

CNS

ANATOMY

21

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Blood supply of the CNS

We have two main systems supplying the CNS:

1- **Vertebro-basilar system** (30% of the total blood supply)

This system is located posteriorly and consists of two vertebral arteries (branches of the first part of the subclavian artery). The fourth parts of vertebral artery ascend beside the medulla oblongata then enter foramen magnum till they reach the upper border of medulla oblongata, where the two vertebral arteries unite to form the basilar artery.

The basilar artery passes anterior to the pons, in the basilar groove, and terminates at the upper border of pons by giving its terminal branches (bifurcation); two *posterior cerebral arteries* (*right and left*) that will curve around the superior cerebellar peduncle to run in the *calcarine sulcus* (on the medial surface of the brain).

Vertebral artery branches:

- A. **Basilar Artery**
- B. **Anterior spinal artery** (one branch from both vertebral arteries connected together) in the anteromedian fissure of the spinal cord. It supplies the anterior two thirds of spinal cord.
- C. **Two posterior spinal arteries** in the posterolateral fissure on the posterior surface of the spinal cord. It supplies the posterior third of spinal cord
- D. **Pica = posterior inferior cerebellar artery** to supply posterior part of inferior surface of the cerebellum and sides of the medulla oblongata.
- E. **Medullary branches** to supply the medulla oblongata

Basilar artery branches :

- A. **Pontine branches**
- B. **Aica = anterior inferior cerebellar artery** to supply anterior part of inferior surface of the cerebellum.
- C. **Superior cerebellar arteries** located under the bifurcation of posterior cerebral arteries to supply the superior cerebellum.

D. **Posterior cerebral arteries** = terminal branches of the basilar.

2- **Internal carotid artery** (70% of the total blood supply)

It's located ventrally (anteriorly), it gives off many branches, but the main two branches are: (1) *anterior cerebral artery*, which will go medially through the longitudinal sulcus and then enters to the **callosal sulcus** above the corpus callosum to supply the medial surface of the brain and (2) *middle cerebral artery* (continuation of the internal carotid artery) which will go laterally to enter **the posterior ramus of the lateral fissure** to supply lateral surface of brain.

There are communications between the basilar artery and internal carotid, that together form a closed circle; circle of Willis

Circle of Willis (circulus arteriosus) in subarachnoid space

It's found in the interpeduncular fossa around the base of the brain. It's protected by **interpeduncular cisterna**.

***The interpeduncular fossa**: in the inferior surface of brain between the right and left hemispheres (on the ventral surface of the midbrain)

Boundaries:

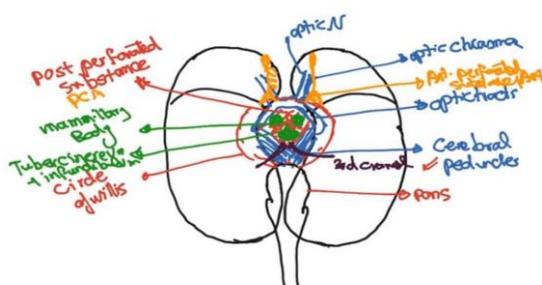
Anterior: optic chiasma, **Posterior:** upper surface of Pons, **anterolateral:** optic tract, **posterolateral:** crus cerebri or cerebral peduncle

Contents: - (past paper Q)

Mamillary body - posterior perforated substance (perforating branches of the posterior cerebral artery) - oculomotor nerve (3rd) (emerges from the medial aspect of the crus cerebri) - tuber cinereum and the infundibulum of pituitary gland.

The **posterior communicating** artery connects internal carotid A and posterior cerebral A). The **anterior communicating**

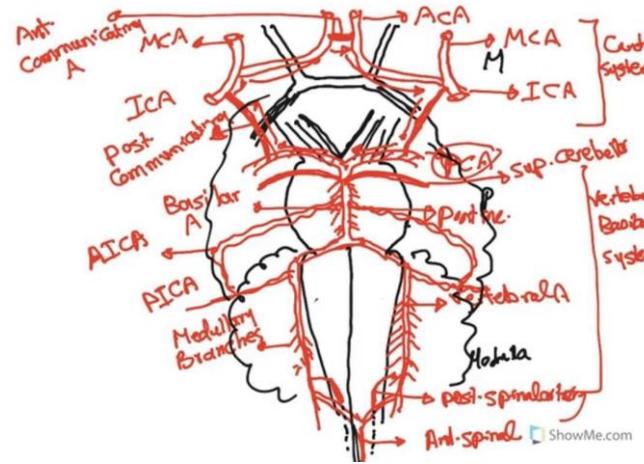
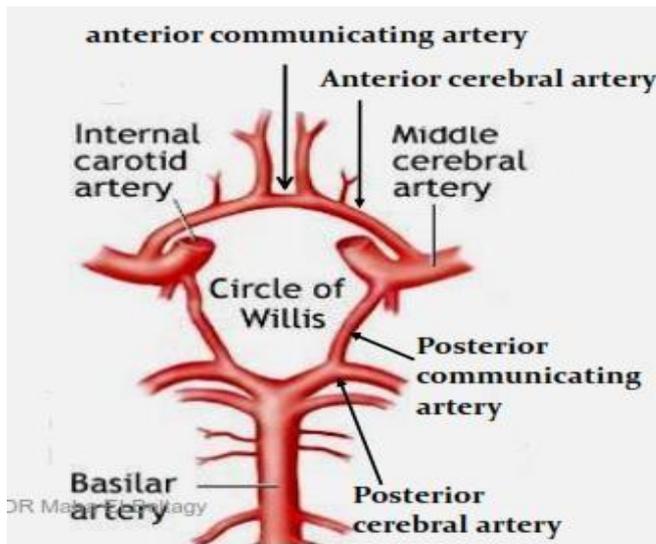
artery joins the two anterior cerebral arteries.



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Anterior perforated substance (anterior cerebral artery) between medial and lateral olfactory stria

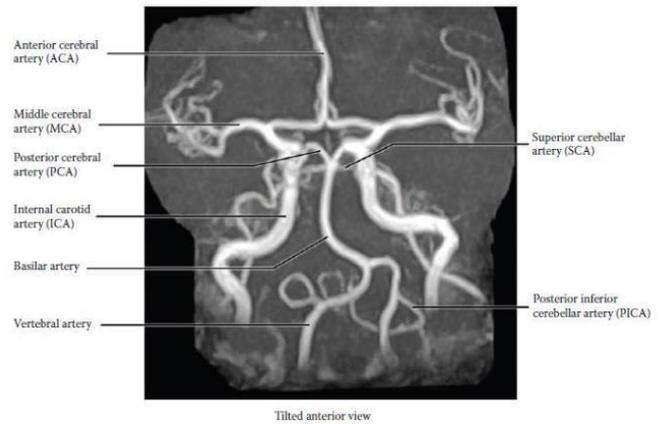
The previous arteries together form the circle of Willis



Physiological importance of the circle: This circle creates collaterals in the cerebral blood supply; if there are any interruptions or embolus in one of these arteries, other arteries will compensate.

Angiograms

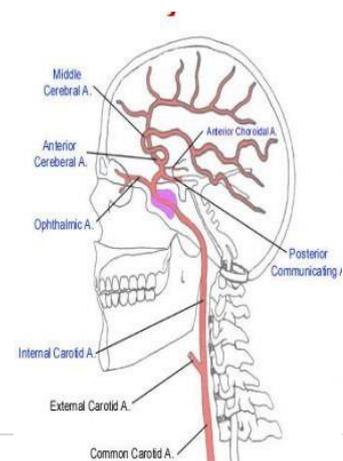
It's an important role in diagnosing injuries or thrombus in the brain. Here is an example of a normal angiogram.



We'll talk more now about the internal carotid artery, which is a branch from the common carotid. Remember that the common carotid artery terminates into internal and external common carotid, which is the main blood supply to the head and neck.

The course of internal carotid:

It arises from the common carotid artery in the neck, entering head at skull base via the carotid foramen to pass through the carotid canal. From there it reaches the petrous part of the temporal bone to enter the



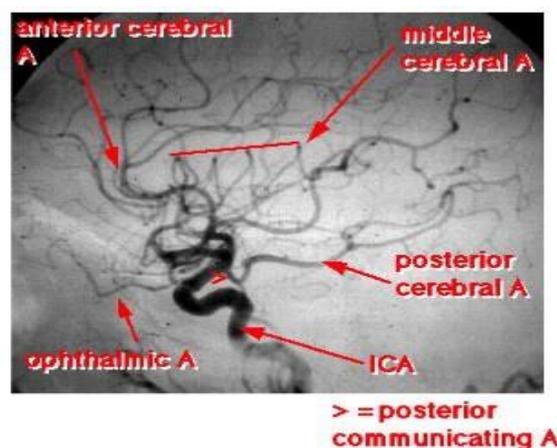
cavernous sinus from its inferolateral end and leaves it anteriorly. After leaving the cavernous sinus, internal carotid bifurcates into anterior and middle cerebral arteries.

Branches of internal carotid:

- 1- **Ophthalmic artery**, it originates after the cavernous sinus
- 2- **Artery to the anterior pituitary and stalk**. It supplies the pituitary and infundibulum. (anterior pituitary artery)
- 3- **Posterior communicating artery**, it's a branch from the stem of the internal carotid itself and as mentioned above it communicates with the posterior cerebral artery
- 4- **Anterior choroidal artery**. It provides the blood supply of the choroid plexus in the lateral ventricle.

**remember that posterior choroidal artery is from posterior cerebral artery also supply lateral ventricle and participates in the formation of choroid plexus*

5- Anterior and middle cerebral artery (bifurcation)



There are three cerebral arteries; anterior, middle and posterior.

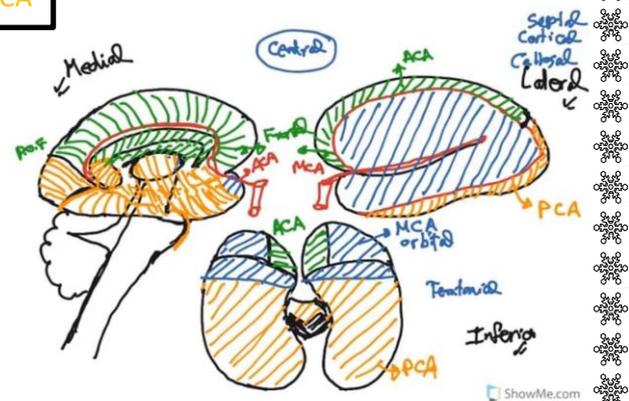
Anterior cerebral artery = medial striate artery

Cortical structures supplied by it:

- Most of the medial surface of the brain.
**Note: the artery runs in the callosal sulcus and ends before the splenium and curve superiorly. So it gives branches that supply that area till the parietooccipital fissure.*

- The frontal pole
- the upper 1 inch of the lateral surface anterior to the parietooccipital fissure
- Medial half of the orbital surface

ACA
MCA
PCA



Callosal parts supplied by it:

- all parts of corpus callosum except the splenium

Septal parts supplied by it: (septum pellucidum between corpus callosum and the fornix which closes the cavity of lateral ventricle)

- all of it

Central structures supplied by it: putamen and anterior half of caudate and lentiform

- Anterior part of corpus striatum
- anterior part of anterior limb of internal capsule

Note: If we are to divide the central structures into two parts; anterior and posterior, The anterior part will be supplied by the anterior cerebral artery while the posterior part will be supplied by middle cerebral artery

Question: if there is an embolus in the anterior cerebral artery, which one of the following parts could be affected:

1-upper limb **2- lower limb (both sensory and motor)** 3-frontal eye field 4-wernick's area 5- broca's area

In these questions you have to associate each area with its function, so the paracentral lobule can be a correct answer

Middle cerebral artery :

Cortical structures supplied by it:

- Most of the lateral surface of the brain **except the upper and lower inches of lateral surface and occipital lobe behind**

parieto-occipital fissure.

- Temporal pole
- lateral half of the orbital surface of the brain

Central structures supplied by it:

- posterior half of corpus striatum and posterior half of anterior limb of internal capsule
- Genu and posterior half of caudate and posterior half of lentiform
- Posterior limb of internal capsule

Posterior cerebral artery : supply all of midbrain and crus cerebri

Cortical structures supplied by it:

- Behind the parietooccipital fissure in both lateral and medial surface.
- Lower one inch of the lateral surface
- Occipital pole
- all of the tentorial surface except temporal pole

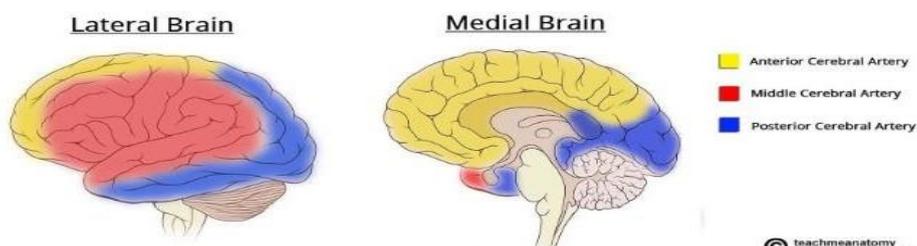
Central and callosal structures supplied by it:

- Splenium of corpus callosum, amygdala, cerebral peduncles, **thalamus**, medial geniculate body, and lateral geniculate body .

***When supplying the thalamus, posterior cerebral artery gives central branches; short and long. The **short central branches** supply the anterior part of the thalamus and the **long ones** supply the thalamus posteriorly.

So, the geniculate bodies (which are posteriorly) are supplied by the long central branches of posterior cerebral.***Posterior cerebral artery gives an important branch below the splenium which is the posterior choroidal artery; it supplies the choroid plexus of the lateral and third ventricles.

Blood Supply to the surfaces of the brain:



Blood supply to the cerebellum

The arteries that supply the cerebellum are:

- 1- Posterior inferior cerebellar artery (PICA) from the vertebral artery
- 2- Anterior inferior cerebellar artery (AICA) from the basilar artery
- 3- Superior cerebellar artery from the basilar artery

= The basilar artery has the largest contribution to the blood supply of cerebellum.

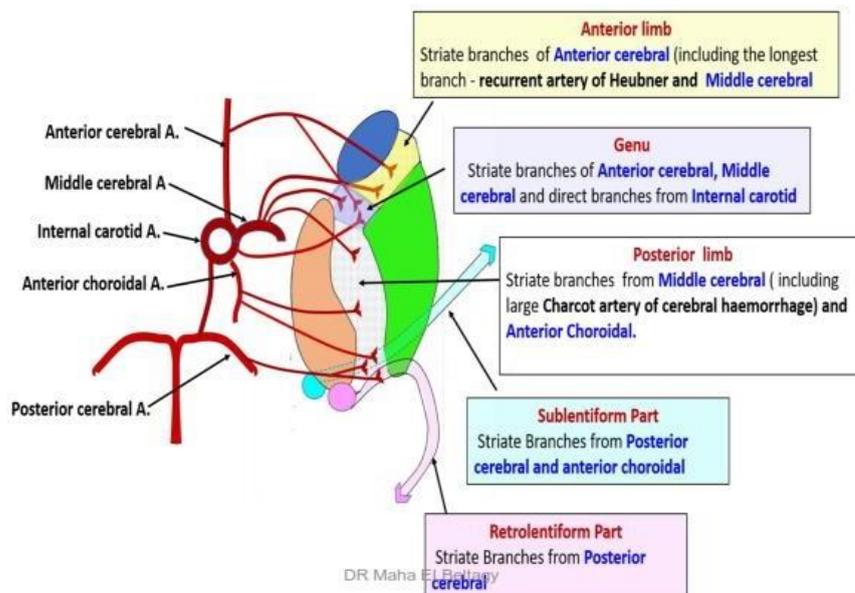
Blood supply to the spinal cord

Anterior two third from -> anterior spinal artery

Posterior one third from -> posterior spinal artery

Blood supply to the internal capsule(very important)

**This picture summarizes everything, so you can come back here at the end*



The parts of the internal capsule and their blood supply:

1- Anterior limb between caudate and lentiform

- anterior half: branches from anterior cerebral artery
- posterior half: supplied directly from the middle cerebral artery.

2- Genu (contains corticobulbar tract)

Double blood supply = middle cerebral artery and direct branches from internal carotid

3- Posterior limb between lentiform and thalamus

- most of it: branch from middle cerebral artery which is the **Charcot artery of the cerebral hemorrhage a branch of middle cerebral artery.**
- posterior end: anterior choroidal artery from the internal carotid and posterior cerebral artery

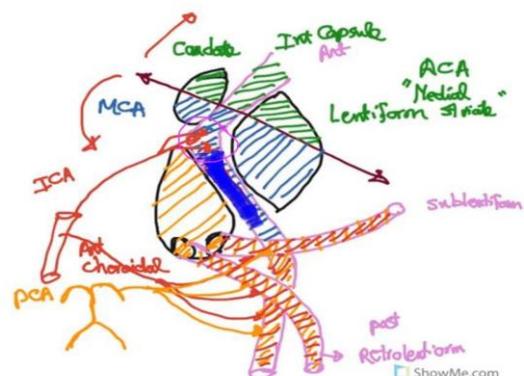
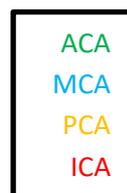
4- Sublentiform between temporal auditory area and medial geniculate body

anterior choroidal artery from the internal carotid and posterior cerebral artery

5- Retrolentiform between occipital lobe and lateral geniculate body

-anterior choroidal artery from the internal carotid and posterior cerebral artery

lesion of posterior limb of internal capsule = an injury to Charcot artery leads to the loss of sensory radiation and motor function, contralateral hemiplegia and contralateral hemianesthesia ; since the posterior limb contains both ascending sensory and descending pyramidal tracts "corticospinal fibers"



Cerebral artery syndromes (very important)

Anterior Cerebral Artery Occlusion

1. **Contralateral hemiparesis and hemisensory loss in lower limb (paracentral lobule).**
2. **Inability to identify objects correctly , apathy ,and personality changes (frontal and parietal lobes).**

Middle Cerebral Artery Occlusion

1. **Contralateral hemiparesis and hemisensory loss involving mainly the Face and arm (precentral and postcentral gyri)**
- 2 . **Fluent aphasia (sensory aphasia) if wernicke's area is affected or non fluent aphasia (motor aphasia) if broca's area is affected**
3. **Contralateral homonymous hemianopia (damage to the optic radiation)**
4. **Agnosia**
5. **Auditory aphasia or contralateral reduction of hearing acuity**

Posterior Cerebral Artery Occlusion

1. **Contralateral homonymous hemianopia with some degree of macular sparing (damage to the calcarine cortex, macular sparing due to the occipital pole receiving collateral blood supply from the middle cerebral artery).**
2. **Visual agnosia (ischemia of the left occipital lobe)**
3. **Impairment of memory (the medial aspect of the temporal lobe)**

Internal Carotid Artery Occlusion

1. The symptoms and signs are those of middle cerebral artery occlusion, including **contralateral hemiparesis and hemianesthesia.**
2. There is **partial or complete loss of sight on the same side**, but permanent loss is rare (emboli dislodged from the internal carotid artery reach the retina through the ophthalmic artery).

Vertebrobasilar Artery Occlusion

- 1-**Ipsilateral pain and temperature sensory loss of the face and contralateral pain and temperature sensory loss of the body.**
2. **Attacks of hemianopia or complete cortical blindness.**
3. **Ipsilateral loss of the gag reflex, dysphagia, and hoarseness as the result of lesions of the nuclei of the glossopharyngeal and vagus nerves.**
4. **Vertigo, nystagmus, nausea, and vomiting**
5. **Ipsilateral Horner syndrome**
6. **Ipsilateral ataxia and other cerebellar signs.**
7. **Unilateral or bilateral hemiparesis.**
- 8-**Comma**

وهكذا اتهمنا من محاضرات النيورواتومي لطلاب الفرقة السالسة من كلية الطب



اذا ضاقت عليك الدنيا تذكر انها ليست بنطلون

"داروين"