BLOOD SUPPLY OF BRAIN AND SPINAL CORD

- **There are two paired arteries which are responsible for the blood supply to the brain; the vertebral arteries, and the internal carotid arteries. These arteries arise in the neck, and ascend to the cranium.**
- **Within the cranial vault, the terminal branches of these arteries form an anastomotic circle, called the Circle of Willis. From this circle, branches arise which supply the majority of the cerebrum.**
- **Other parts of the CNS, such as the pons and spinal cord, are supplied by smaller branches from the vertebral arteries.**

Internal Carotid Arteries

The internal carotid arteries (ICA) originate at the bifurcation of the left and right common carotid arteries, at the level of C4.

They move superiorly within the carotid sheath, and enter the brain via the carotid canal of the temporal bone.

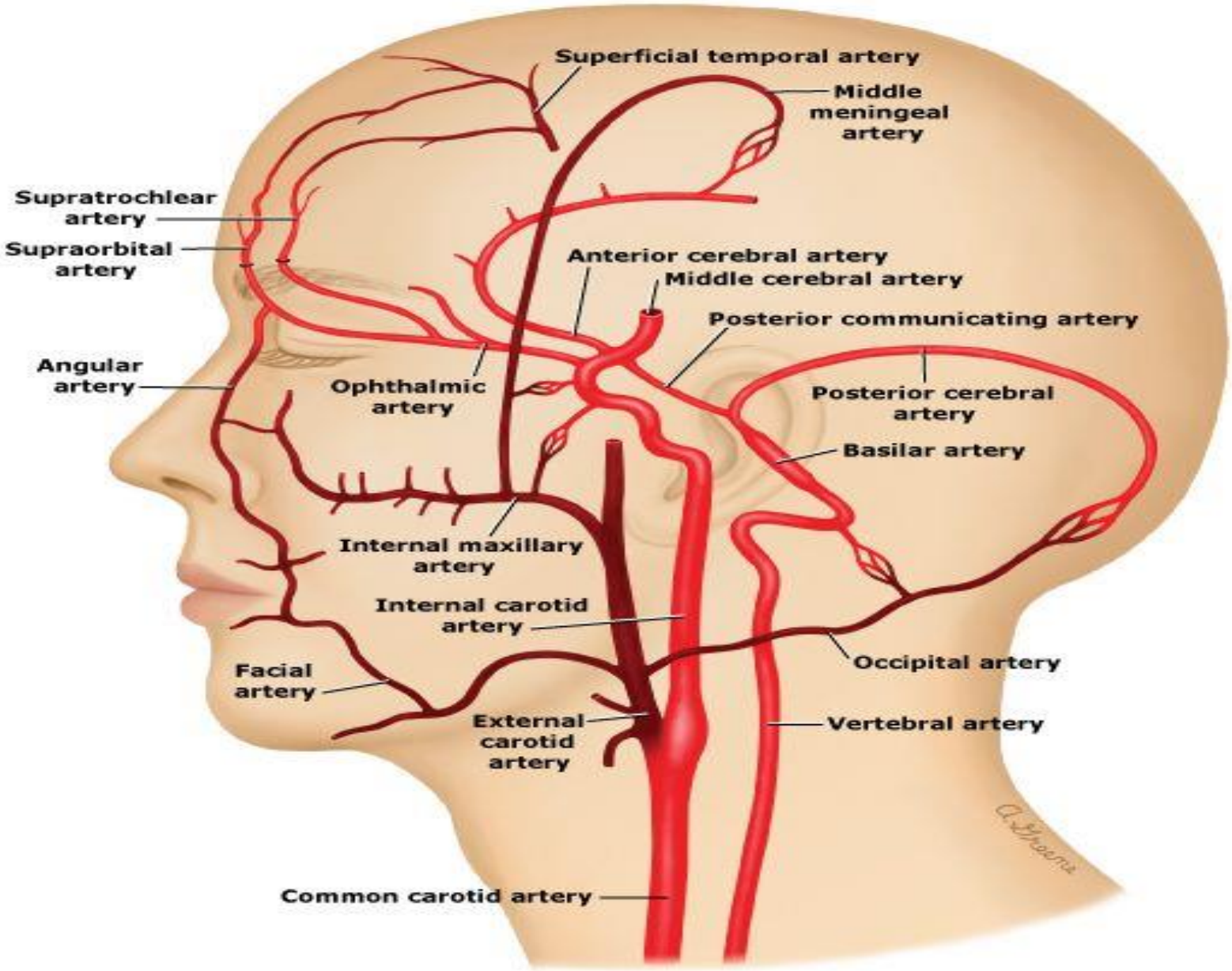
- **Branches-**

1. **Ophthalmic artery – Supplies the structures of the orbit.**
2. **Posterior communicating artery – Acts as an**

anastamotic ‘connecting vessel’ in the Circle of Willis.

3. Anterior cerebral artery – Supplies part of the cerebrum.

The internal carotids then continue as the middle cerebral artery, which supplies the lateral portions of the cerebrum.


Superficial temporal artery
Middle meningeal artery
Supratrochlear artery
Supraorbital artery
Anterior cerebral artery
Middle cerebral artery
Posterior communicating artery
Angular artery
Ophthalmic artery
Posterior cerebral artery
Basilar artery
Internal maxillary artery
Internal carotid artery
Occipital artery
Facial artery
External carotid artery
Vertebral artery
Common carotid artery

Vertebral Arteries

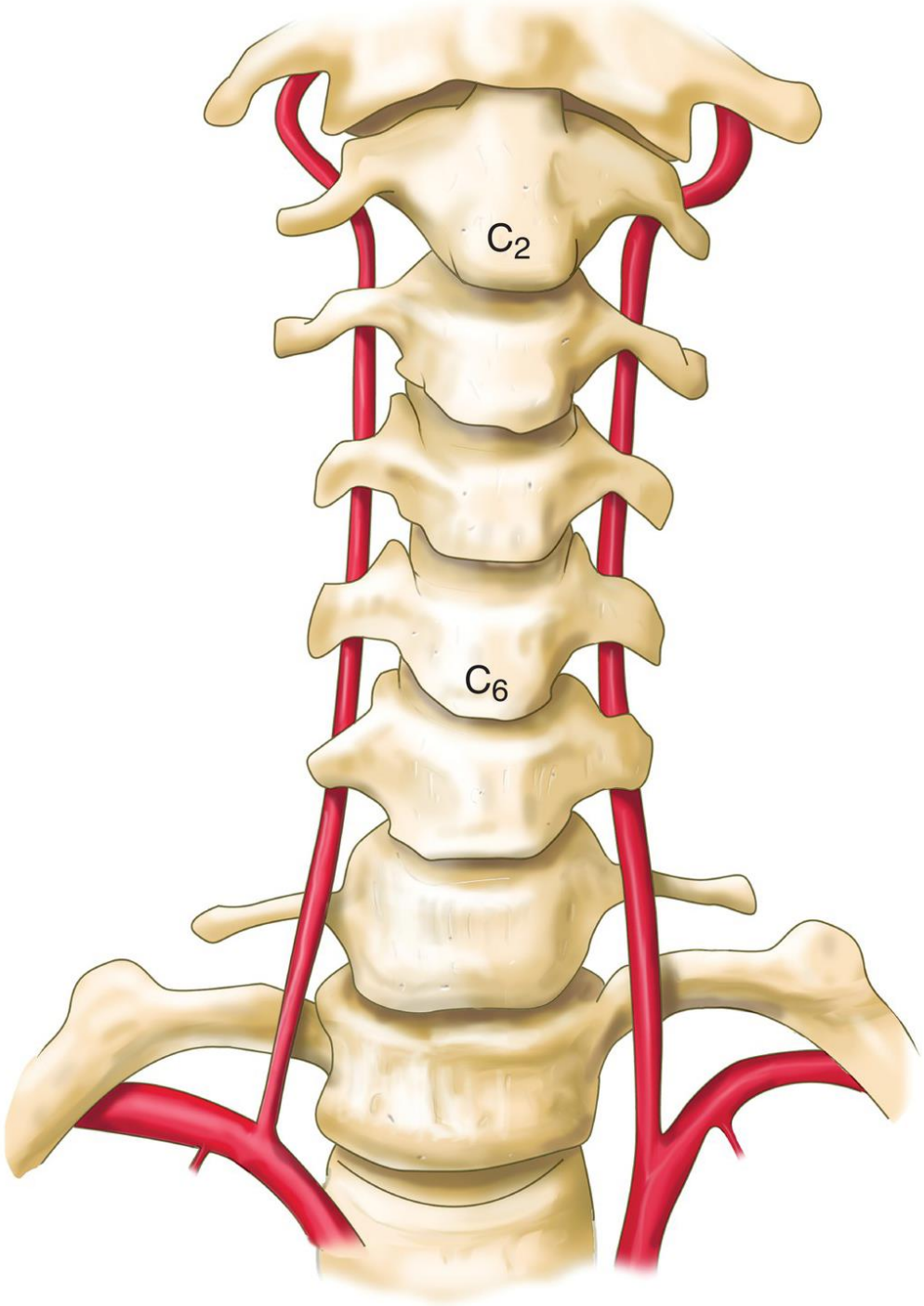
- **The right and left vertebral arteries arise from the subclavian arteries, medial to the anterior scalene muscle. They then ascend up the posterior side of the neck, through holes in the transverse processes of the cervical vertebrae, known as foramen transversarium.**
- **The vertebral arteries enter the cranial cavity via the foramen magnum. Within the cranial vault, some branches are given off:**

1. **Meningeal branch – supplies the falx cerebelli.**

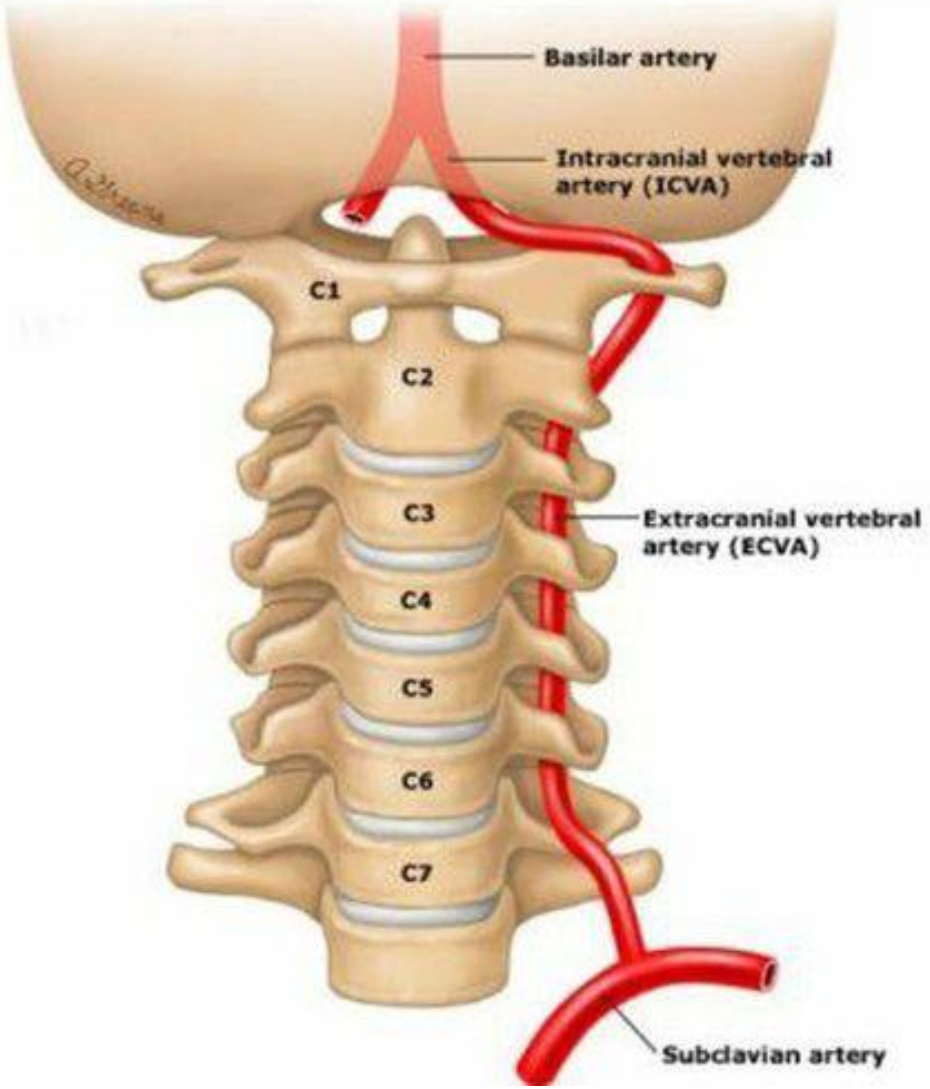
2. Anterior and posterior spinal arteries – supplies the spinal cord

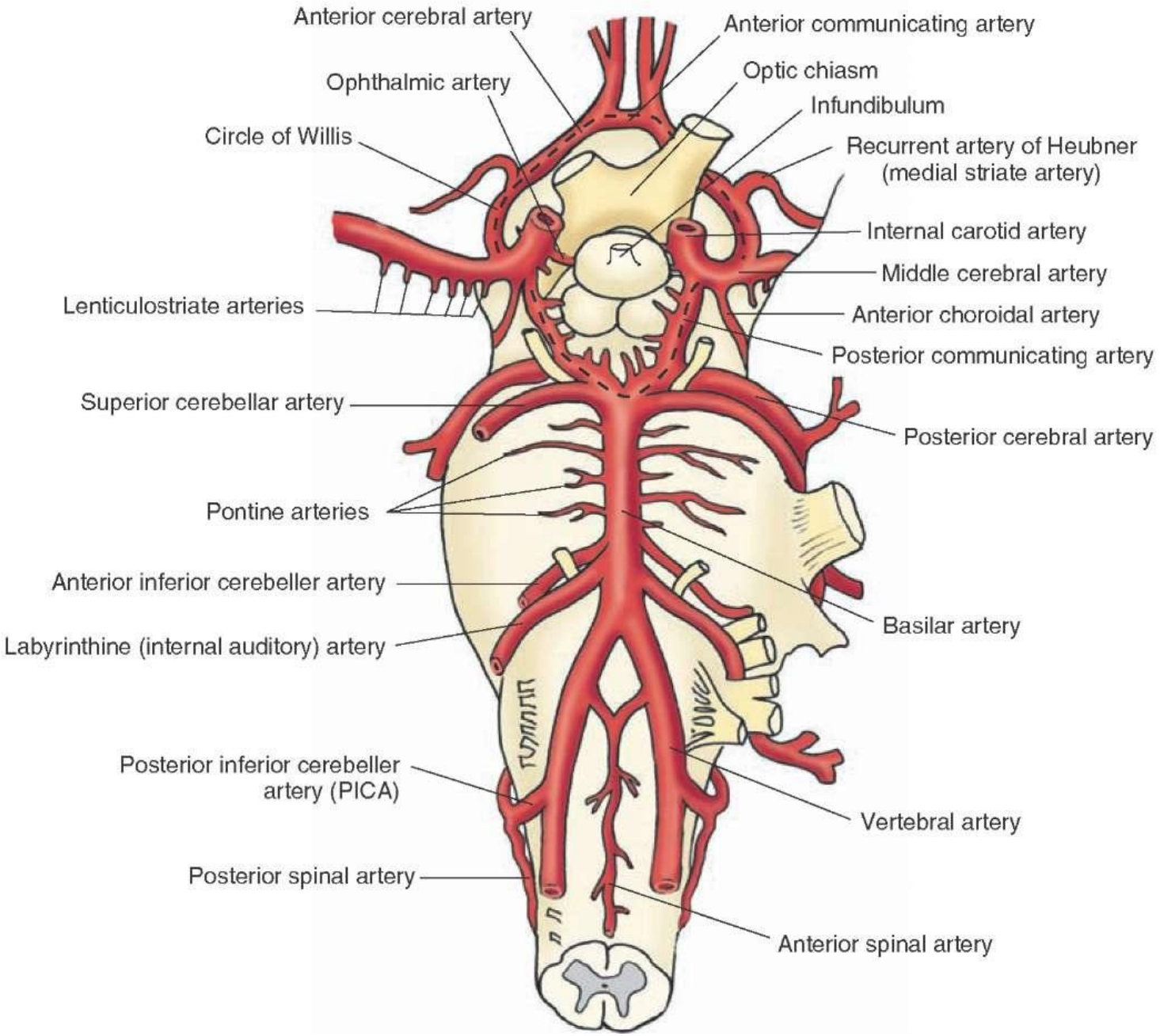
3. Posterior inferior cerebellar artery – supplies the cerebellum.

- After this, the two vertebral arteries converge to form the basilar artery in relation to ventral surface of pons. Several branches from the basilar artery originate here, and go onto supply the cerebellum and pons.
- The basilar artery terminates by bifurcating into the posterior cerebral arteries.


C2
C6

Anatomy of extracranial vertebral arteries




Anterior cerebral artery
Anterior communicating artery
Ophthalmic artery
Optic chiasm
Infundibulum
Circle of Willis
Recurrent artery of Heubner
(medial striate artery)
Internal carotid artery
Middle cerebral artery
Lenticulostriate arteries
Anterior choroidal artery
Posterior communicating artery
Superior cerebellar artery
Posterior cerebral artery
Pontine arteries
Anterior inferior cerebeller artery
Basilar artery
Labyrinthine (internal auditory) artery
Posterior inferior cerebeller
artery (PICA)
Vertebral artery
Posterior spinal artery
Anterior spinal artery

Arterial Circle of Willis

The terminal branches of the vertebral and internal carotid arteries all anastamose to form a circular blood vessel, called the Circle of Willis or circulus arteriosus. This circle is formed in relation to the base of brain.

There are three main paired of the Circle of Willis:

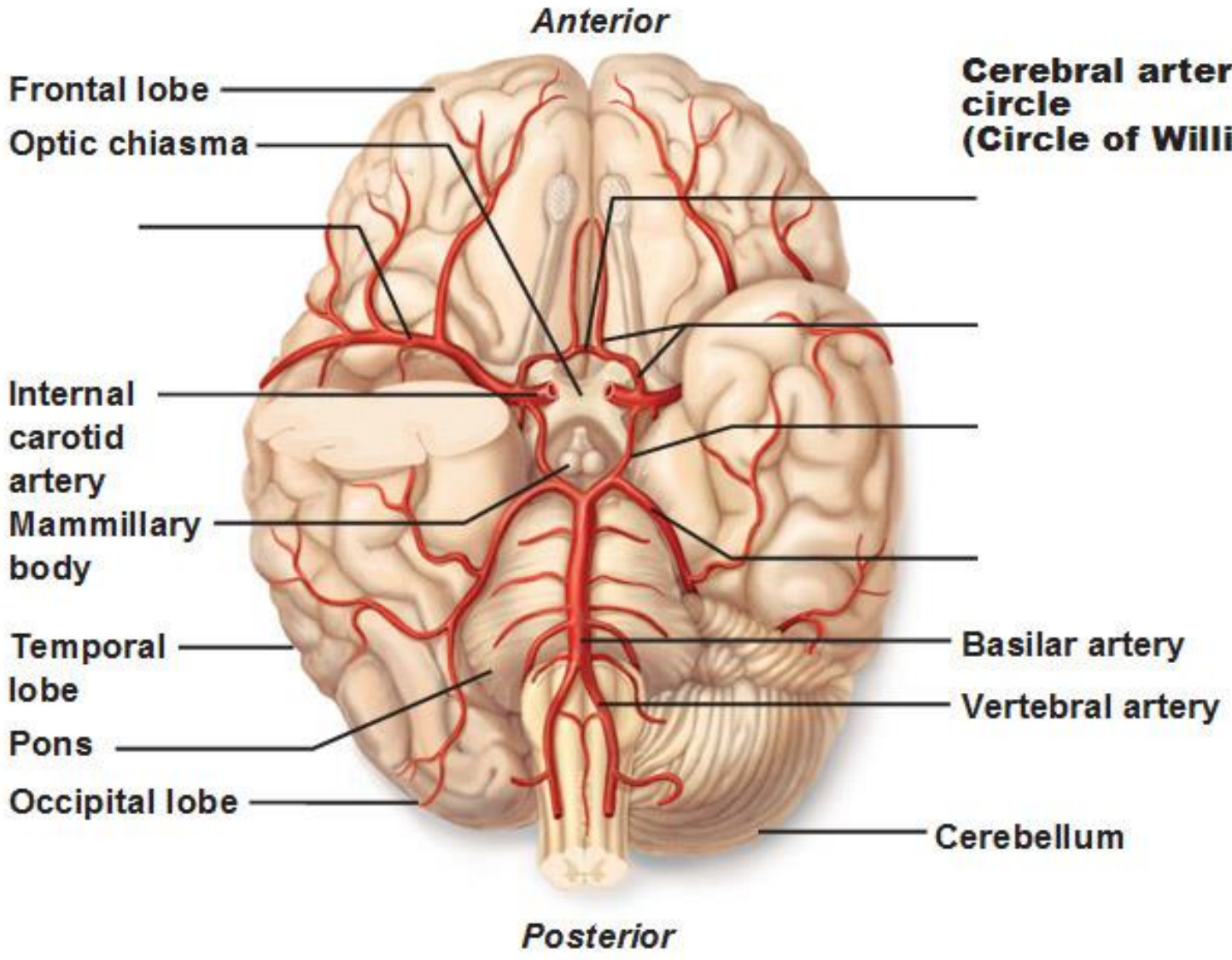
1. **Anterior cerebral arteries: These are terminal branches of the internal carotids.**
2. **Internal carotid arteries: Present immediately proximal to the origin of the middle cerebral arteries.**

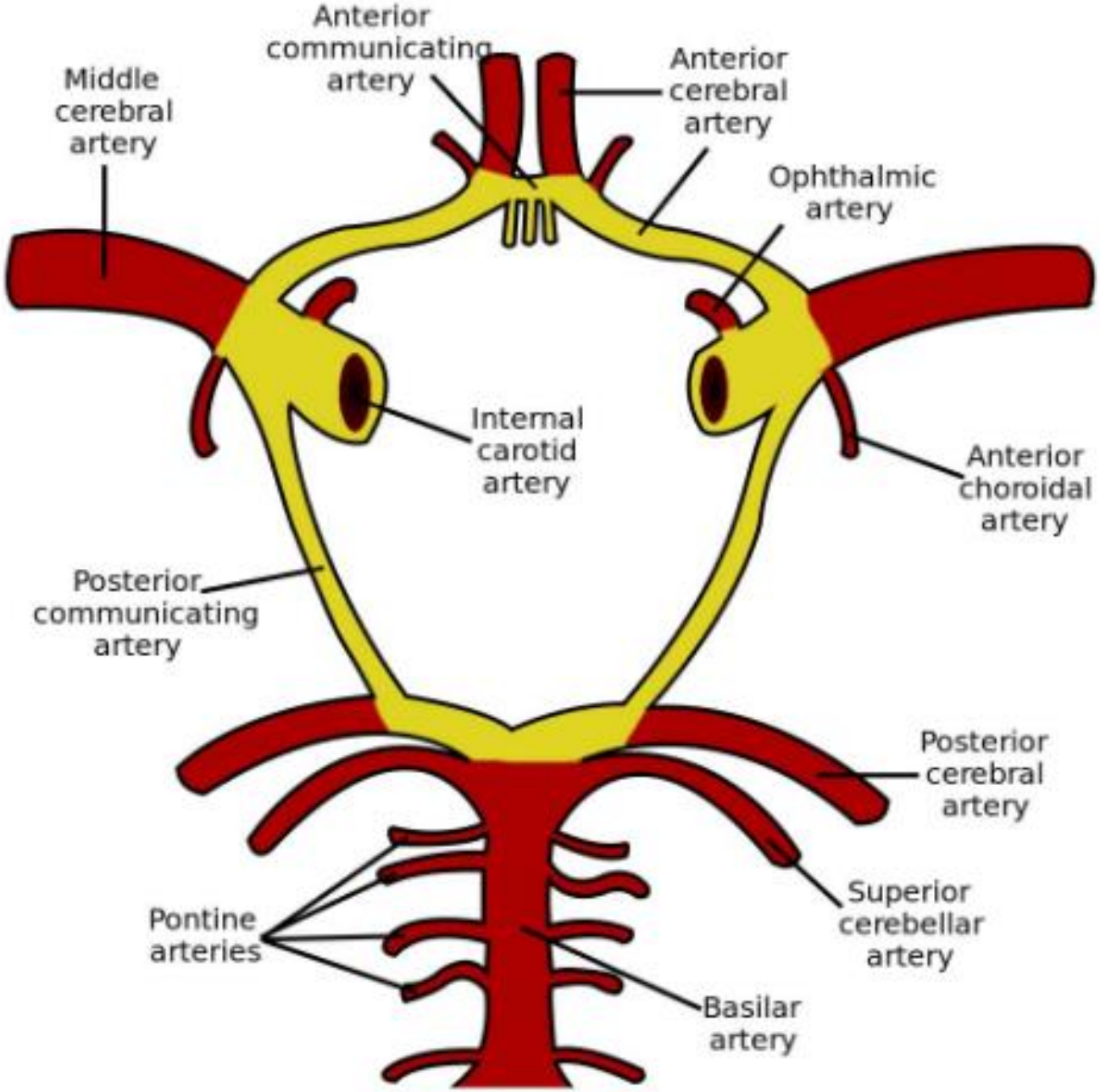
3. Posterior cerebral arteries: These are terminal branches of the vertebral arteries.

To complete the circle, two ‘connecting vessels’ are also present:

1. Anterior communicating artery: This artery connects the two anterior cerebral arteries.
2. Posterior communicating artery: A branch of the internal carotid, this artery connects the ICA to the posterior cerebral artery.

Major arteries serving the brain
(inferior view, right side of cerebellum and part of right temporal lobe removed)




Anterior communicating artery
Middle cerebral artery
Anterior cerebral artery
Ophthalmic artery
Internal carotid artery
Anterior choroidal artery
Posterior communicating artery
Posterior cerebral artery
Superior cerebellar artery
Pontine arteries
Basilar artery

- **Artery of Heubner- recurrent branch of ACA- thrombosis in this artery results in contralateral paralysis of face and upper limb.**

Regional Blood Supply to the Cerebrum

- **Cerebral arteries- 2 sets of branches-**

1. **Cortical- supply the cortex**
2. **Central- or perforators- deep into the substance of CH. Consist of 6 main groups-**

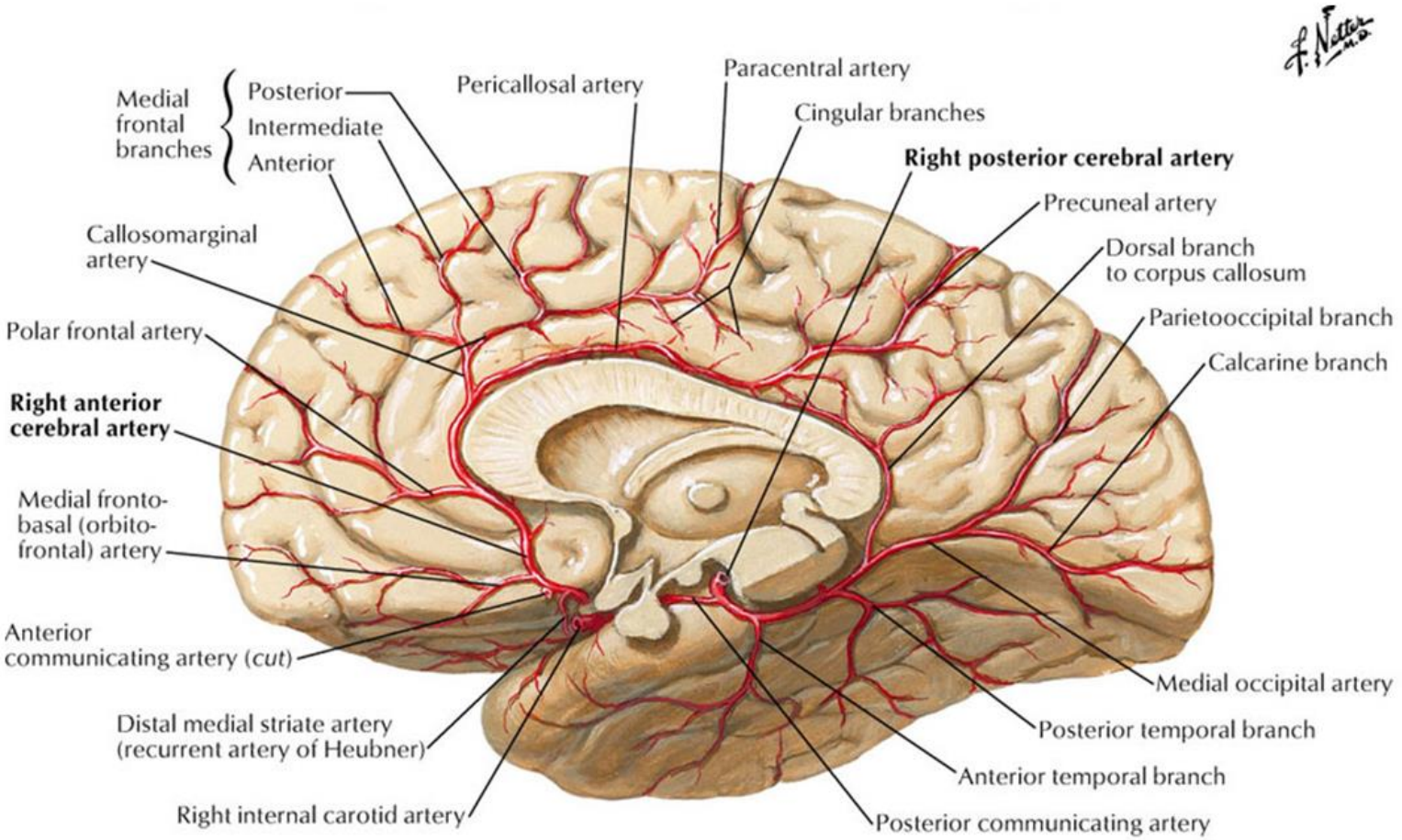
(1) **Anteromedial group- arise from antero cerebral and anterior communicating A.**

(2) **Right and left Anterolateral group- also c/d striate arteries, arise from middle cerebral A. , divide into 2 sets-**

- **Medial striate A.- supply lentiform nucleus, caudate nucleus, internal capsule.**
- **Lateral striate A. – Charcot's A. –Artery of haemorrhage**

(3) Posteromedial group- arise from post. Cerebral A. and post. Communicating A., enter the interpeduncular region

(4) Right and left Posterolateral group- arise from post. Cerebral A. , wind around cerebral peduncle.

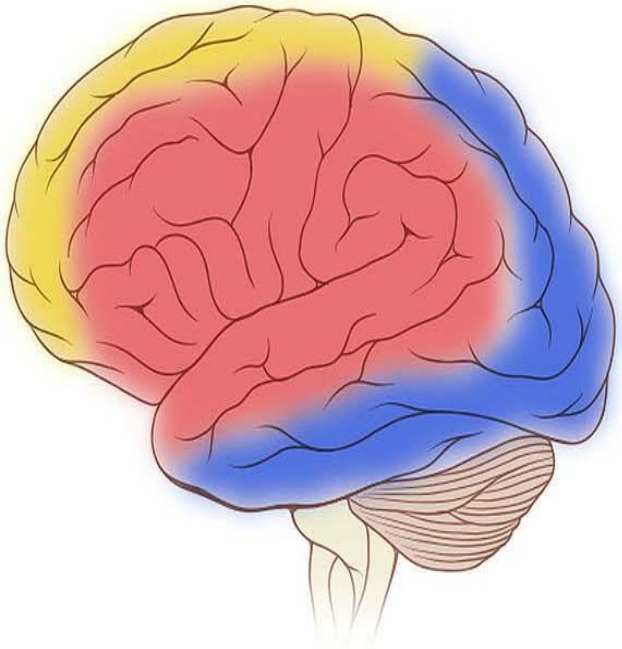


*Note: Anterior parietal (postcentral sulcal) artery also occurs as separate anterior parietal and postcentral sulcal arteries.

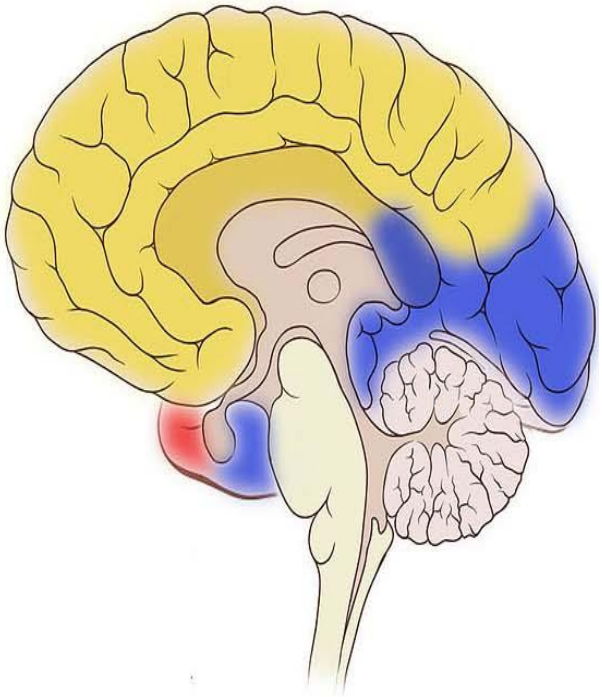
Cortex supply

1. Superolateral surface of CH- middle cerebral artery
2. Medial surface- anterior cerebral artery.
3. Inferior surface- orbital surf.- middle cerebral artery, tentorial surf.- posterior cerebral A.

Lateral Brain



Medial Brain



Anterior Cerebral Artery

Middle Cerebral Artery

Posterior Cerebral Artery

THALAMUS BLOOD SUPPLY-

- **Mainly perforating branches of the posterior cerebral A.**

HYPOTHALAMUS BLOOD SUPPLY-

- **Central branches of anteromedial group-anterior part**
- **Central branches of posteromedial group-posterior part**

Venous drainage of CH

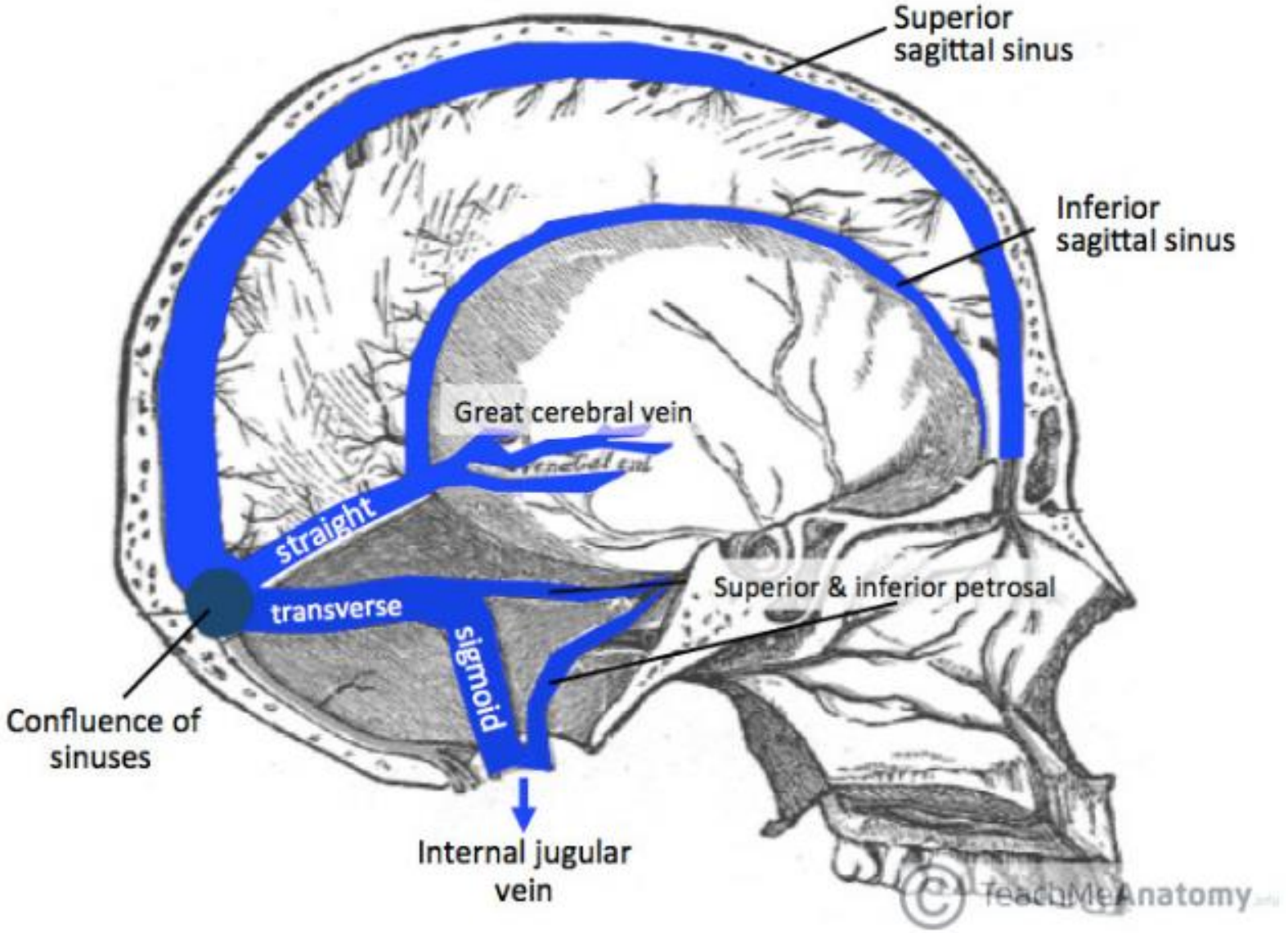
- **The cerebrum, cerebellum and brainstem are drained by numerous veins, which empty into the dural venous sinuses.**

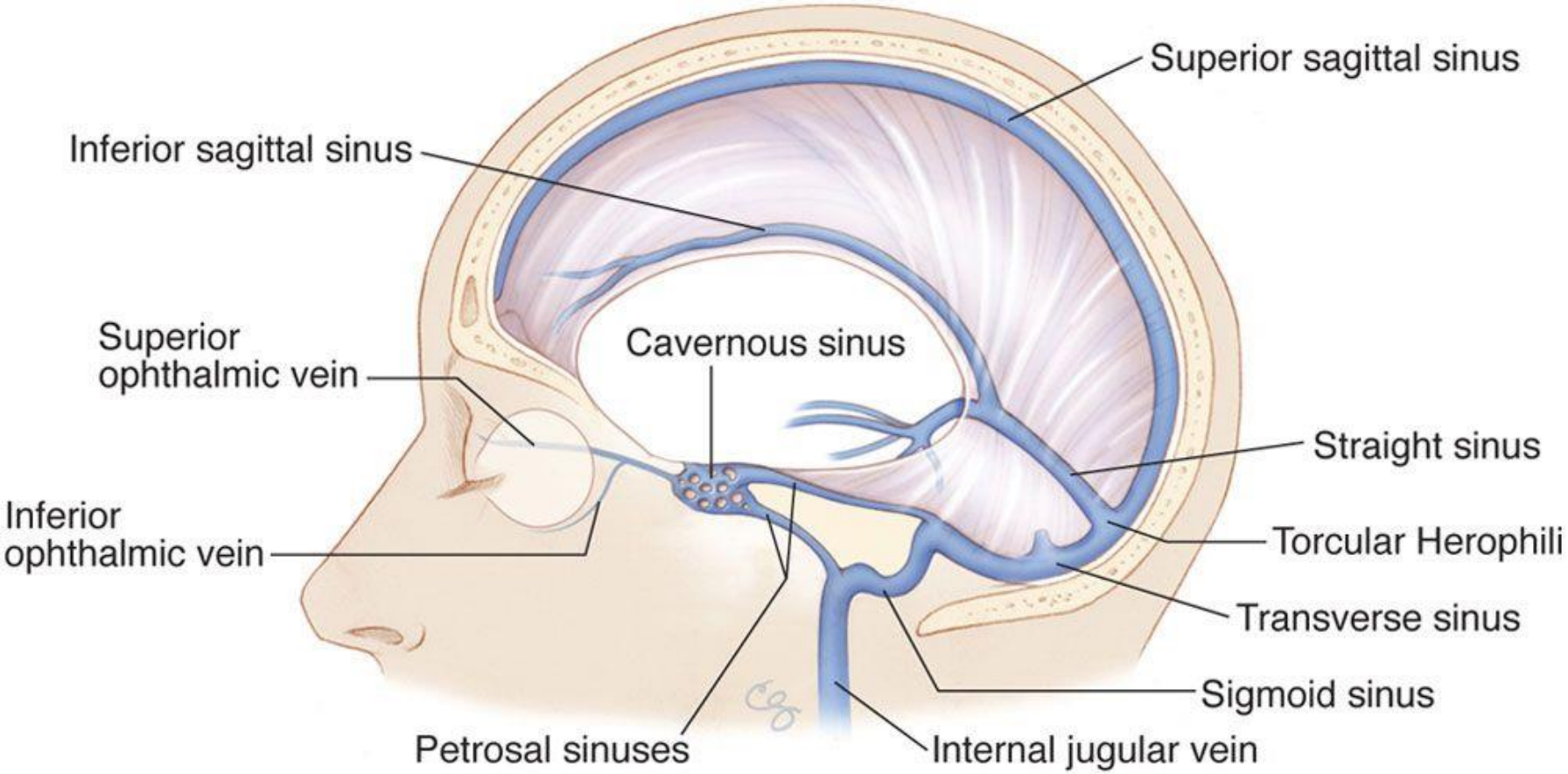
Dural Venous Sinuses

- **The dural venous sinuses lie between the periosteal and meningeal layers of the dura mater. They are best thought of as collecting pools of blood, which drain the central nervous system, the face, and the scalp.**
- **All the dural venous sinuses ultimately drain into the internal jugular vein.**
- **Dural venous sinuses do not have valves.**

- **There are eleven venous sinuses in total. The straight, superior, and inferior sagittal sinuses are found in the falx cerebri of the dura mater. They converge at the confluence of sinuses (overlying the internal occipital protuberance).**
- **The straight sinus is a continuation of the great cerebral vein and the inferior sagittal sinus.**

- **From the confluence, the transverse sinus continues bi-laterally and curves into the sigmoid sinus to meet the opening of the internal jugular vein.**
- **The cavernous sinus drains the ophthalmic veins and can be found on either side of the sella turcica. From here, the blood returns to the internal jugular vein via the superior or inferior petrosal sinuses.**


Superior sagittal sinus
Inferior sagittal sinus
Great cerebral vein
straight
transverse
sigmoid
Superior & inferior petrosal
Confluence of sinuses
Internal jugular vein
© TeachMeAnatomy


Superior sagittal sinus
Inferior sagittal sinus
Superior ophthalmic vein
Cavernous sinus
Straight sinus
Inferior ophthalmic vein
Torcular Herophili
Transverse sinus
Sigmoid sinus
Petrosal sinuses
Internal jugular vein

Veins of the Cerebrum

- **The veins of cerebrum are responsible for carrying blood from the brain tissue, and depositing it in the dural venous sinuses.**
- **They can be divided into superficial and deep groups, which are colorfully arranged around the gyri and sulci of the brain.**

Superficial System

- **The superficial system of veins is largely responsible for draining the cerebral cortex:**

1. **Superior cerebral veins: Drain the upper parts of the superolateral and medial surface and end into superior sagittal sinus.**
2. **Superficial middle cerebral vein: Drains the lateral surface of each hemisphere, carrying blood to the cavernous sinus.**

3. **Inferior cerebral veins: Drain the inferior aspect of each cerebral hemisphere, depositing blood into cavernous and transverse sinuses.**
4. **Superior anastamotic vein: Connects the superficial middle cerebral vein to the superior sagittal sinus.**
5. **Inferior anastamotic vein: Connects the superficial middle cerebral vein to the transverse sinus.**

Deep System

- **The great cerebral vein (vein of Galen) -it is formed by the union of two internal cerebral veins, and drains into the straight sinus.**
- **Basal vein- wind round the midbrain to end in the great cerebral vein.**

- **MEDULLA-**

1. **Anterior spinal A.**
2. **posterior spinal A.**
3. **PICA**

Veins- drain into superior and inferior petrosal sinuses

PONS-

1. **Branches from basilar A.**

Veins- drain into superior and inferior petrosal sinuses

MIDBRAIN

1. **Branches from basilar A.**
2. **Posterior cerebral**
3. **Superior cerebellar A.**

- **Venous drainage of midbrain- into great cerebral vein or basal vein.**

Blood Supply to Cerebellum

1. Superior cerebellar artery (SCA) from basilar artery- Superior surface
2. Anterior inferior cerebellar artery (AICA) from basilar artery- anterior part of inferior surface
3. Posterior inferior cerebellar artery (PICA) from vertebral artery- posterior part of inferior surface

Venous drainage of cerebellum

Superior surface- drain into straight, transverse and superior petrosal sinus

Inferior surface- Rt. and Lt. sigmoid sinus, inferior petrosal sinus, occipital and straight sinus

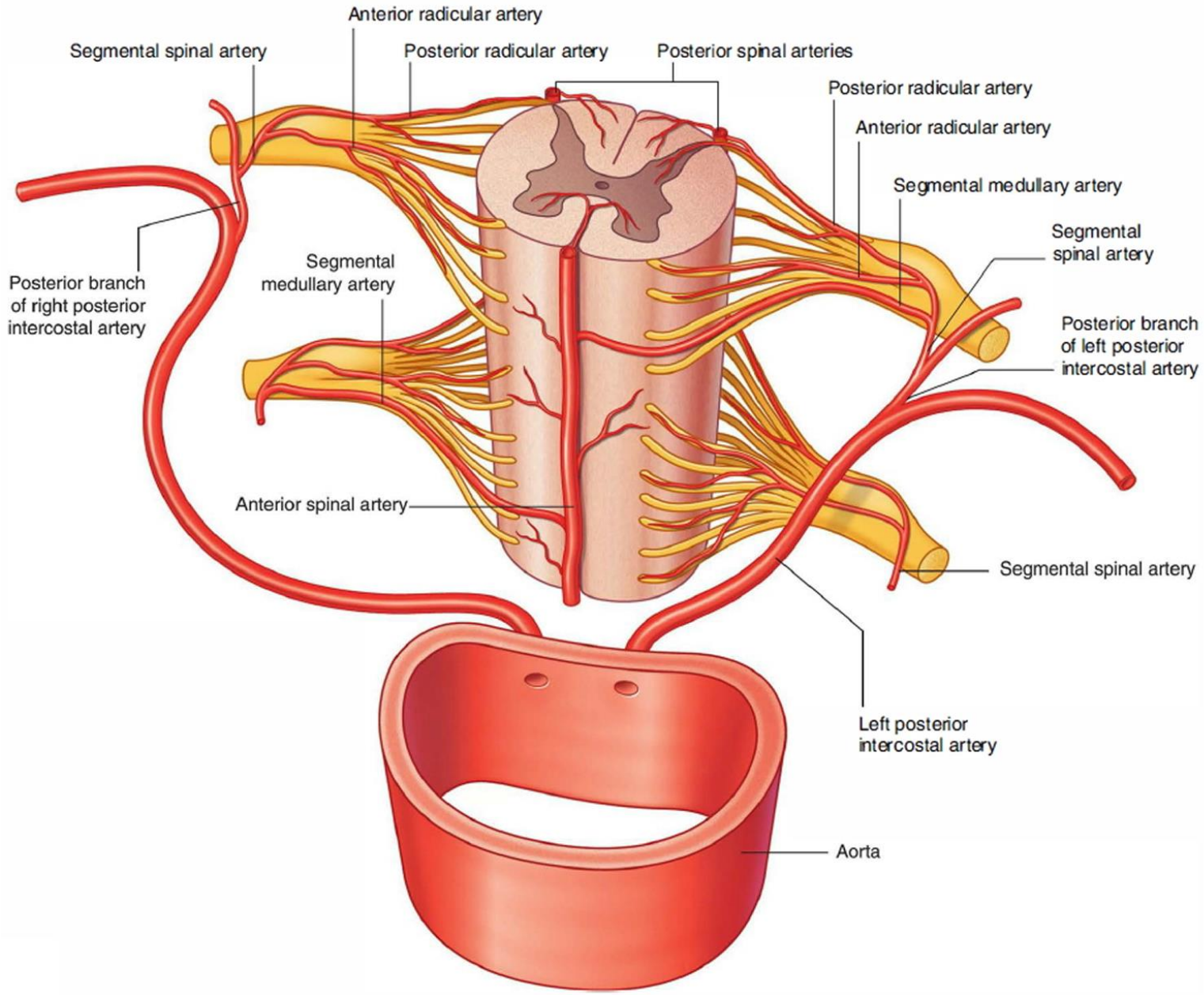
Arterial Supply to the Spinal Cord

- **The spinal cord is primarily supplied by three longitudinal arteries, which extend along the length of spinal cord:**

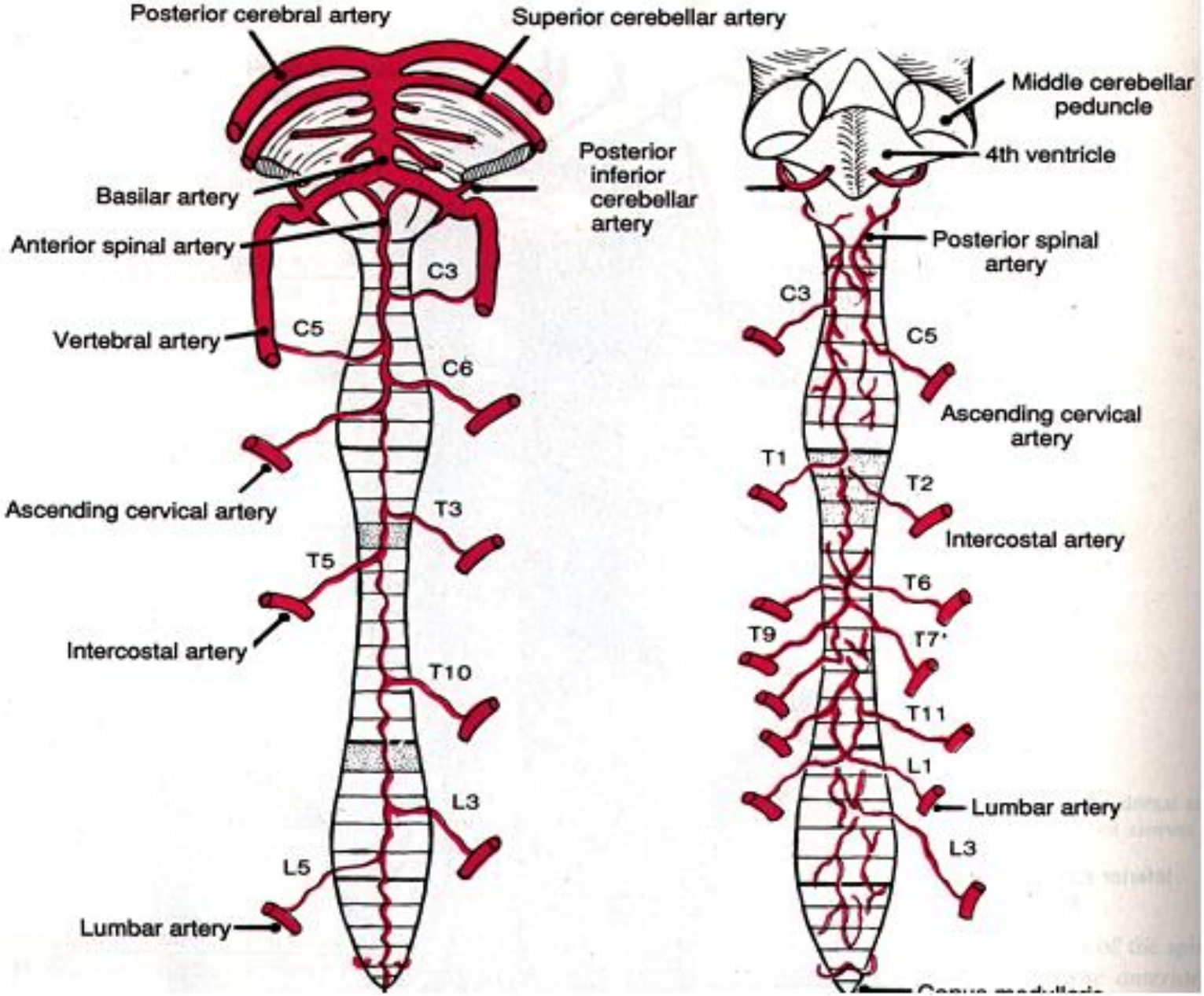
1. **Anterior spinal artery – travelling in the anterior median fissure.**
2. **Two posterior spinal arteries – run along the posterolateral sulcus.**

The main source of blood to the spinal arteries is from the vertebral arteries.

However, the blood from the vertebral arteries reaches only up to the cervical segments


Anterior radicular artery
Segmental spinal artery
Posterior radicular artery
Posterior spinal arteries
Posterior radicular artery
Anterior radicular artery
Segmental medullary artery
Segmental spinal artery
Posterior branch of right posterior intercostal artery
Segmental medullary artery
Posterior branch of left posterior intercostal artery
Anterior spinal artery
Segmental spinal artery
Left posterior intercostal artery
Aorta

- **Arterial blood supply below the cervical region comes from the radially arranged posterior and anterior radicular arteries, which run into spinal cord alongside the dorsal and ventral nerve roots**
- **These radicular arteries arise from spinal branches of the vertebral, ascending cervical, deep cervical, Intercostal, lumbar and sacral arteries.**
- **Largest of the anterior radicular arteries is known as arteria radicularis magna- lower 2/3 of spinal cord**


Posterior cerebral artery
Superior cerebellar artery
Middle cerebellar peduncle
Posterior inferior cerebellar artery
4th ventricle
Basilar artery
Anterior spinal artery
Posterior spinal artery
C3
C3
Vertebral artery
C5
C5
C6
Ascending cervical artery
T1
T2
Ascending cervical artery
Intercostal artery
T3
T5
T6
T9
T7'
Intercostal artery
T10
T11
L1
Lumbar artery
L3
L3
L5
Lumbar artery

Venous drainage of spinal cord

- **Arranged in the form of six longitudinal channels.**

1. **Anteromedian**
2. **Posteromedian**
3. **Anterolateral-2**
4. **Posterolateral-2**

These channels are interconnected by a plexus of veins that form a venous vasocorona.