after it enters the skull.
- It **descends** to the spinal cord along the line of the **posterior roots** of the spinal nerves.

- 3- *The anterior spinal artery:***

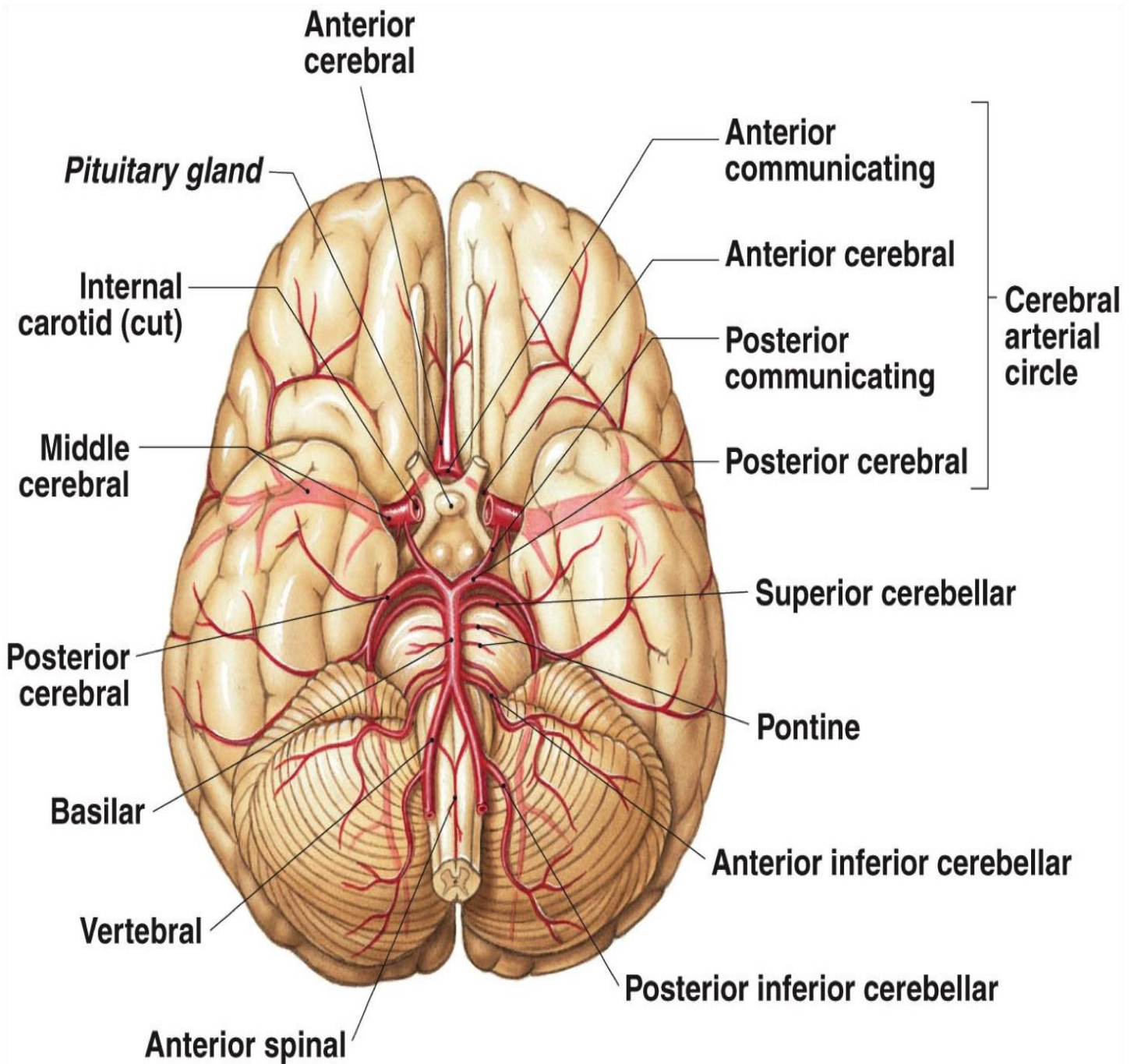
- It arises from the **uppermost** part of the vertebral artery.
- The two anterior spinal arteries run obliquely downwards and medially in front of the medulla and **unite** to form a single median anterior spinal artery which **descend** along the **anterior median fissure** of the spinal cord down to the **filum terminale**.
- **Branches** : **supply** the **anterior part** of the **medulla oblongata** & **anterior 2/3 of the spinal cord** .



**I.C.A. System, Vertebral-Basilar System & Circle of Willis
Arterial Supply of Brain, Brain Stem, Spinal Cord**



Arterial Supply of the Brain



Branches of the basilar artery:

1- ***The anterior inferior cerebellar artery:***

- It passes laterally and backwards **around** the lower border of the pons.
- It **ends** by supplying the anterior small part of the inferior surface of the cerebellar hemisphere.

2- ***The internal auditory arteries:***

- Accompany the 7th and 8th cranial nerves into the **internal auditory meatus** to supply the internal ear.

3- ***The pontine branches:***

- These are many small twigs which **supply the** pons, the middle cerebellar peduncles and the roots of the trigeminal nerve.

4- ***The superior cerebellar artery:***

- It **arises** from the basilar artery close to its **end**.
- It passes laterally and backwards **around** the lower part of midbrain to reach the superior surface of the cerebellum and **ends** by supplying it.

5- ***The posterior cerebral arteries:*** are the two terminal branches: see later.

The Three Cerebral Arteries

A- The Anterior Cerebral artery:

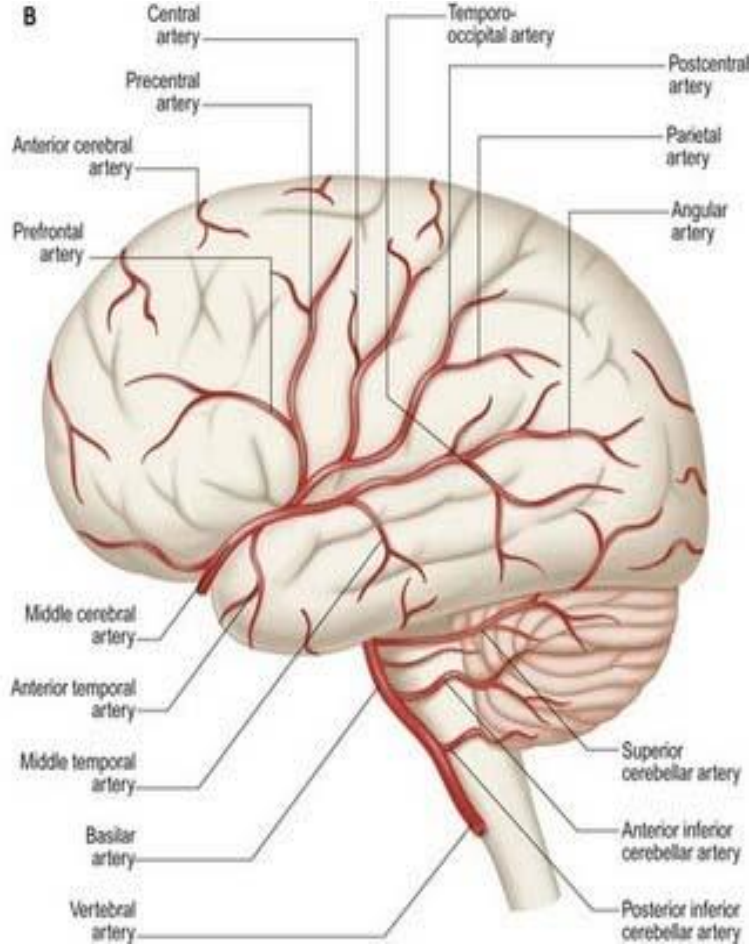
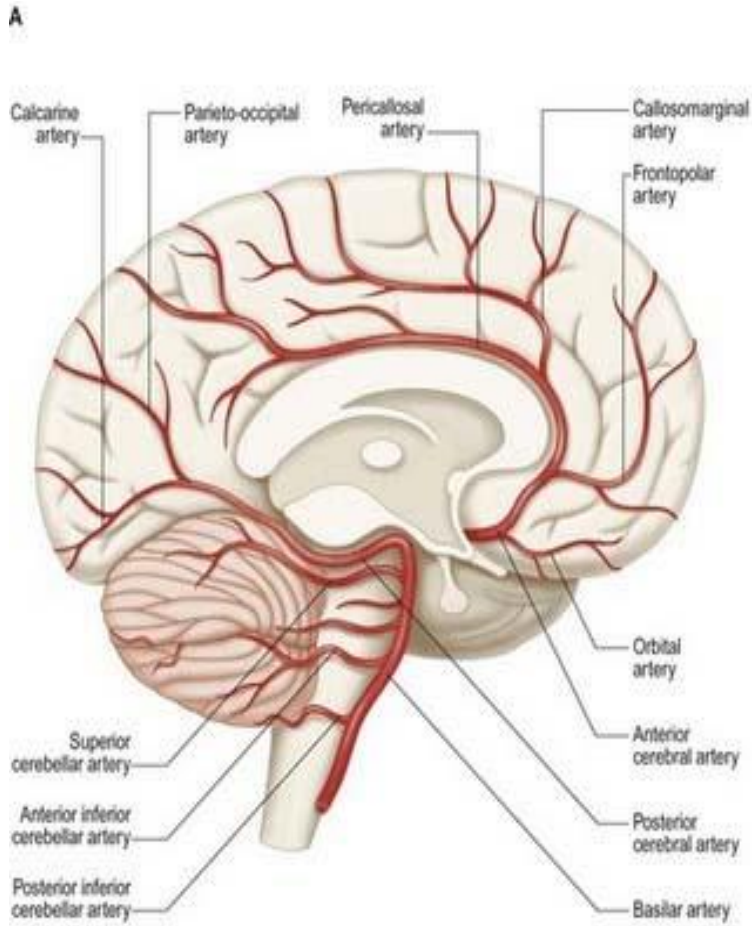
- ***Begins:*** Below the **anterior perforated substance** as the smaller of the 2 terminal branches of the ICA.
- ***Course:***
 - It passes **forwards and medially** to reach the anterior part of the **median longitudinal cerebral fissure** where it becomes in **close** relation with its fellow of the opposite side. At this site the two anterior cerebral arteries become **connected** to each other by a short **anterior communicating** artery.
 - Then, the anterior cerebral artery turns sharply **upwards** in the median longitudinal fissure to reach the **medial surface** of the cerebral hemisphere where it runs in the **callosal sulcus**, curves around the **corpus callosum** the splenium where it ends.
- ***Ends:*** by turning **upwards** anterior to the parieto-occipital sulcus becoming a terminal cortical artery.

- **Branches:**
 - 1- **Cortical branches:** To supply:
 - The **medial surface** of the hemisphere from the **frontal pole** back to the **parieto-occipital sulcus**.
 - The **upper 1 inch** of the **lateral surface** of the cerebral hemisphere.
 - The **medial 1/2** of the **orbital surface** of the cerebral hemisphere.
 - 2- **Central branches:** Penetrate the **anterior perforated** substance to supply:
 - The **anterior part** of the **corpus striatum**.
 - The anterior part of **the anterior limb** of **internal capsule**.
 - 3- **Branches to the septal region:** Including **septum pellucidum**.
 - 4- **Callosal branches:** To supply all parts of the **corpus callosum except the splenium** (which is supplied by the **posterior** cerebral artery).
- **Clinical importance:** Anterior cerebral artery supplies three importance regions:
 - a- The **motor and sensory areas** for the lower limb and perineum.
 - b- The **septal region:** (where a small lesion may result in prolonged **unconsciousness**).
 - c- The **corpus callosum:** lesion to the corpus callosum may result in **apraxia** (inability to do **purposeful movements** while the muscles concerned in the movements are not paralysed).

B- The Middle Cerebral Artery:

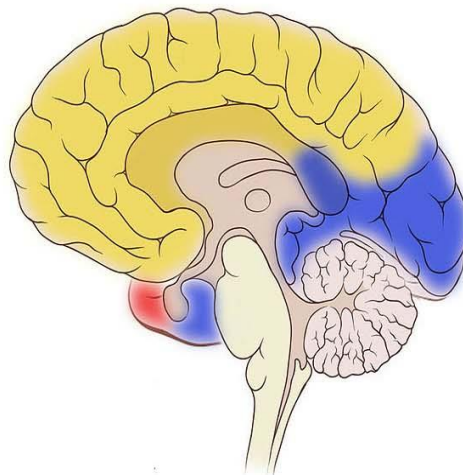
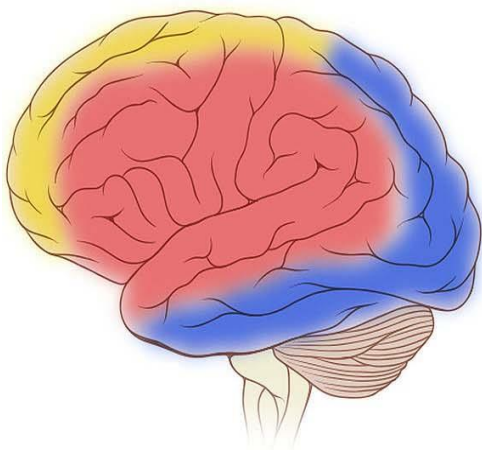
- **Begins:** Below the **anterior perforated** substance as the larger of the 2 terminal branches of the ICA. It is also in more **direct continuation** with ICA (therefore, small **emboli** which pass through the ICA go more frequently to the middle cerebral than to the anterior cerebral artery).
- **Course:**
 - It runs **laterally** in the **stem of lateral fissure** then continued **backwards** in the **posterior ramus** of lateral fissure crossing over the surface of the **insula** where it ends.

Neuroanatomy



Lateral Brain

Medial Brain



- Anterior Cerebral Artery
- Middle Cerebral Artery
- Posterior Cerebral Artery

- **Ends:** By breaking up into **many terminal cortical branches** which emerge from the posterior ramus of lateral fissure and appear on the lateral surface of the cerebral hemisphere.
- **Branches:**
 - 1- **Cortical branches:** To supply: (i), (ii) and (iii):
 - i. The **whole lateral surface** of the hemisphere **except:**
 - a- **One inch** in breadth along the **superior border** of the hemisphere back to the parieto-occipital sulcus which is supplied by the **anterior cerebral artery.**
 - b- Lateral surface of the **occipital lobe** and a **narrow strip** of the temporal lobe along the **inferior border** of the hemisphere which are supplied by branches of the **posterior cerebral artery.**
 - ii. The **temporal pole and the insula.**
 - iii. The **lateral 1/2 of the orbital surface** of frontal lobe.
 - 2- **Central branches:**
 - They penetrate the **anterior perforated substance** to supply:
 - The posterior part of **corpus striatum.**
 - The **posterior part of anterior limb, the genu and the anterior part of posterior limb of the internal capsule.**
 - One large branch of these arteries is called the **artery of cerebral haemorrhage** which frequently ruptures causing intracerebral haemorrhage and causes pressure on the motor fibres in the internal capsule producing hemiplegia .
- **Clinical importance:** Middle cerebral artery supplies the following importance areas:
 - a- The **motor and sensory areas** for the whole body, **except** the lower limbs.
 - b- The **auditory area**, in the **superior temporal** gyrus.
 - c- The **motor area of speech** in the **inferior frontal** gyrus (Broca's area).
 - d- The **internal capsule.**

C- The Posterior Cerebral Artery:

- ***Begins:*** The right and left posterior cerebral arteries begin at the **upper border of the pons** as the 2 terminal branches of the **basilar artery**.
- ***Course:***
 - Each posterior cerebral artery **curves laterally and backwards around the lower part of the midbrain** above **parallel** to the **superior cerebellar artery** with **trochlear nerve in between**.
 - Then it continues to reach a position **below the splenium** of corpus callosum on the medial surface of the hemisphere where it **ends** by dividing into **terminal cortical branches** .
- ***Branches:***
 - 1- ***Cortical branches:*** To supply:
 - a- **The tentorial surface** of the hemisphere **behind the temporal pole** (which is supplied by the middle cerebral artery).
 - b- The medial, lateral and inferior surfaces of the **whole occipital lobe** .
 - c- A narrow strip on the **lateral surface** of the temporal lobe along the **inferior border** of the hemisphere.
 - 2- ***Central branches:***
 - a- **Short medial group:** pierce the **posterior perforated** substance and supply the **cerebral peduncles** of the midbrain, the **mammillary bodies**, the **subthalamic** region and the anterior part of **thalamus**.
 - b- **Long lateral group:** **curve round** the lateral side of the **midbrain** to supply the lateral and medial **geniculate bodies**, the 4 colliculi (**tectum** of midbrain), the posterior part of **thalamus** and the **pineal body**.
 - 3- ***The posterior choroidal artery:***
 - Arises from the posterior cerebral artery while it is lying **below the splenium** of corpus callosum.
 - It passes forwards inside the brain in the edges of the tela choroidea of the 3rd ventricle to supply the choroid plexuses of the 3rd and central part of the lateral ventricle.
 - It also supplies the **thalamus** through its dorsal surface.

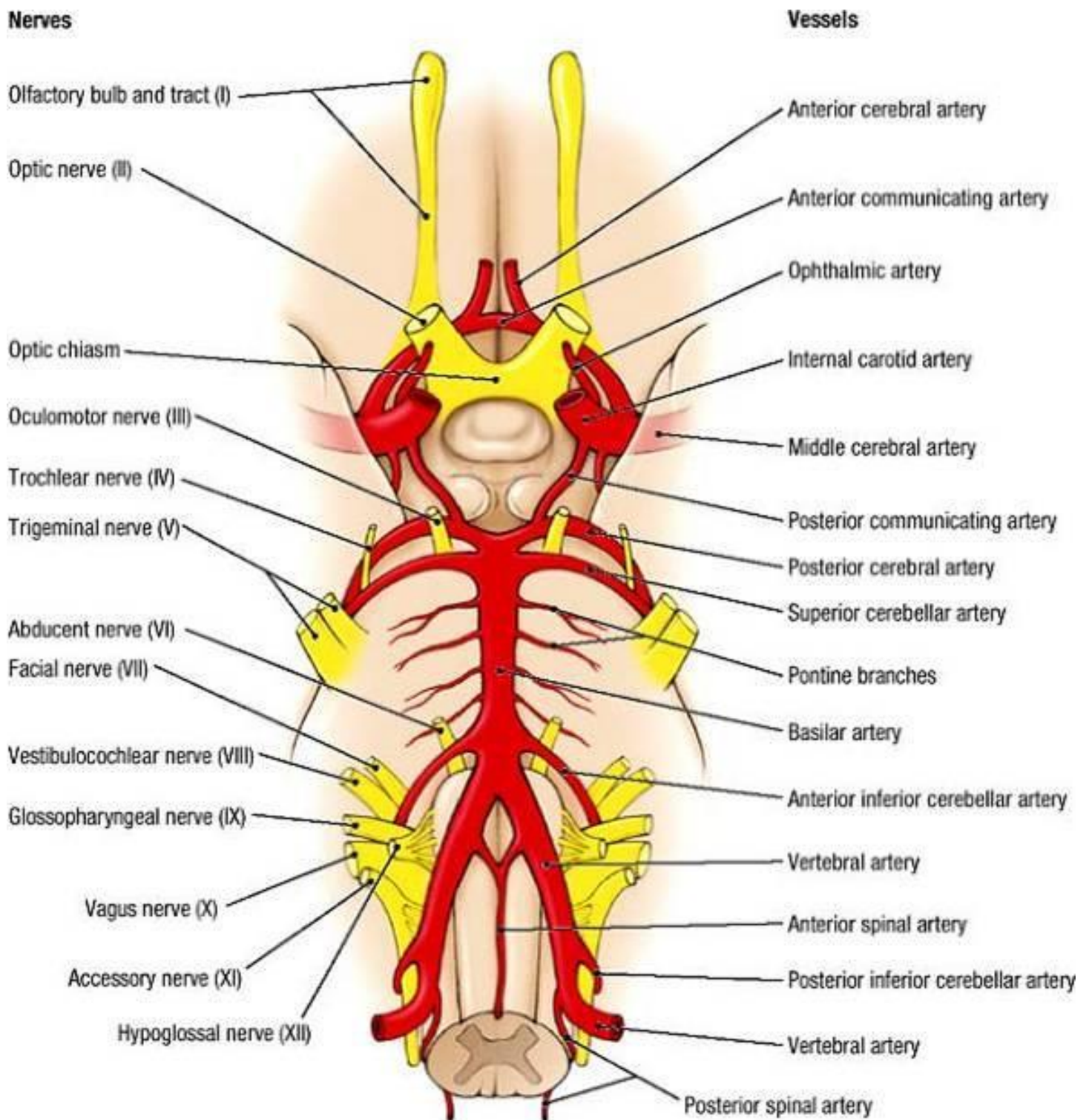
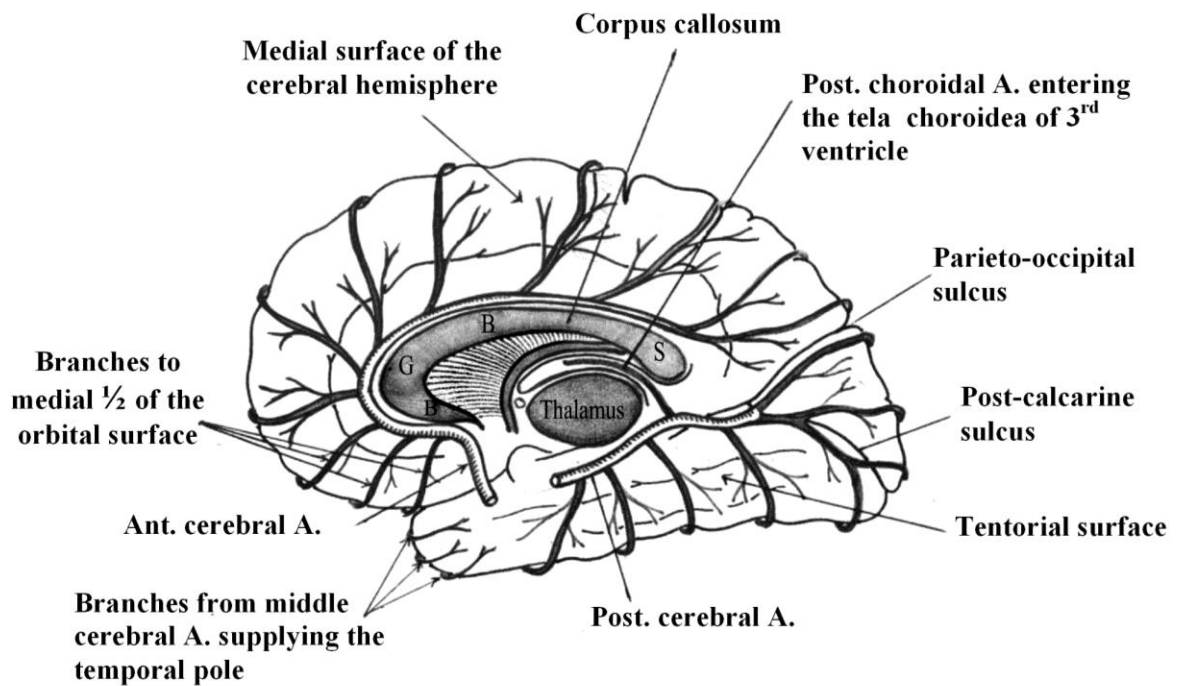
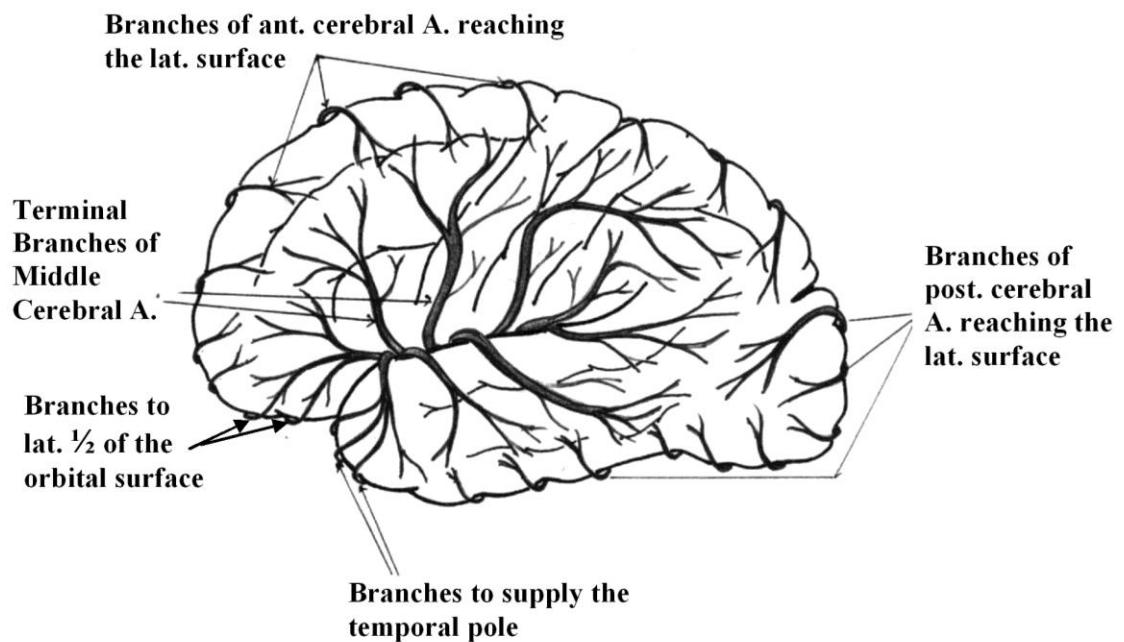


Figure 7.48. Blood vessels and cranial nerves at the base of the brain.



Ant. & Post. Cerebral Arteries



Middle Cerebral A. (Lat. Surface of the Hemisphere)

- **Clinical importance:** It supplies 5 important regions:
 - a- The whole **visual cortex** in the occipital lobe.
 - b- The centre of **smell in the uncus**.
 - c- Most of the **thalamus**.
 - d- Most of the **midbrain**.
 - e- Most of the **choroid plexuses** of the lateral and the 3rd ventricle.

The Circulus Arteriosus (The Arterial Circle of Willis)

- It lies in the **interpeduncular cistern** at the base of the brain. It lies in the neighbourhood of the **interpeduncular fossa**, around the region of the **hypothalamus**.
- The circle of Willis is **formed from**:
 - a- **6 large** arteries (3 on either side).
 - b- **3 communicating** arteries (one anterior and 2 posterior).
- The six large arteries are:
 - 1- Rt. and Lt. **anterior cerebral** arteries.
 - 2- Rt. and Lt. **internal carotid** arteries (ICA).
 - 3- Rt. and Lt. **posterior cerebral** arteries.
- The communicating arteries are:
 - 1- **Posterior communicating** artery: connects the **ICA** with the **posterior cerebral** artery of its same side.
 - 2- **Anterior communicating** artery: connects the 2 **anterior cerebral** arteries.
- It is common that one of the arteries forming the circle of Willis **may be very small or completely absent without any clinical disturbances under normal conditions**.
- Under normal conditions little mingling of the blood of the 2 sides occurs, but if **one big artery becomes closed before it enters** in the formation of the circle of Willis, the **connections may open up**.
- The **cortical branches** of the cerebral arteries **anastomose** with one another **before, but not after**, they enter the brain, where they become end-arteries.
- The **central branches** are **end-arteries**, i.e. they do not anastomose with neighbouring vessels.

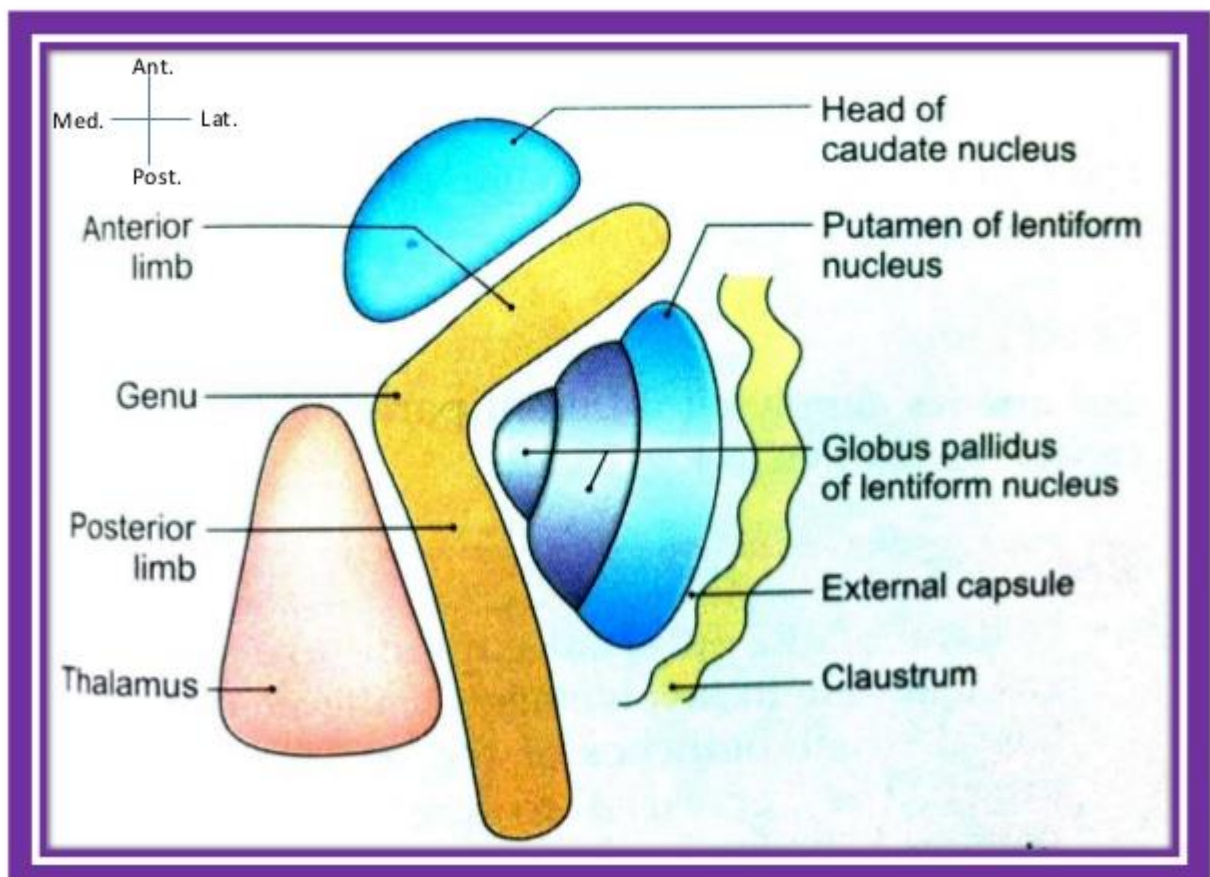
Summary of the Arterial Supply of the Different Parts of the Brain

1. ***Lateral surface of the cerebral hemisphere:***
 - a- **Middle cerebral artery supplies the main part.**
 - b- Anterior cerebral artery supplies a strip about one inch adjoining the upper border from the frontal pole till the parieto-occipital sulcus.
 - c- Posterior cerebral artery supplies:
 - The occipital lobe.
 - A narrow strip of the temporal lobe adjoining the lower border.
2. ***Medial surface of the cerebral hemisphere:***
 - a- **Anterior cerebral artery supplies the medial surface from the frontal pole almost to the parieto-occipital sulcus.**
 - b- Posterior cerebral artery supplies the area behind this sulcus (occipital lobe).
3. ***Tentorial surface of the hemisphere:***
 - a- **Posterior cerebral artery** supplies the main part.
 - b- **Middle cerebral artery** supplies the **temporal pole**.
4. ***Orbital surface of the hemisphere:***
 - a- Its **medial 1/2**: by anterior cerebral artery.
 - b- Its **lateral 1/2**: by middle cerebral artery.
5. ***Corpus callosum:***
 - a- Rostrum, genu and body are supplied by **anterior** cerebral artery.
 - b- **Splenium** is supplied by **posterior** cerebral artery.
6. ***Choroid plexuses of the ventricles:***
 - a- **Lateral ventricle:**
 - Choroid plexus of the **central part (body)**: is supplied by the **posterior choroidal artery** (branch of posterior cerebral artery).
 - Choroid plexus of the **inferior horn**: is supplied by the **anterior choroidal artery** (branch of internal **carotid** artery).
 - b- Third ventricle: **posterior choroidal** artery.
 - c- Fourth ventricle: **posterior inferior cerebellar artery** (branch of 4th part of vertebral artery).

7. **Corpus striatum and the internal capsule:**

- a- **Anterior part** of corpus striatum and anterior part of the anterior limb of the internal capsule are supplied by central branches of the **anterior cerebral artery**.
- b- The rest of **corpus striatum, posterior part of anterior limb, the genu and the anterior part of the posterior limb of the internal capsule** are supplied by central branches of the **middle cerebral artery**.
- c- The posterior part of the **posterior limb, the retrolentiform part and the sublentiform part** of the internal capsule are supplied by the **anterior choroidal branch** of ICA.

N.B.: Tail of caudate and amygdaloid nucleus are supplied by the anterior choroidal artery (branch of internal carotid artery).



8.

posterior choroidal branch, medial and lateral central branches.

- b- Posterior communicating artery: branch from internal carotid artery.
- c- Anterior choroidal artery supplies the lateral geniculate body (LGB).

9. **Hypothalamus:** Is supplied from all arteries forming the **circle of Willis**.
10. **The cerebellum:**
 - a- The **superior surface:** is supplied by **superior cerebellar** branch of basilar artery.
 - b- The inferior surface: is supplied by:
 - **Posterior inferior cerebellar** branch of vertebral artery (supplies the major posterior part).
 - **Anterior inferior cerebellar** branch of basilar artery supplies a small anterior part.
11. **The midbrain:** Central branches of **posterior** cerebral artery (terminal branch of basilar artery) helped by **superior cerebellar** artery and the posterior communicating artery.
12. **The pons:**
 - Anterior part : is supplied by the pontine branches of the **basilar** artery.
 - Posterior part (tegemntum):
 - a- In **lower** pons: by the **posterior inferior cerebellar** artery.
 - b- In **upper** pons: by the **superior cerebellar** artery.
13. **The medulla oblongata:** It is supplied by branches of the vertebral artery:
 - **Anterolateral** surface: is supplied by medullary branches of:
 - a- **Anterior spinal** artery (medially).
 - b- 4th part of the **vertebral** artery (laterally).
 - **Posterolateral** surface: is supplied by the **posterior inferior cerebellar** artery.
 - Gracile and cuneate tracts and nuclei: are supplied by the **posterior spinal** artery.

Veins of the Brain

I. Veins of the vertebro-basilar system:

- They drain the **brain stem, the cerebellum** and the posterior small part of the cerebral hemisphere.
- They correspond to the branches of the vertebral and the basilar arteries including the posterior cerebral arteries.
- **They drain into basilar and the vertebral veins.**

II. Veins of the internal carotid system:

- They drain the major part of the **cerebral hemisphere**.
- They differ from the arteries in being arranged in two sets:

A- ***Superficial veins draining the cortex:***

i. ***Veins on the lat. surface of the hemisphere:***

- 1- ***Superior cerebral veins:*** drain the upper part of the lateral surface of the hemisphere and run upwards to end in the superior sagittal dural venous sinus.
- 2- ***Superficial middle cerebral vein:*** lies on the posterior ramus of lateral fissure and receives the veins of the middle part of the lateral surface. It then passes medially in the stem of lateral fissure to end in the cavernous venous sinus.
- 3- ***Inferior cerebral veins:*** drain the lowest part of the lateral surface and end in the transverse venous sinus.

ii. ***Veins on the medial surface of the hemisphere:***

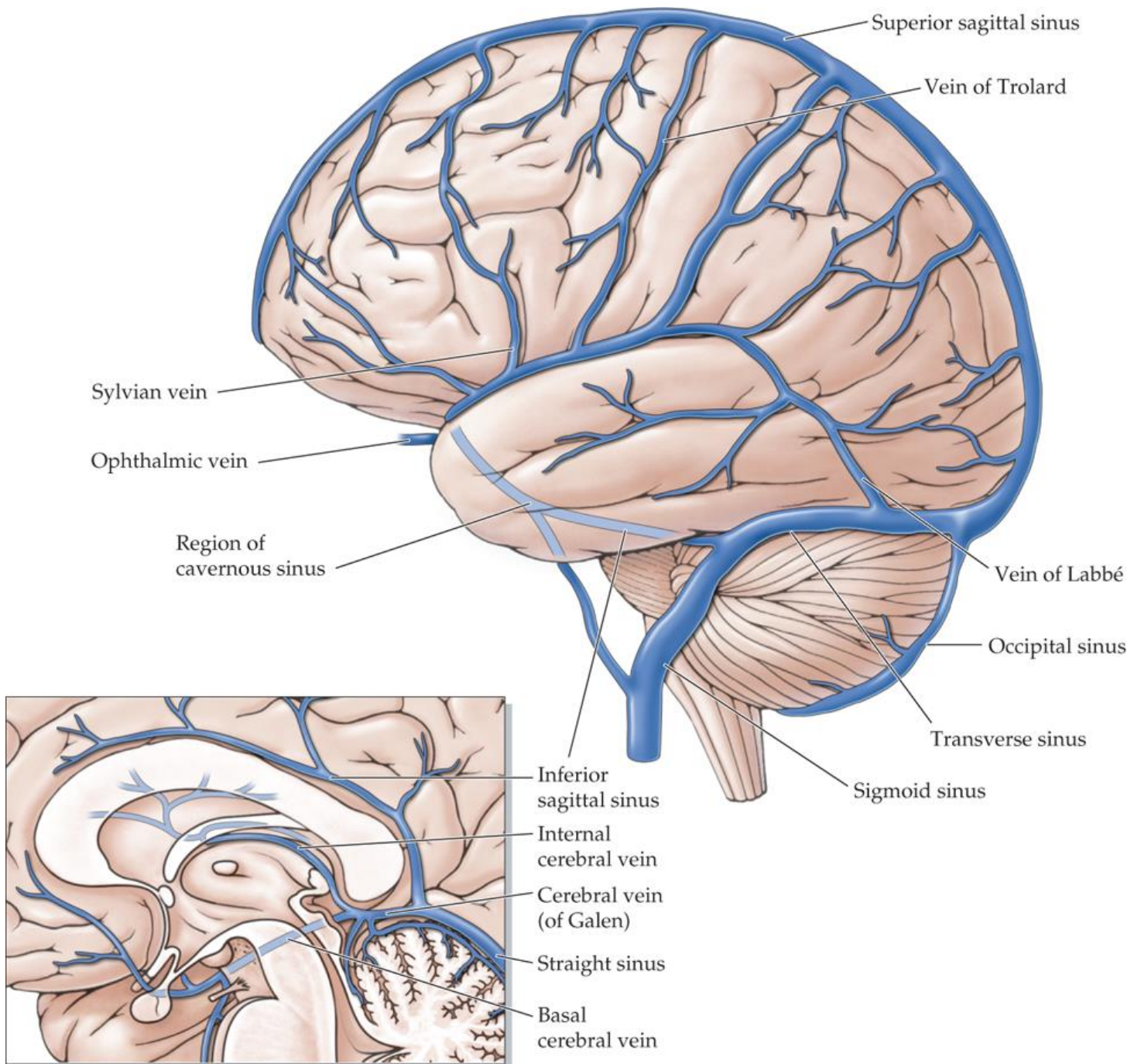
- 1- Veins from the upper part drain into both superior and inferior sagittal venous sinuses.
- 2- Veins from the lower part drain into the anterior cerebral vein which lies alongside the anterior cerebral artery. This vein begins near the splenium, runs forwards over the upper surface of the corpus callosum, then downwards around the genu and ends near the anterior perforated substance into the basal vein.

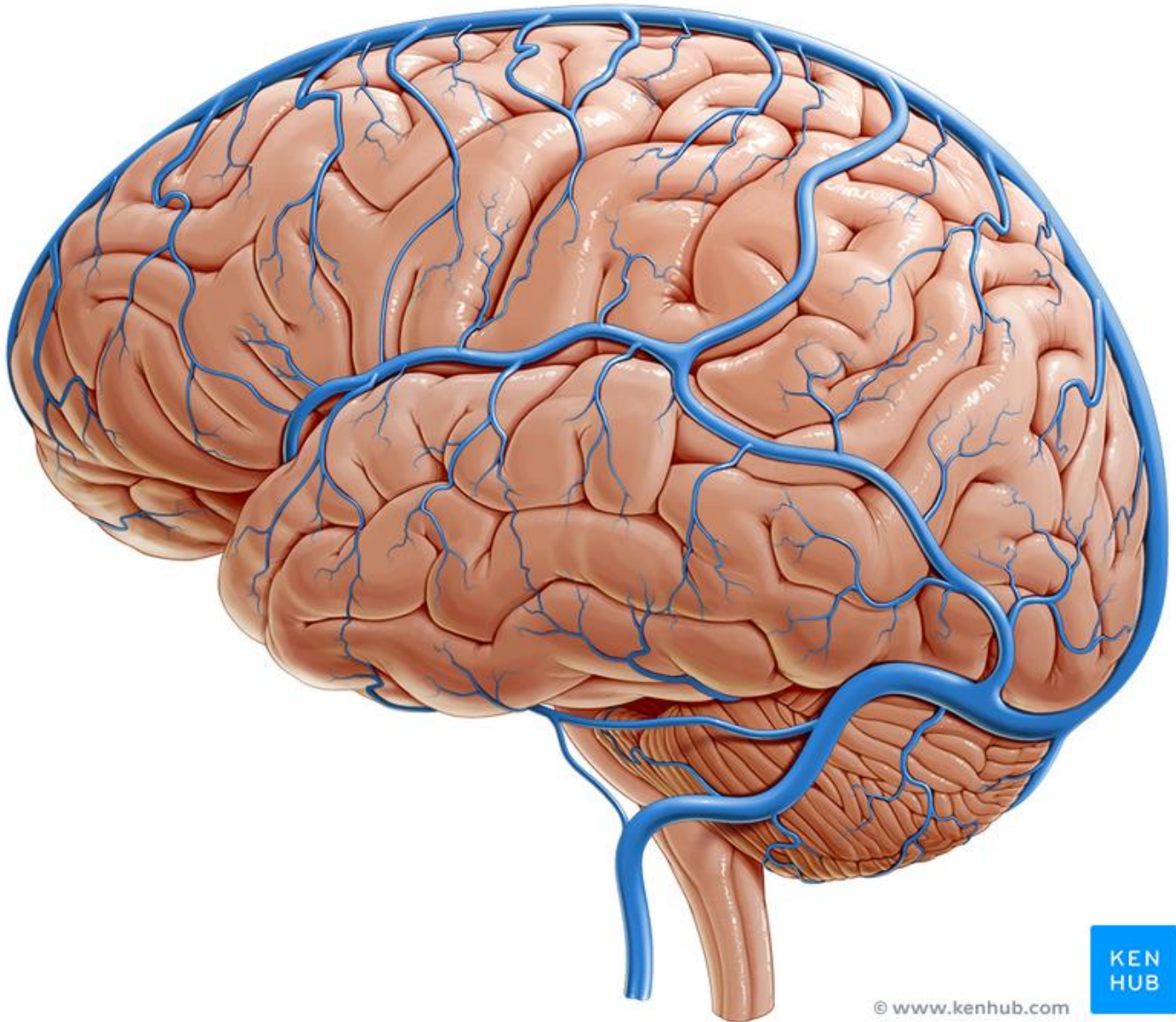
B- ***Deep veins draining the deeper parts of the hemisphere:***

- 1- ***Deep middle cerebral vein:*** lies in the bottom of the posterior ramus of the lateral fissure on the surface of the insula. It winds medially in the stem of lateral fissure to ends near the anterior perforated substance by joining the anterior cerebral vein to form the basal vein.
- 2- ***Basal vein: (Rt. and Lt.):***
 - Is formed below the anterior perforated substance by union of deep middle cerebral vein and the anterior cerebral vein.
 - It curves backwards around the upper part of the lateral surface of the midbrain till it comes below the splenium of corpus callosum.

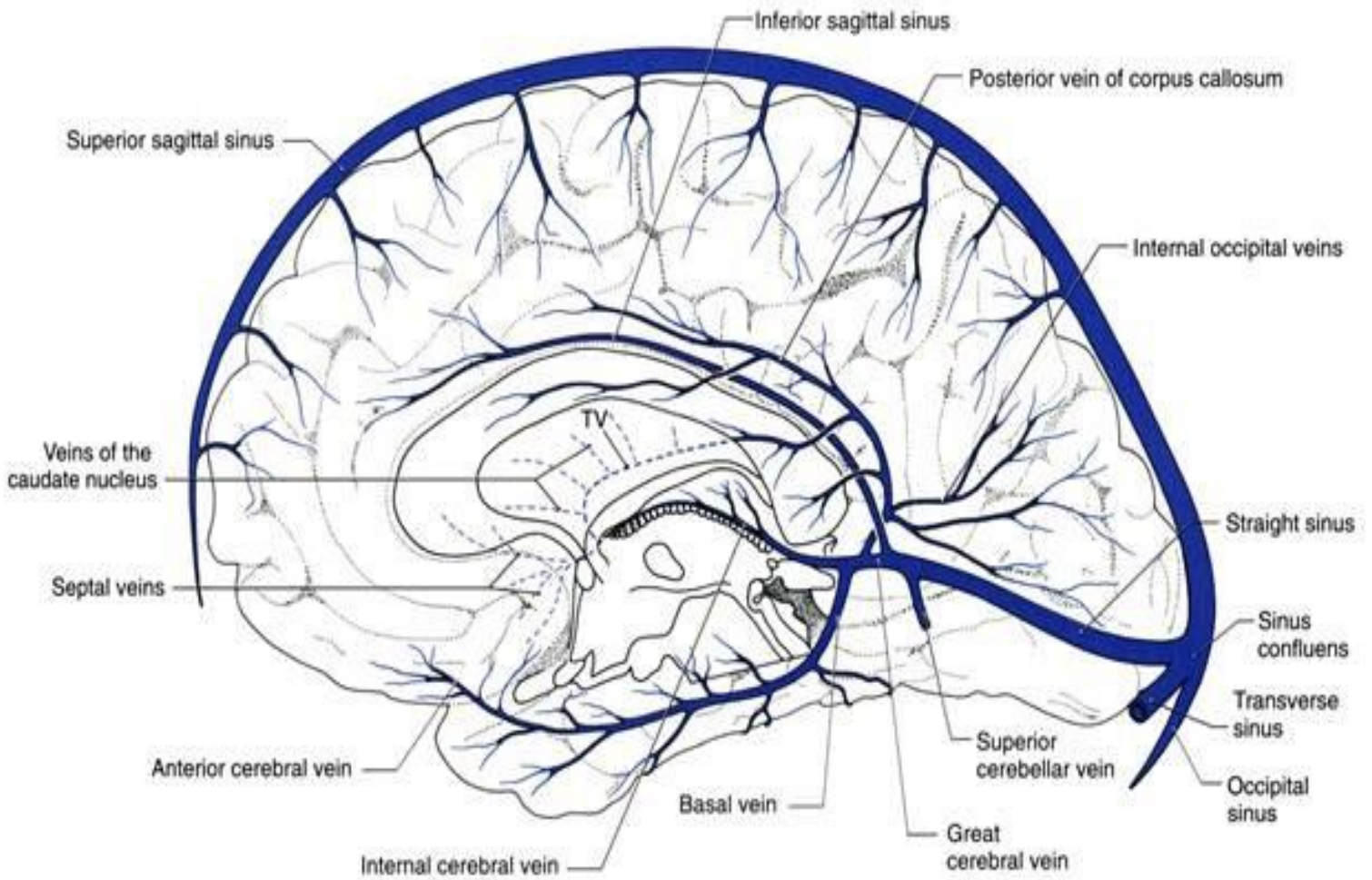
- 3- **Internal cerebral veins:** emerge from the tela choroidea below the splenium of corpus callosum. They drain the choroids plexuses of both lateral and 3rd ventricles.
- 4- **Great cerebral vein:** begins below the splenium of corpus callosum by union of Rt. and Lt. internal cerebral veins and Rt. and Lt. basal veins (i.e. 4 veins). The great cerebral vein then turns sharply upwards behind the splenium to join the inferior sagittal venous sinus to form the straight venous sinus.

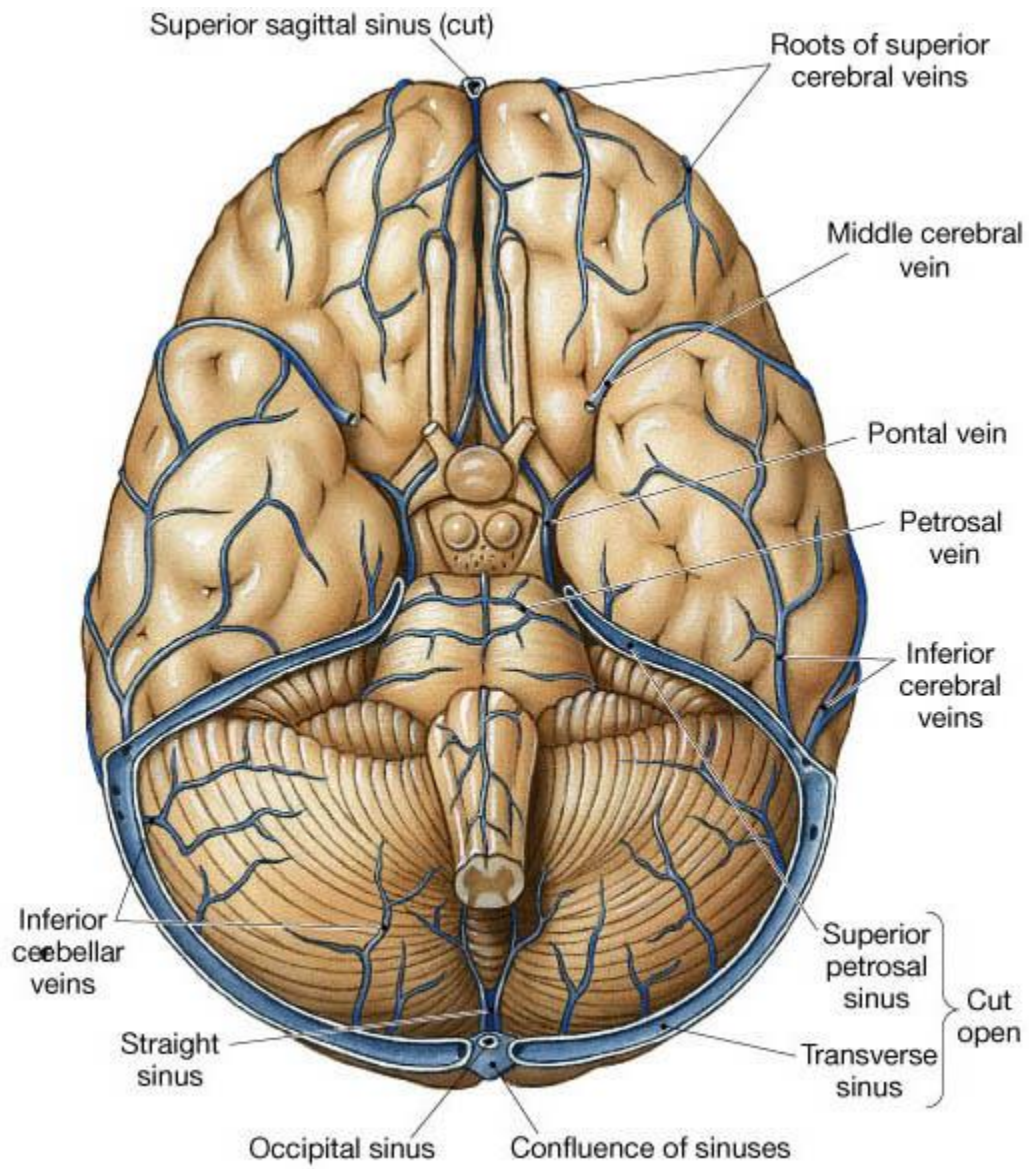
Neuroanatomy





Neuroanatomy





(b) Venous drainage of the brain, inferior view