

CNS

Anatomy



Sheet



Slide

Number

7

Done by:

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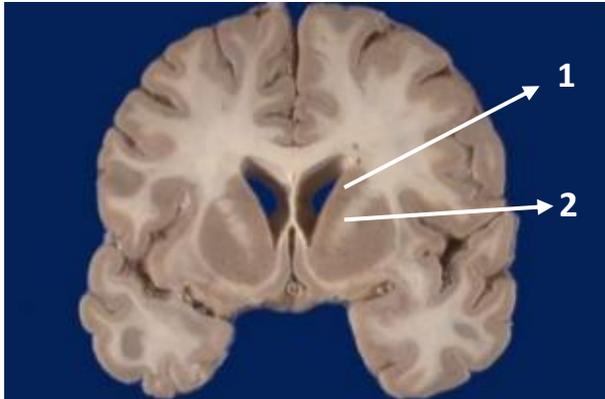
Doctor:

Maha Albeltagy

Revision:

The doctor started the lecture by a revision of some previous concepts.

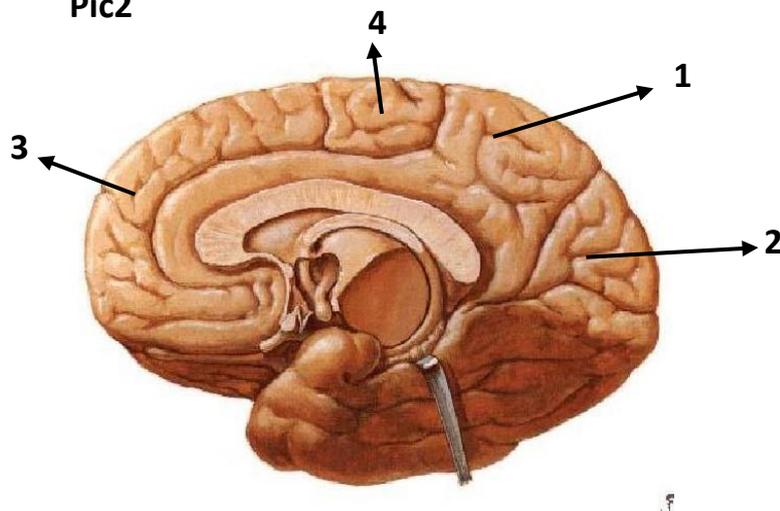
Pic1



1-Caudate nucleus

2-Anterior limb of the internal capsule

Pic2



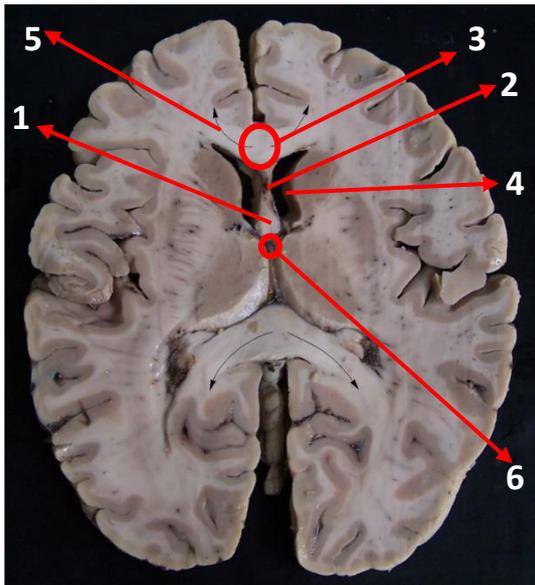
1-Precuneus gyrus

2-Cuneus gyrus

3-Medial frontal gyrus

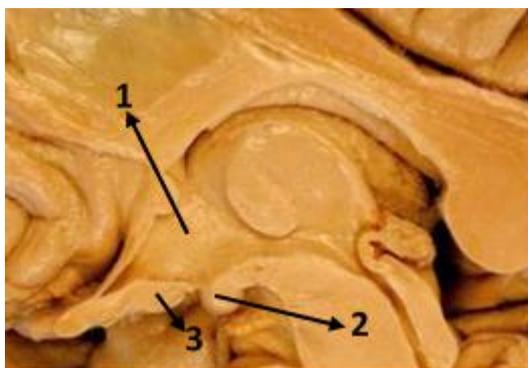
4-Paracentral lobule

Pic3 "Horizontal section of the brain"



- 1-Anterior column of fornix
 - 2-Septum pellucidum
 - 3-Genu of corpus callosum
 - 4-Anterior horn of the lateral ventricle
 - 5-Forceps minor
 - 6-Interventricular foramen "*Foramen of monro*"
-

Pic4



- 1-Hypothalamus
- 2-Mammillary body
- 3-Tuber cinereum "*it is inferiorly continuous with the infundibulum that attaches with the pituitary gland*"

Lecture7-Blood supply of the CNS

The blood supply of the CNS is divided into 2 systems regarding the source:

1-Vertebrobasilar system

2-Carotid system

1) Vertebrobasilar system

The vertebrobasilar system is made by 2 vertebral arteries and 1 basilar artery.

1-The 2 vertebral arteries originate from the 1st part of subclavian

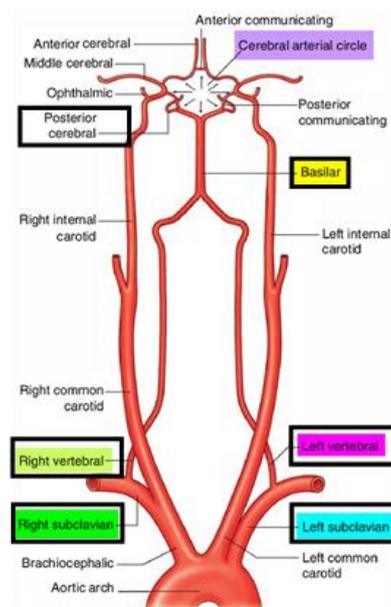
2-They both enter the cranium from foramen magnum lateral to medulla oblongata.

3-Both vertebral arteries unit at the upper end of medulla oblongata forming the basilar artery.

4-The basilar artery continues in front of the pons in the basilar groove.

5-The basilar artery then divides at the upper end of pons into 2 posterior cerebral arteries.

This vertebrobasilar system supplies 30% of the brain, the remaining 70% are supplied by the carotid system” which source is the internal carotid artery”.



Note the black boxes

2) Carotid system

1-The common carotid branches from the subclavian

2-In the neck, it branches into external and internal carotid arteries.

3-The internal carotid enters the carotid foramen then continues in the carotid canal that is located on the petrous part of temporal bone to enter the skull.

4-After the internal carotid enters through the carotid canal, it continues its passage through the floor of the cavernous sinus.

5-At the anterior part of the cavernous sinus it divides into anterior and middle cerebral arteries.

Important note: The internal carotid artery gives branches before it terminates into middle and anterior cerebral arteries, its branches are:

1-Ophthalmic artery

2-Artery to the anterior pituitary and stalk

3-Posterior communicating artery (PCoA)

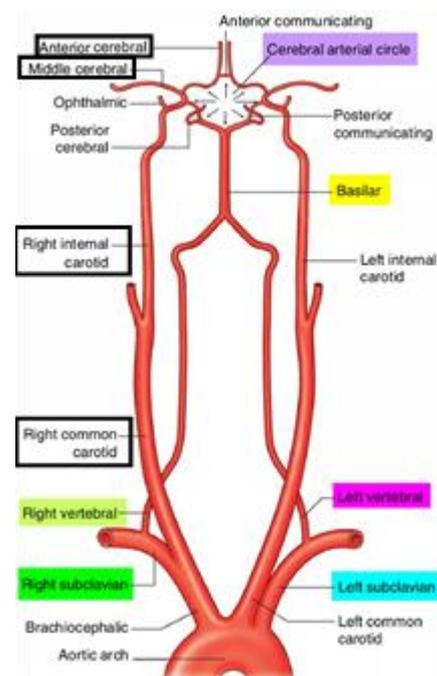
4-Anterior choroidal artery (AChA)

5-Bifurcating into the ACA and MCA

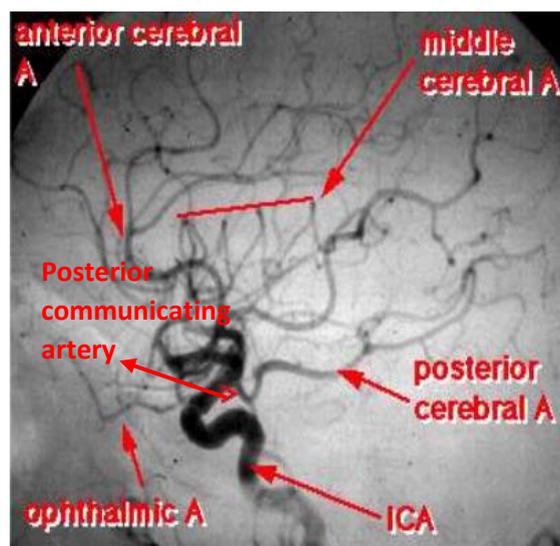
The continuation of the 3 cerebral arteries:

-The anterior cerebral artery runs in the callosal sulcus that is located on the medial side of the brain.

-The middle cerebral artery runs in the posterior ramus of the lateral fissure which is located on the lateral side of the brain



Note the black boxes



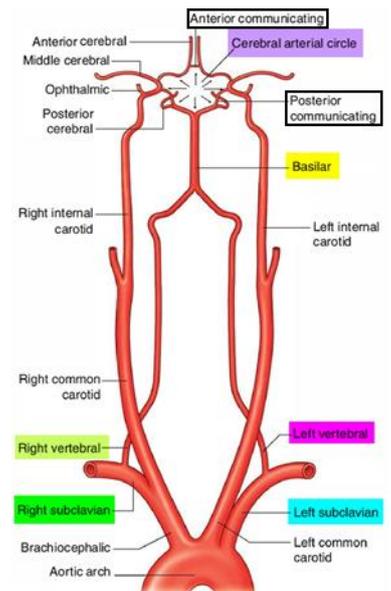
internal carotid angiogram: which is an X-ray image showing the ICA and its branches, taken during the injection of a contrast dye in the ICA (post cerebral isn't a branch of the ICA)

-The posterior cerebral artery runs in the calcarine sulcus which is located on the posterior side of the brain.

Communicating arteries:

1-One anterior communicating artery: joins right and left anterior cerebral arteries together.

2-Two posterior communicating arteries: each one joins the internal carotid artery and the posterior cerebral artery together on its side.



Note the black boxes

Circle of Willis:

-9 arteries that were mentioned before make a circulatory anastomosis that supplies blood to the brain called circle of Willis, this circle is responsible for about 70% of brain's blood supply.

-Right and left anterior cerebral arteries.

-Right and left posterior cerebral arteries.

- Right and left internal carotid arteries.

- Right and left posterior communicating arteries.

-A single anterior communicating artery.

-Location:

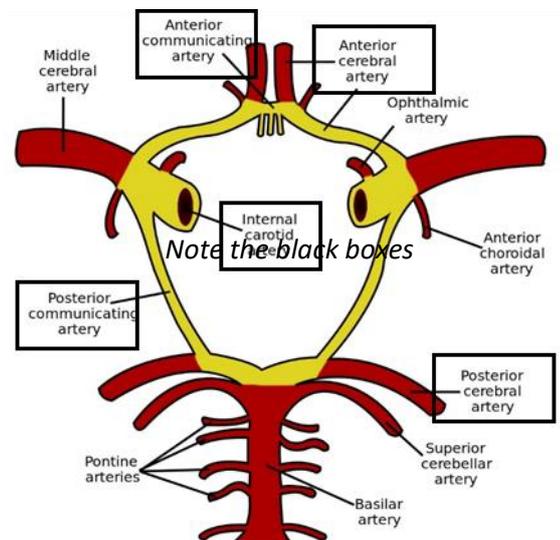
It lies in the interpeduncular fossa on the ventral part of midbrain and has the same boundaries as the interpeduncular fossa:

*anterior: optic chiasma

*posterior: pons

*posteriolateral: cerebral peduncles

*anteriorlateral:optic tracts



Note the black boxes

Note: contents of the interpeduncular fossa are:

1-Mammillary bodies/2-Posterior perforated substance/3-Tuber cinereum/4-Oculomotor nerve

Blood supply of the CNS regarding the area supplied:

- 1) Cortical blood supply: blood supply to the cortex
- 2) Central blood supply: blood supply to the basal nuclei and internal capsule
- 3) Callosal blood supply: blood supply to corpus callosum
- 4) Septum pellucidum blood supply
- 5) Spinal cord blood supply
- 6) Thalamus blood supply
- 7) Cerebellum blood supply

1) Cortical blood supply

1-Blood supply to the lateral surface of brain:

The majority of the lateral surface until the parietooccipital fissure:

Supplied by middle cerebral artery

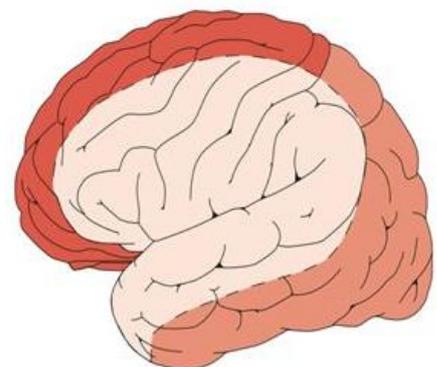
The minority of the lateral surface:

*Upper 1 inch in front of parietooccipital fissure
+the frontal pole:

Supplied by anterior cerebral artery

*Lower 1 inch + the area behind
parietooccipital fissure and preoccipital notch +the
occipital pole:

Supplied by posterior cerebral artery



■ Anterior cerebral artery
■ Middle cerebral artery
■ Posterior cerebral artery

Lesions:

1-Fluent aphasia

Area affected: Wernick's area

The area's location: located around the posterior ramus of the lateral fissure on the lateral surface. It is supplied by middle cerebral artery.

Artery affected by a lesion: middle cerebral artery

If there is a lesion in the middle cerebral artery, it will cause fluent aphasia.

2-Motor aphasia"non-fluent aphasia"

Area affected: Borcaa's area

The area's location: Located in the inferior frontal gyrus on the lateral surface.

Artery affected by a lesion: middle cerebral artery

If there is a lesion in the middle cerebral artery, it will cause motor aphasia.

3-Contralateral hearing defect

Area affected: The primary auditory area (41&42)

The area's location: Located at the middle part of the superior temporal gyrus.

Artery affected by a lesion: middle cerebral artery

If there is a lesion in the middle cerebral artery, it will cause contralateral hearing defect.

Note: It's a contralateral hearing defect since the primary auditory area on the right side receives blood supply mainly from the right middle cerebral arteries and to a lesser extent from the left middle cerebral artery, and the primary auditory area on the left side receives blood supply mainly from the left middle cerebral arteries and to a lesser extent from the right middle cerebral artery.

So a lesion in the main middle cerebral artery that supplies the primary auditory area on one side will cause a hearing defect in the contralateral

ear. While a lesion in both left and middle cerebral arteries that supply the primary auditory area on one side cause contralateral cortical deafness.

e.g.: if the left middle cerebral artery that supplies the left primary auditory area is affected, this will cause right ear hearing defect. Since the left primary auditory area also receives blood supply from the right middle cerebral artery to a lesser extent.

4-Auditory agnosia

Area affected: Auditory association area (area 22)

The area's location: located just posterior to the primary auditory area (the rest of the superior temporal gyrus)

Artery affected by a lesion: middle cerebral artery

If there is a lesion in the middle cerebral artery, it will cause auditory agnosia.

5-Paralysis of contralateral trunk muscles

Area affected: Motor area of the trunk muscles

The area's location: Middle part of motor area 4 above hand and fingers area

Artery affected by a lesion: Middle cerebral artery

If there is a lesion in the middle cerebral artery, it will cause paralysis of the trunk muscle of the contralateral side.

6-Schizophrenia or behavioural changes

Area affected: Prefrontal cortex and frontal pole which are responsible for behavioural control

Artery affected by a lesion: Anterior cerebral artery

If there is a lesion in the anterior cerebral artery, it will cause schizophrenia or behavioural changes

2-Blood supply to the medial surface of brain:

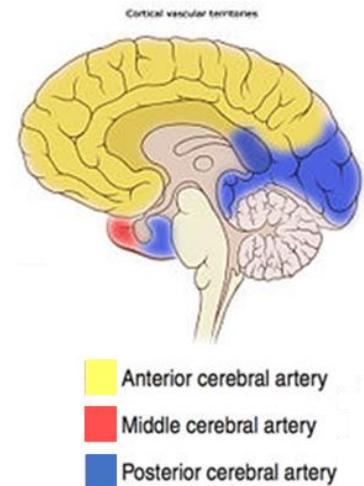
The majority of the medial surface until the parietooccipital fissure:

Anterior cerebral artery

The minority of the medial surface:

*Tentorial surface +the area behind parietooccipital fissure(occipital lobe and pole):

Posterior cerebral artery



Lesions:

1-Visual agnosia

Area affected: Visual association area

The area's location: Cuneus and lingual gyri except the area occupied by primary visual area 17 around the calcarine fissure

Artery affected by a lesion: Posterior cerebral artery.

If there is a lesion in the posterior cerebral artery, it will cause visual agnosia.

2- Contralateral Homonymous hemianopsia

Homonymous hemianopsia is the loss of half of the visual field in the same side in both eyes.

Right half of the brain controls the left visual field , and the left half of the brain controls the right visual field

Area affected: The primary visual area

The area's location: Around calcarine sulcus lips

Artery affected by a lesion: Posterior cerebral artery

If there is a lesion in the posterior cerebral artery in that area, it will cause Homonymous hemianopsia of the visual field contralateral to the primary visual area affected.

e.g.: if the right posterior cerebral artery is affected by a lesion. The left hemifield of both eyes will be lost “left Homonymous hemianopsia”.



Right Homonymous hemianopsia

Left Homonymous hemianopsia

3-Macular sparing

It is visual field loss that preserves vision in the center of the visual field while vision in peripheral areas is lost due to a lesion in the posterior cerebral artery.

The reason behind this phenomenon is that the area responsible for the processing of central, precise and high-resolution vision has a double arterial supply from posterior and middle cerebral arteries. This area is in the primary visual cortex and processes neuronal signals coming from the macula of retina. Macula of retina is located around fovea of retina. However, other areas in the occipital lobe are damaged due to lesions in the posterior cerebral artery.

4-Contralateral Sensory and motor loss of lower extremity

Area affected: Paracentral lobule

The area's location: Medial surface of the brain

Artery affected by a lesion: Anterior cerebral artery

If there is a lesion in the anterior cerebral on one side, it will cause sensory and motor loss of lower extremity of the contralateral side.

3-Blood supply to the inferior surface of brain:

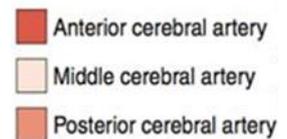
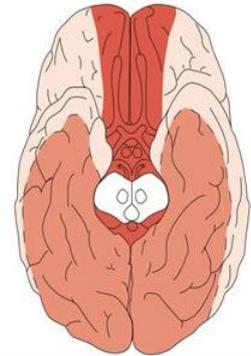
The stem of the lateral fissure divides the inferior surface into:

***Tentorial surface** which receives its blood supply from the posterior cerebral artery except temporal poles

***Orbital surface** which is further divided into:

-Medial side that receives its blood supply from anterior cerebral artery.

-Lateral side that receives its blood supply from middle cerebral artery.



Each pole is supplied by different cerebral artery:

Occipital pole: Posterior cerebral artery

Frontal pole: Anterior cerebral artery

Temporal pole: middle cerebral artery

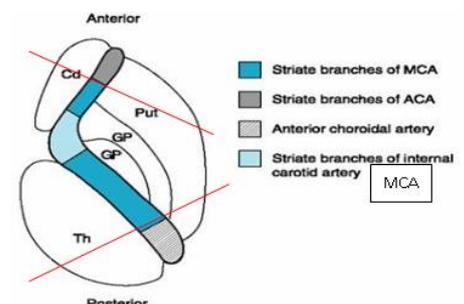
2) Central blood supply

Blood supply of the basal nuclei and internal capsule.

Note1: The structures identified in a horizontal section of the brain moving laterally to medially:

1-Insula/2-Clastrum/3-External capsule/4-Putamen/5-Globus pallidus external/6-Globus pallidus internal/7-Internal capsule/8-Caudate nucleus/9-Thalamus/10-Third ventricle

Note2: Striatum is made up by: 1-Caudate nucleus, 2-Lentiform nucleus, 3- the anterior limb of the internal capsule



A-Anterior cerebral artery:

It supplies anterior half of striatum which includes:

1-Anterior half of caudate, 2-Anterior half of the anterior limb of internal capsule, 3-Anterior half of lentiform

Note: Nucleus accumbens "pleasure centre" is also supplied by anterior cerebral artery since it is anterior to the anterior part of both caudate and lentiform nuclei

B-Middle cerebral artery:

*It supplies posterior half of striatum which includes:

1-Posterior half of caudate, 2-Posterior half of the anterior limb of internal capsule, 3-Posterior half of lentiform

*It also supplies: 1-Genu of internal capsule, 2-Anterior half of posterior limb of the internal capsule

Lesions:

1-Contralateral hemiplegia:

In the anterior half of posterior limb of internal capsule, there is a descending pyramidal tract called corticospinal tract that descends to reach the anterior horn of the spinal cord.

The middle cerebral artery supplies the anterior half of posterior limb of internal capsule. If there is a lesion in the middle cerebral on one side, it will cause motor loss of the contralateral side "contralateral hemiplegia".

2-Contralateral hemiplegia and hemianesthesia:

In addition to neuronal descending motor tracts in the anterior half of posterior limb of internal capsule. There are ascending sensory neuronal tracts in the posterior half of the posterior limb of the internal capsule called thalamocortical tracts. Both sensory and motor tracts may be damaged due to Charcot artery haemorrhage.

Charcot artery is a branch of the middle cerebral artery and it's called the artery of haemorrhage since it has a very thin wall that can be easily ruptured due to hypertension.

If this artery ruptured, blood will accumulate and compress on the neuronal tracts that ascend and descend within the anterior half and posterior half of the posterior limb of the internal capsule respectively leading to a contralateral hemianesthesia and hemiplegia.

C-Anterior choroidal artery:

Main blood supply of: 1-The posterior half of the posterior limb of internal capsule, 2-Retrolentiform of internal capsule 3-Sublentiform of internal capsule

D-Posterior cerebral artery:

*It contributes with 10% of blood supply of: 1-The posterior half of the posterior limb of internal capsule, 2-Retrolentiform of internal capsule 3-Sublentiform of internal capsule.

*Amygdala nucleus which is located on the inferior surface of the brain in the uncus.

Lesions of anterior choroidal artery and posterior cerebral artery:

-Contralateral visual defect

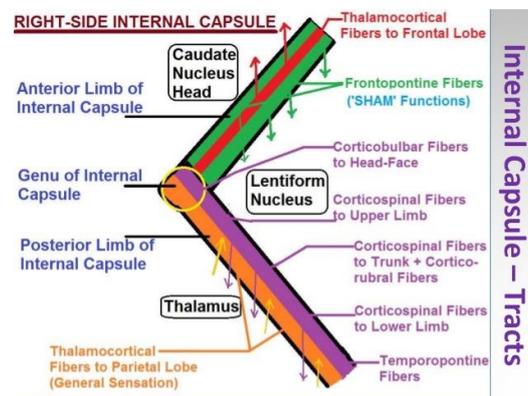
Optic radiations pass through retrolentiform part of the internal capsule to join the primary visual area with the optic tract.

If there is a lesion in the anterior choroidal and posterior cerebral (mainly posterior cerebral artery)on one side, it will cause visual defect on the contralateral side.

- Contralateral auditory defect

Auditory radiations pass through sublentiform part of the internal capsule.

If there is a lesion in the anterior choroidal and posterior cerebral on one side, it will cause auditory defect on the contralateral side.



3) Callosal blood supply

Corpus callosum is supplied by anterior cerebral artery except for the splenium which is supplied by posterior cerebral artery.

4)Septum pellucidum blood supply

Supplied by branches of the anterior and middle cerebral arteries.

5)Spinal cord blood supply

Anterior 2/3 of the spinal cord is supplied by anterior spinal artery.

Posterior 1/3 of the spinal cord is supplied by posterior spinal artery.

Both anterior and posterior spinal arteries are branches of the vertebral artery.

Lesions:

*In the anterior spinal artery:Motor defects

*In the posterior spinal artery:Sensory defects

6) Thalamus blood supply including metathalamus

It's supplied by posterior cerebral artery.

7) Cerebellum blood supply

*Superior cerebellar artery (SCA) and anterior inferior cerebellar artery (AICA) which are branches from the basilar artery.

*Posterior inferior cerebellar artery (PICA) which is a branch from the vertebral artery

Refer to the slides for more details

The end