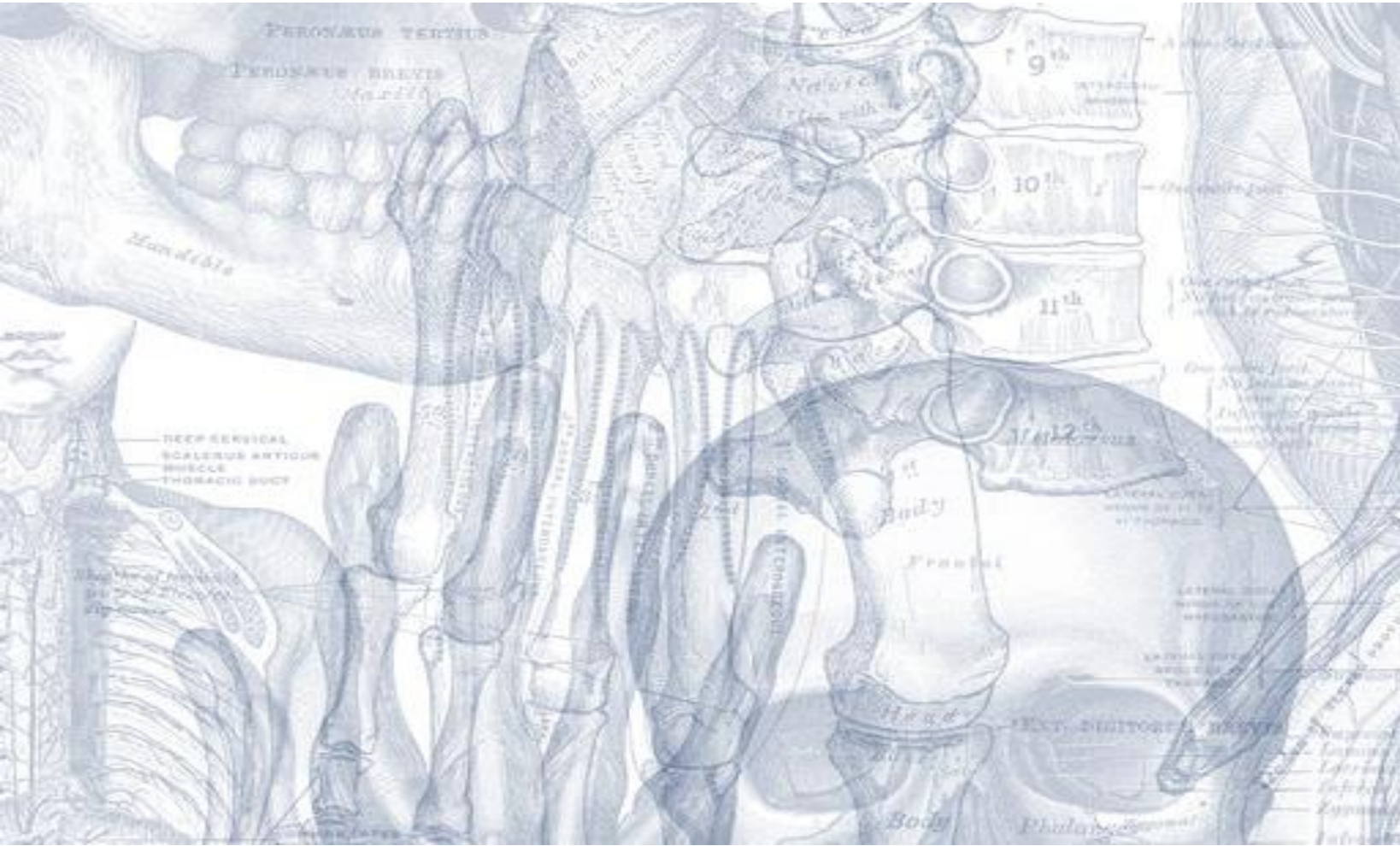


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Cerebral Blood Circulation

Please view our [Editing File](#) before studying this lecture to check for any changes.

Color Code

- Important
- Doctors Notes
- Notes/Extra explanation

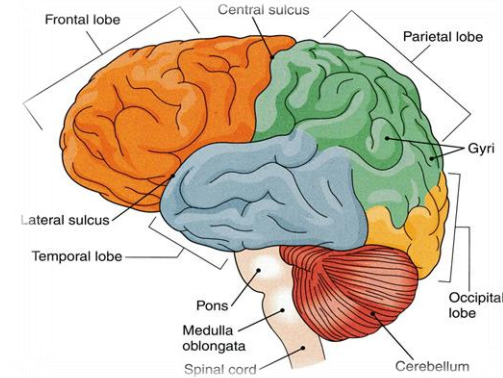
Objectives

- ✓ List the cerebral arteries.
- ✓ Describe the cerebral arterial supply regarding the origin, distribution and branches.
- ✓ Describe the arterial Circle of Willis .
- ✓ Describe the cerebral venous drainage and its termination.
- ✓ Describe arterial & venous vascular disorders and their clinical manifestations.

You can skip the first 3 slides; it's just revision.

REVIEW: The Brain

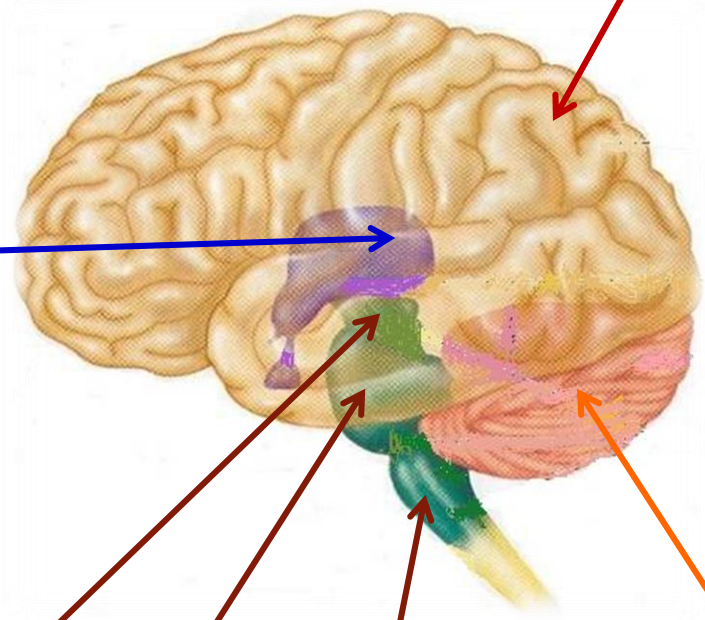
- Large mass of nervous tissue located in cranial cavity.
- Has four major regions.



Cerebrum
(Cerebral hemispheres)

- The largest part of the brain, and has two hemispheres.
- The surface shows elevations called gyri, separated by depressions called sulci.
- Each hemisphere divided into four lobes by deeper grooves.
- Lobes are separated by deep grooves called fissures.

Diencephalon:
Thalamus,
Hypothalamus,
Subthalamus &
Epithalamus



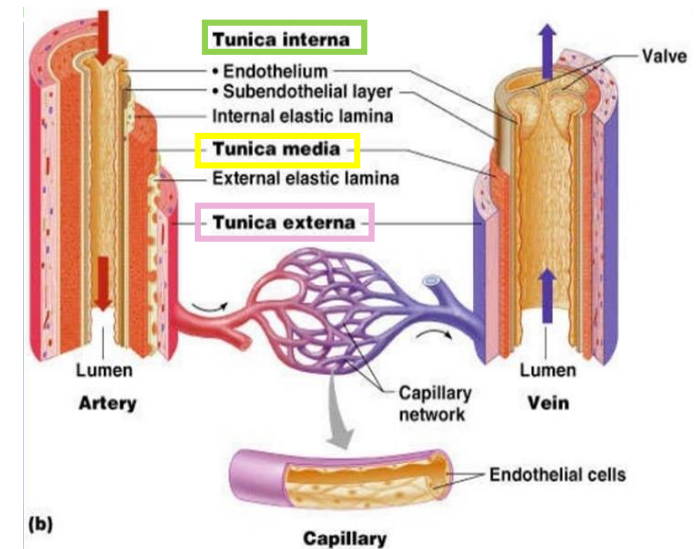
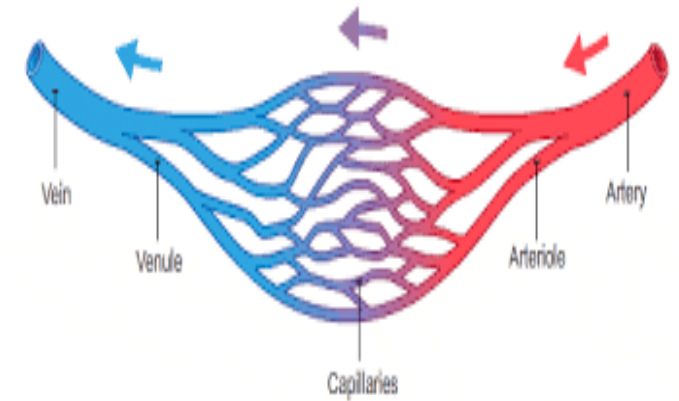
Brainstem: Midbrain, Pons & Medulla oblongata

Cerebellum

REVIEW: Blood Vessels & Histology

Only on the boys' slides

- Blood vessels are the part of the **circulatory system** that transports blood throughout the human body.
- There are three major types of blood vessels:
 - Arteries, which carry the blood away from the heart.
 - Capillaries, which enable the actual exchange of water and chemicals between the blood and the tissues.
 - Veins, which carry blood from the capillaries back toward the heart.
- The word vascular, meaning relating to the blood vessels, is derived from the Latin vas, meaning vessel.
- Avascular refers to being without (blood) vessels.
- The arteries and veins have three layers, but the middle layer is thicker in the arteries than it is in the veins:
 1. **Tunica Intima** (the thinnest layer): a single layer of simple squamous endothelial cells.
 2. **Tunica Media** (the thickest layer in arteries): is made up of smooth muscle cells and elastic tissue.
 3. **Tunica Adventitia** (the thickest layer in veins) entirely made of connective tissue.
- Capillaries consist of little more than a layer of endothelium and occasional connective tissue.



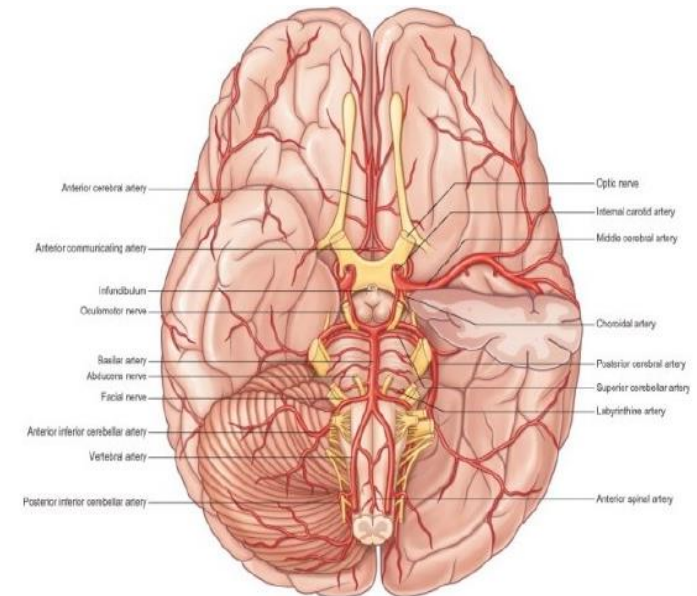
REVIEW: Blood

- Blood is the actual carrier of the oxygen and nutrients into arteries.
- Blood is made mostly of **plasma**, which is a yellowish liquid that is 90% water.
- Plasma contains also **salts, glucose** and other **substances**.
- Most important, plasma contains **proteins** that carry important nutrients to the body's cells and strengthen the body's immune system.
- Blood has main 3 types of blood cells that circulate with the plasma.



Cerebral Circulation

- It is the movement of blood through the network of blood vessels to supply the brain.
- The movement of blood in the cerebral circulation is called **cerebral blood flow**.
- The arteries carry oxygenated blood and other nutrients to the brain.
- The veins carry deoxygenated blood back to the heart removing carbon dioxide and other metabolic products.



Cerebral Arterial supply

The arterial supply of the cerebrum is composed of/provided by 2 arterial systems:

1) Carotid System

Composed of:

- **Internal carotid** artery and its branches:
- **Anterior cerebral** artery*
- **Middle cerebral** artery*

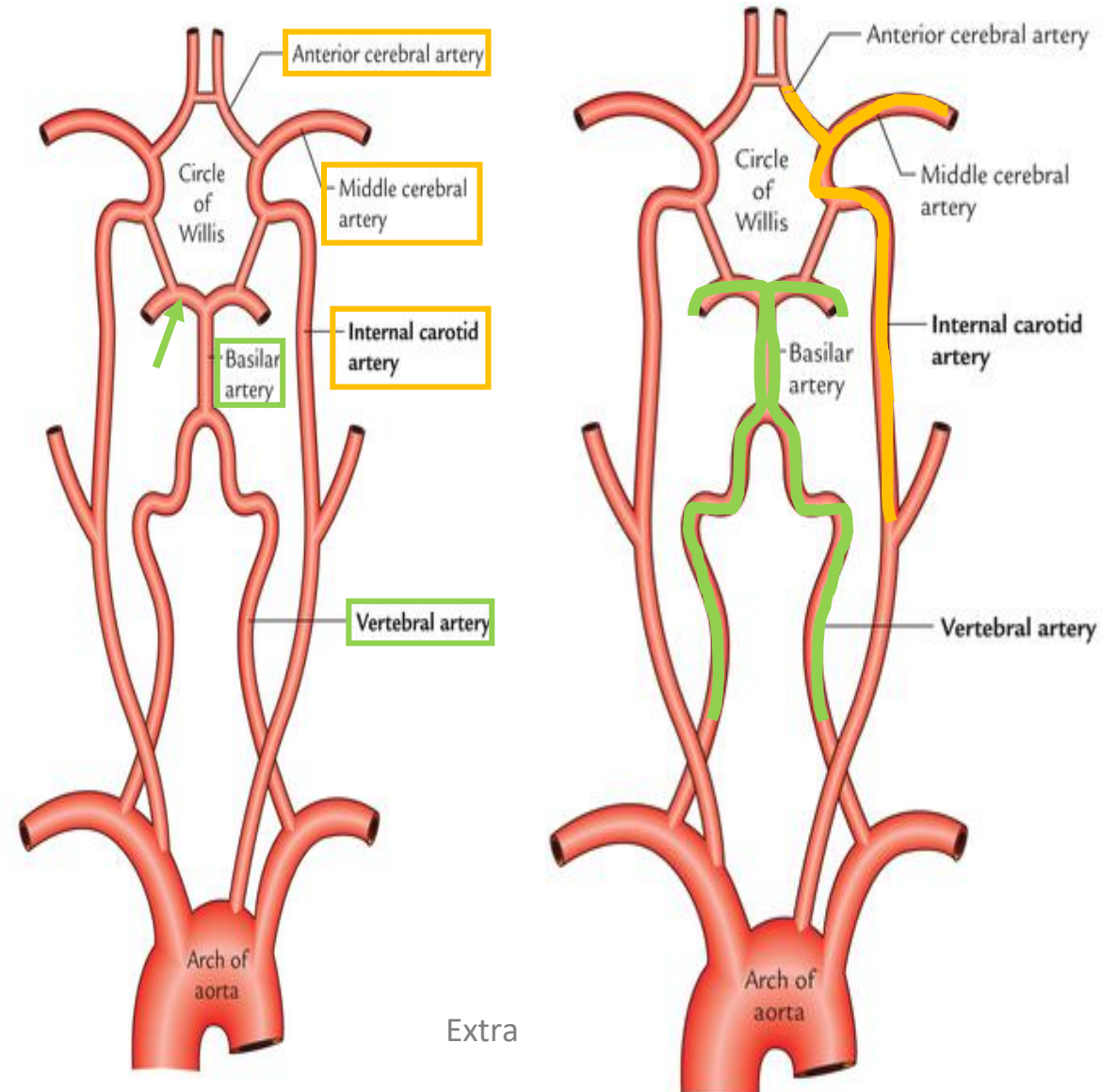
Supply *anterior* portion of brain

2) Vertebro-Basilar System

The two **vertebral** arteries (from the **subclavian** artery) unite to form **basilar** artery*. It divides at the *upper border of pons* into **two posterior cerebral** arteries*

Supply *posterior* portion of brain

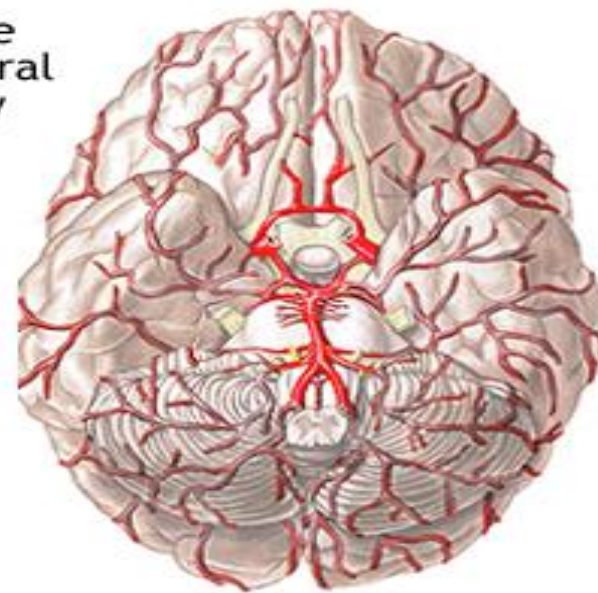
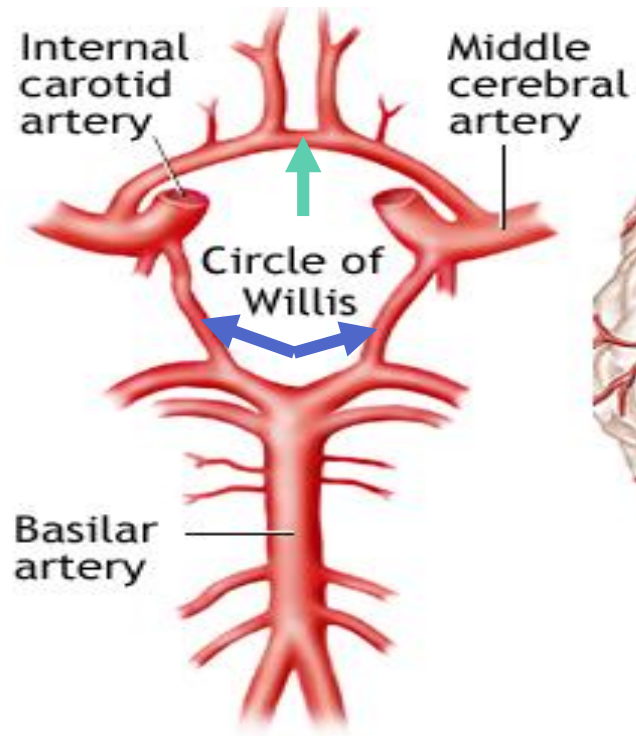
*We will talk about these in more detail later.



Cerebral Arterial supply

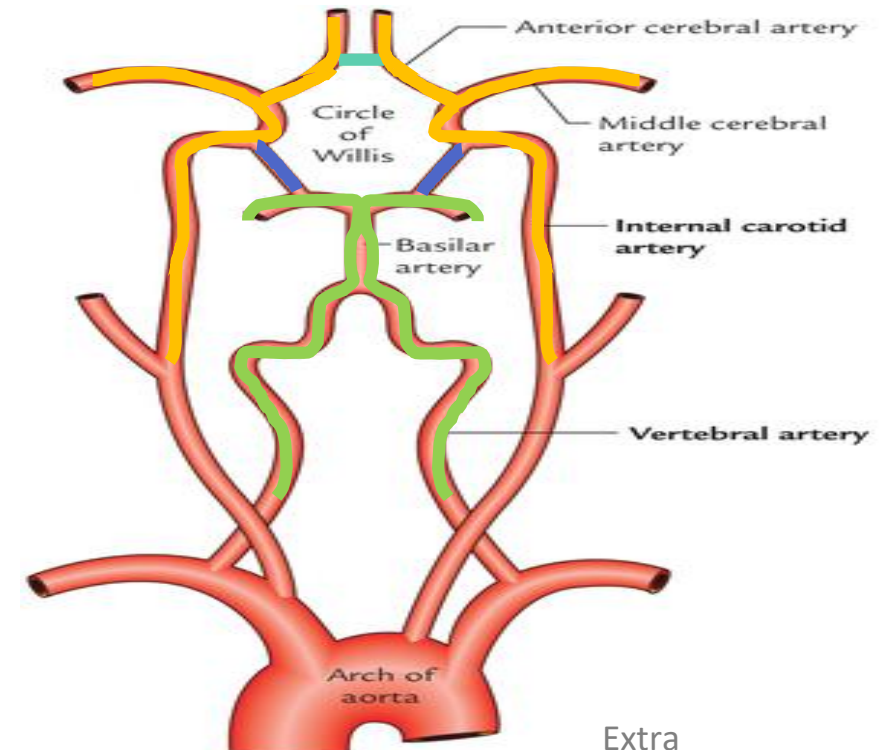
Only on the boys' slides

- The two anterior cerebral circulations (left and right) are connected to each other by 1 anterior communicating artery.
- The anterior circulation (carotid) is interconnected to the posterior circulation (basilar) via bilateral (2) posterior communicating arteries.
- Posterior communicating arteries are part of **Circle of Willis**.



Bottom view of brain

ADAM.



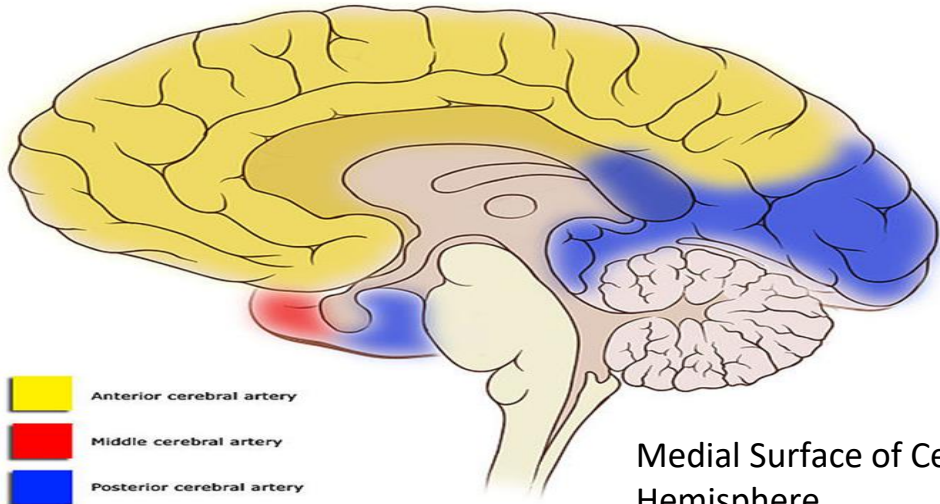
Extra

Cerebral Arterial supply

Origin	Internal carotid artery		Basilar artery
Branch	Anterior Cerebral Artery (ACA)	Middle Cerebral Artery (MCA)	Posterior Cerebral Artery (PCA)
Supplies	<ol style="list-style-type: none"> Orbital and medial surfaces of frontal and parietal lobes. A narrow part on the superolateral surface. 	<p>Entire Superolateral surface*:</p> <ol style="list-style-type: none"> Somatosensory Cortex Motor Cortex Language areas: <ul style="list-style-type: none"> • Broca's Area: linked to <u>speech production</u>. • Wernicke's Area: It is involved in the understanding of written and spoken language Auditory areas: <ul style="list-style-type: none"> • Primary auditory area • Heschl's Gyrus: to process incoming auditory information 	<ol style="list-style-type: none"> Anterior and inferior temporal lobes Uncus: <ul style="list-style-type: none"> • Located on the tip end of the medial surface of the parahippocampal gyrus. • Part of the olfactory cortex that processes information from the sense of smell. Inferior temporal gyri Inferior and Medial Occipital lobe (visual area)

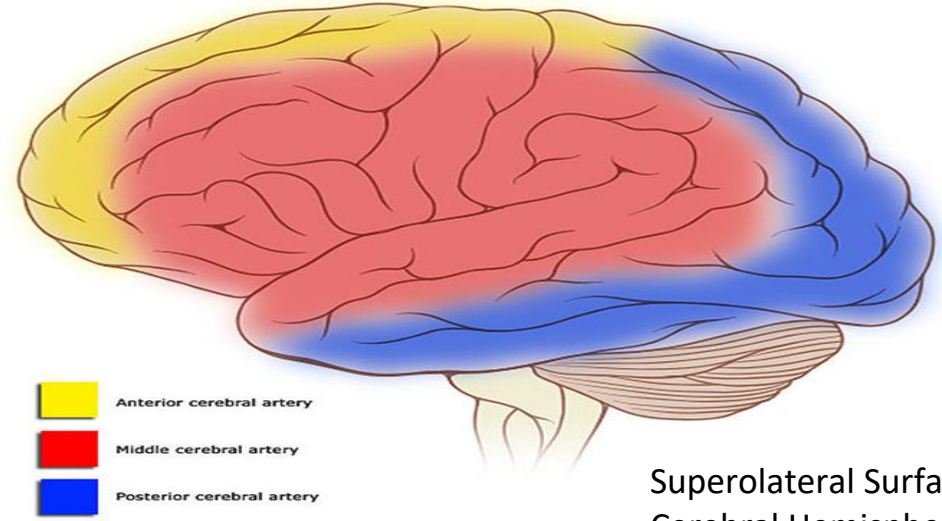
*Except for a narrow part by the ACA, MCA supplies all the motor area except the leg area. (Snell) **except foot and perinium**

Cortical vascular territories



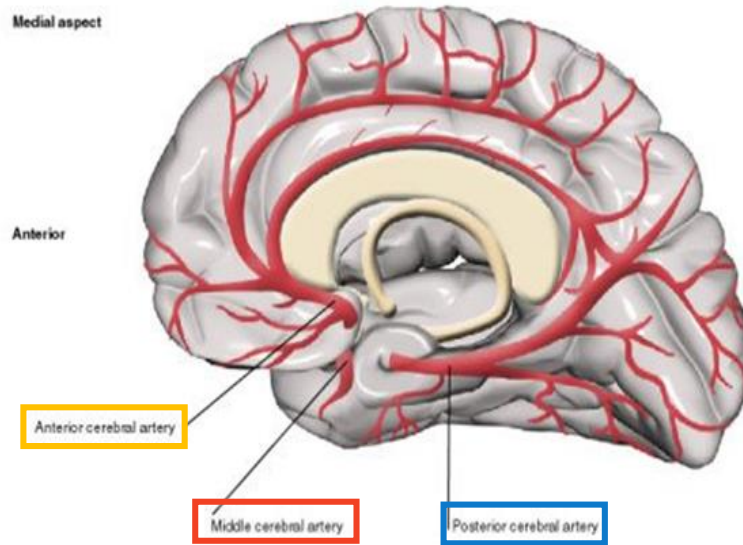
Medial Surface of Cerebral Hemisphere

Cortical vascular territories



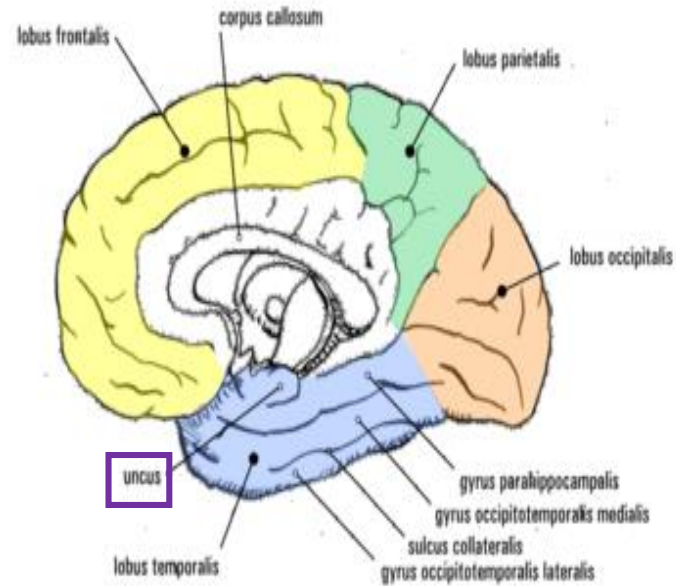
Superolateral Surface of Cerebral Hemisphere

Medial aspect



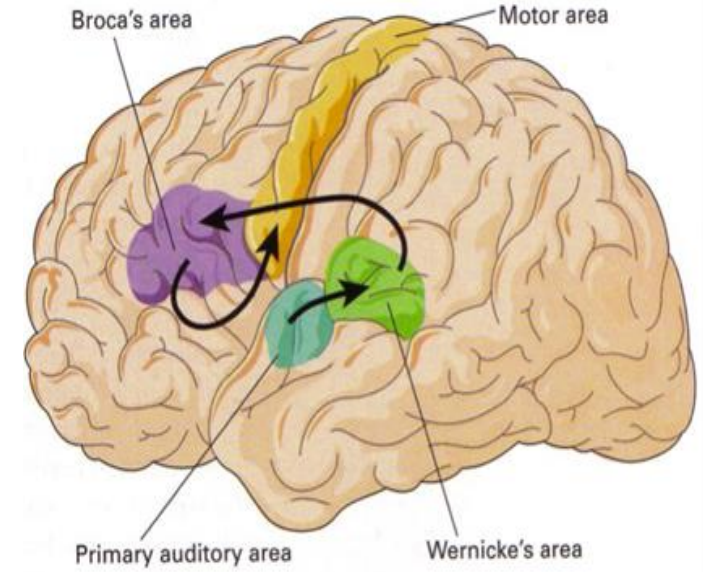
Anterior

Posterior



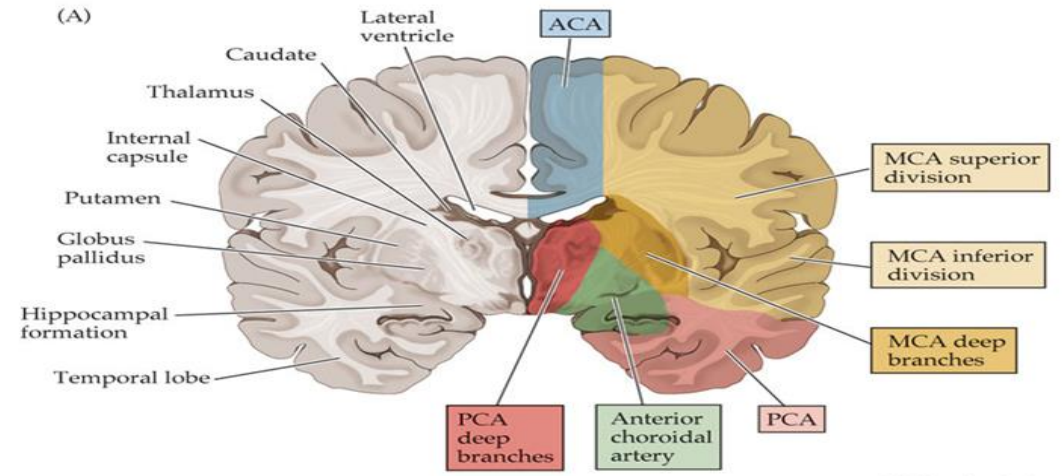
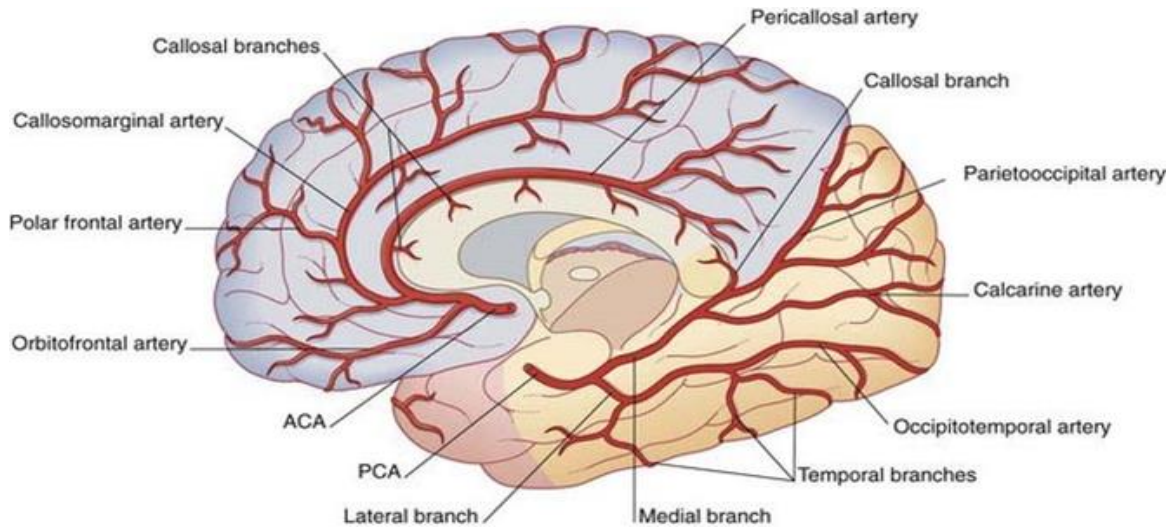
Broca's area

Motor area



Primary auditory area

Wernicke's area



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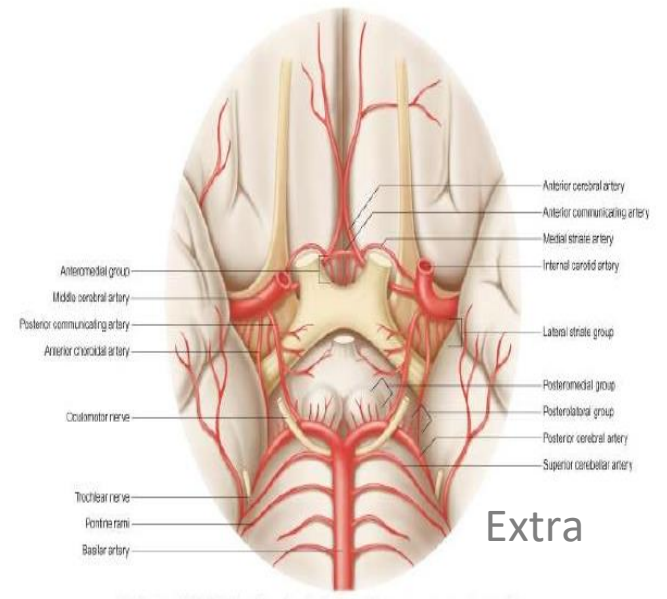
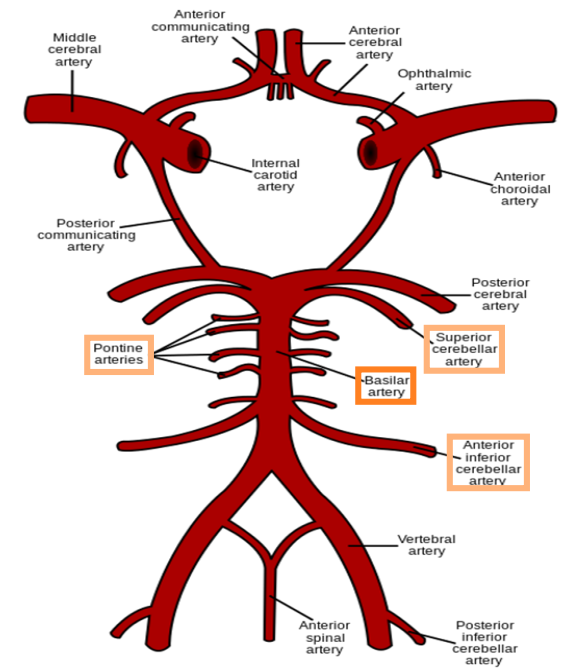
Basilar artery

Only on the boys' slides

Supplies:	Mid brain and cerebellum
Branches:	<ul style="list-style-type: none"> • Anterior inferior cerebellar artery. • Pontine branches. • Superior cerebellar artery.

Notes:

- The vertebral arteries unite at the lower border of the pons to form the basilar artery.
- Pontine: related to the pons.

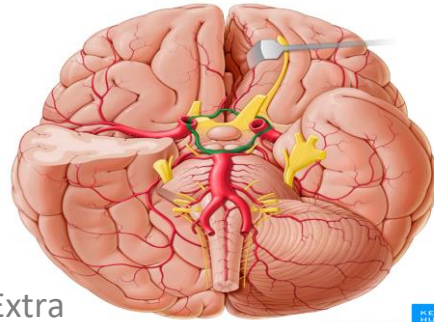


Extra

Circulus Arteriosus (Circle of wills*)

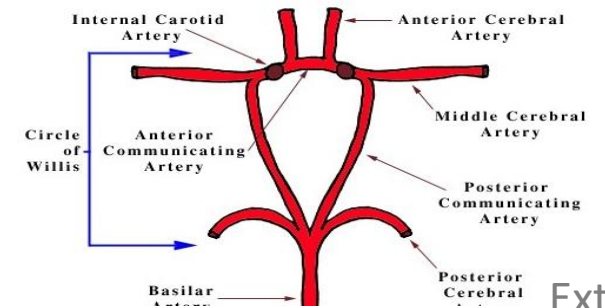


- It **joins** the carotid and vertebrobasilar systems**.
- It is **located** on the base of the brain.
- It **encircles** (surrounds):
 1. Optic chiasma.
 2. Hypothalamus.
 3. Midbrain.
 4. Pituitary gland.



Extra

CIRCLE OF WILLIS



Extra

It is **formed** by:

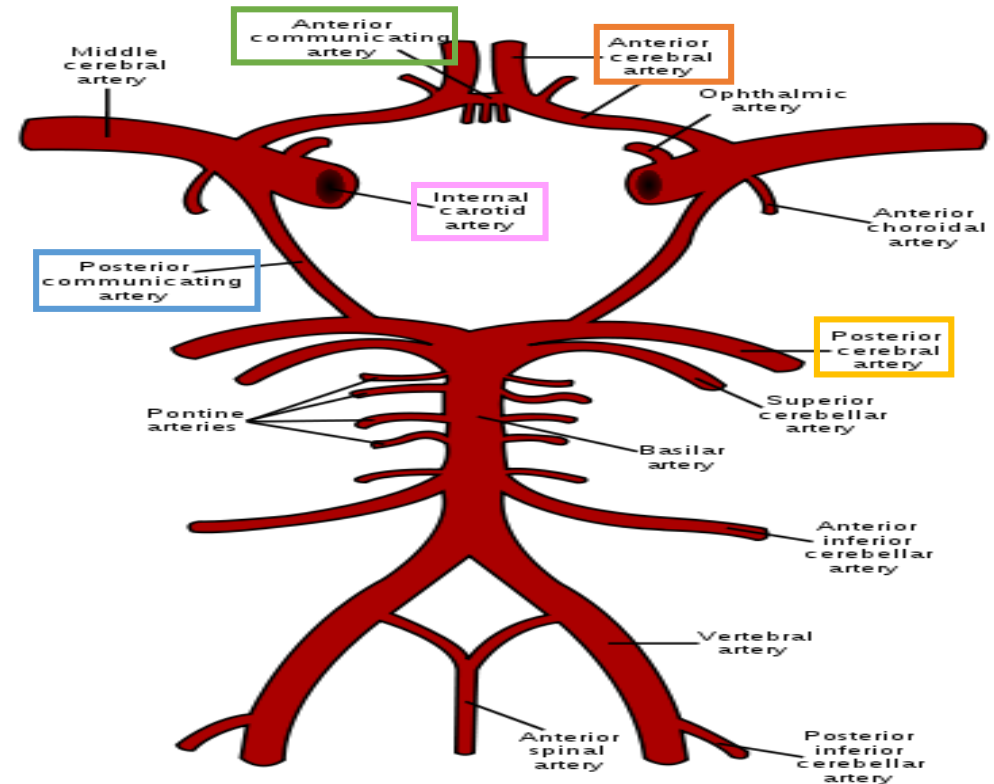
Two **internal** carotid arteries

Two *anterior cerebral* arteries

Two *posterior cerebral* arteries

Two *posterior communicating* arteries

One *anterior communicating* artery

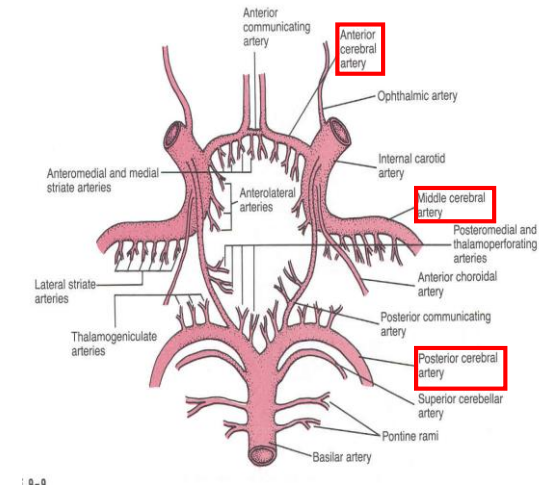
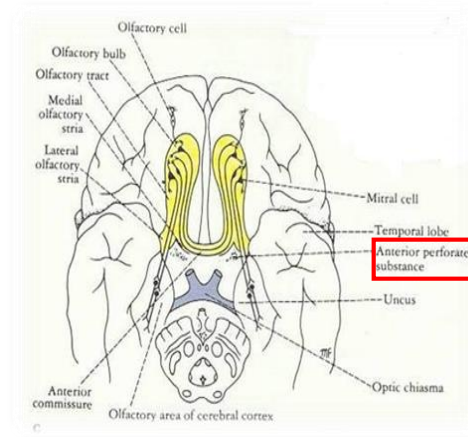


*Named after Thomas Willis (1621–1675), an English physician.

** the circle of Willis is Formed by the anastomosis between the two internal carotid arteries and the two vertebral arteries. (Snell)

Circulus Arteriosus (Circle of wills)

- **Branches:** *Perforating arteries*
numerous small vessels that penetrate the surface of the brain through the anterior and posterior perforating substances.
- They are divided into:



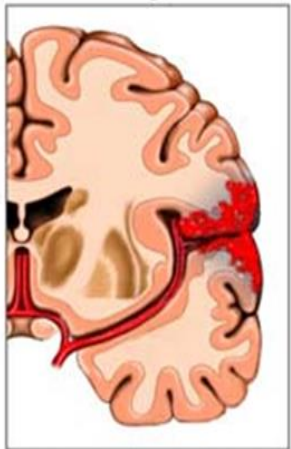
	Anterior Perforating Arteries	Posterior Perforating Arteries
<i>Arise from:</i>	<ul style="list-style-type: none"> • Anterior cerebral artery. • Anterior communicating artery. • Middle cerebral artery. 	<ul style="list-style-type: none"> • Posterior cerebral artery . • Posterior communicating artery.
<i>Enter brain through:</i>	<ul style="list-style-type: none"> • Anterior perforated substance (an irregularly quadrilateral (having 4 sides) area in front of the optic tract and behind the olfactory trigone). 	<ul style="list-style-type: none"> • Posterior Perforated substance. (perforated substance: a layer of grey matter, that is pierced to allow blood vessels to pass)
<i>Supplies</i>	<ol style="list-style-type: none"> 1. Large part of basal ganglia. 2. Optic chiasma. 3. Internal capsule (a white matter structure). 4. Hypothalamus . 	<ol style="list-style-type: none"> 1. Ventral portion of Midbrain. 2. Parts of Subthalamus and Hypothalamus.

Arterial Disorders

Stroke

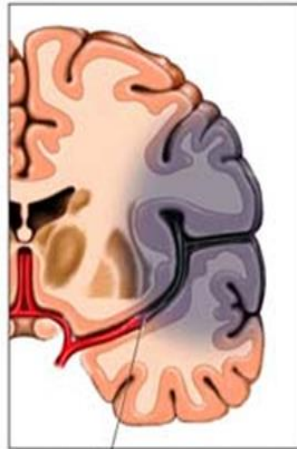
- It happens when blood supply to the brain is interrupted or reduced.
- Sudden occlusion
- It can be: Ischemic or hemorrhagic.

Hemorrhagic Stroke



Hemorrhage/blood leaks into brain tissue

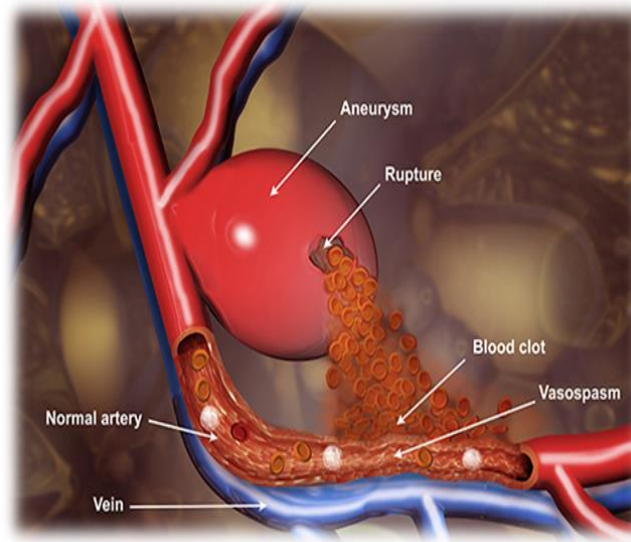
Ischemic Stroke



Clot stops blood supply to an area of the brain

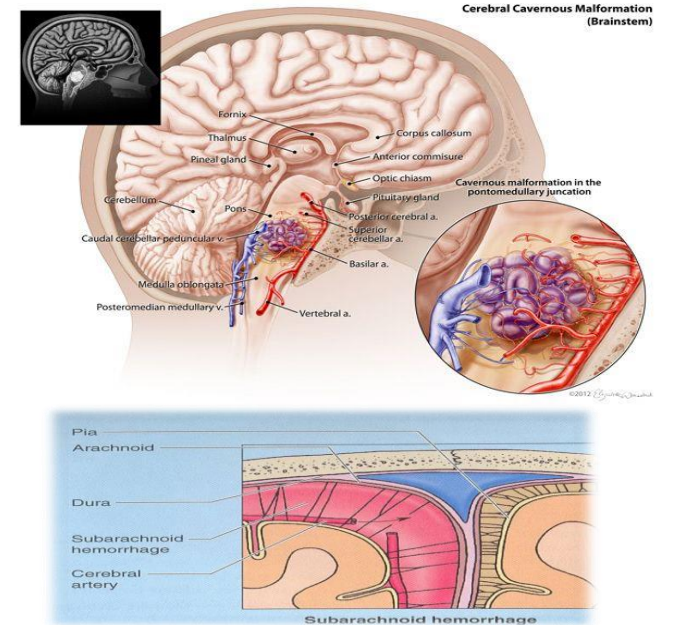
Aneurysm

- localized, blood-filled balloon-like bulge in the wall of a blood vessel.

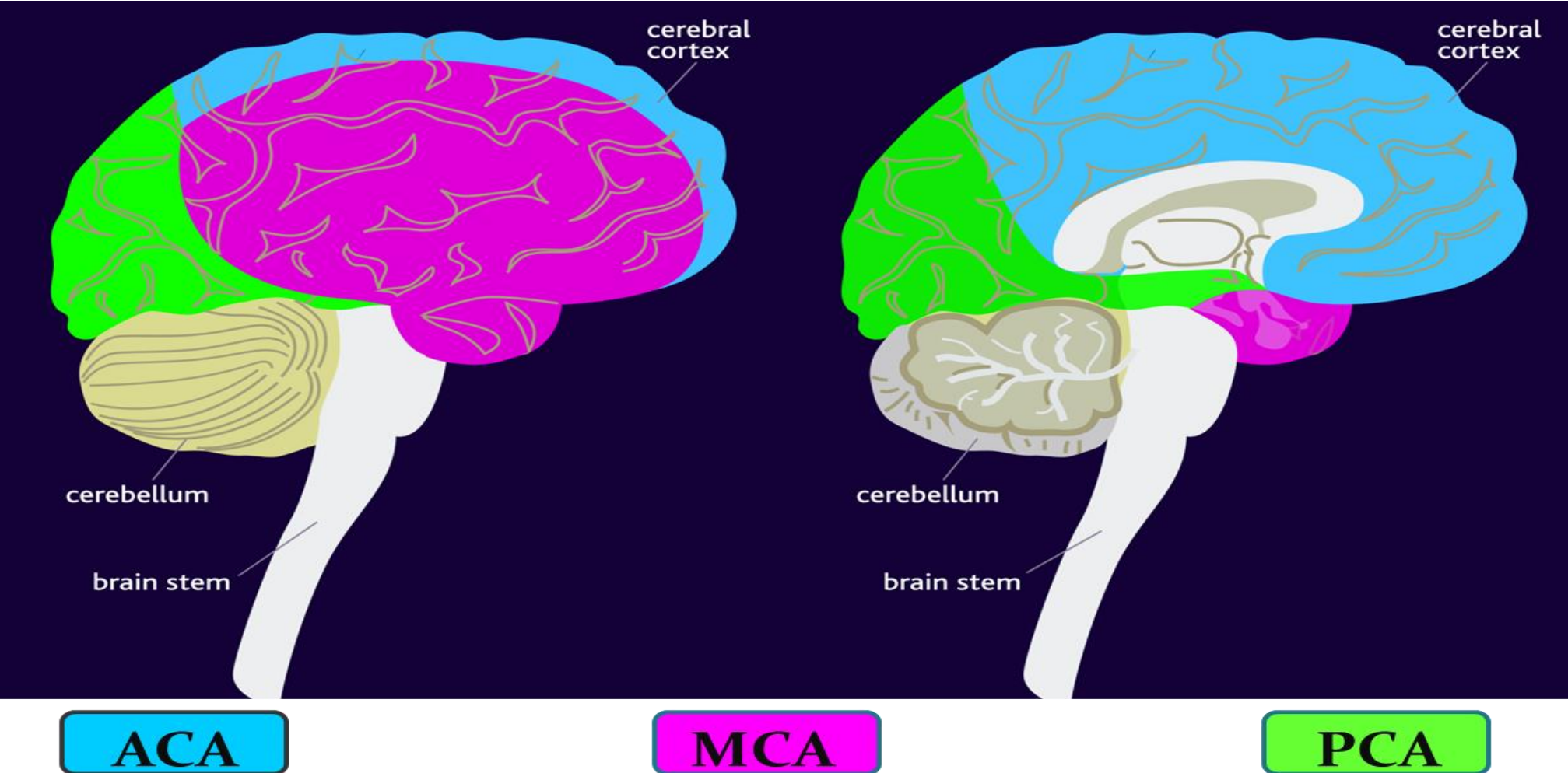


Angioma

- benign tumors derived from cells of the vascular or lymphatic vessel walls (epithelium) or derived from cells of the tissues surrounding these vessels.



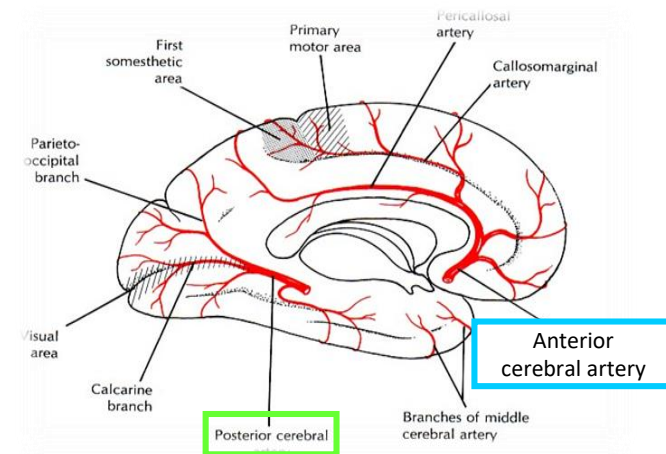
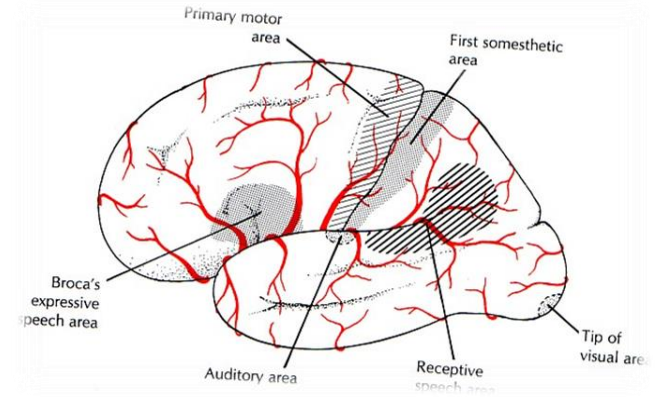
Effects of Occlusion of Cerebral Arteries



Effects of Occlusion of Cerebral Arteries (Manifestations)

(Important may come as scenario)

Artery	Anterior Cerebral Artery (ACA)	Middle Cerebral Artery (MCA)	Posterior Cerebral Artery (PCA)
Effect	<ol style="list-style-type: none"> Motor disturbance in contralateral distal leg Difficulty in prefrontal lobe functions: <ul style="list-style-type: none"> Cognitive thinking Judgement Motor initiation Self monitoring 	<ol style="list-style-type: none"> Contralateral weakness of: <ul style="list-style-type: none"> face, arm, and hands more than legs Contralateral sensory loss of: <ul style="list-style-type: none"> face, arm, and hands more than legs Visual field cut (damage to optic radiation) Aphasia (language disturbance): <ul style="list-style-type: none"> In Broca's area: production In Wernicke's area: comprehension 	<ol style="list-style-type: none"> Visual disturbances: <ul style="list-style-type: none"> Unilateral lesion: contralateral homonymous hemianopsia Bilateral lesions: cortical blindness, patients unaware they cannot see (Anton's Syndrome) Memory impairment: if temporal lobe is affected



Notes:

Optic radiation: **axons** from the neurons in the lateral geniculate nucleus to the primary visual cortex.

Hemianopsia: decreased vision or blindness in half the visual field.

Homonymous hemianopsia: the loss of half of the visual field on the same side in both eyes (see picture on right).

Cortical blindness: total or partial vision loss because of damage to the occipital cortex.



Cerebral Venous Drainage

- The veins are thin walled and are devoid of (don't have) valves.
- The cortical veins are:

I. Superficial cortical veins

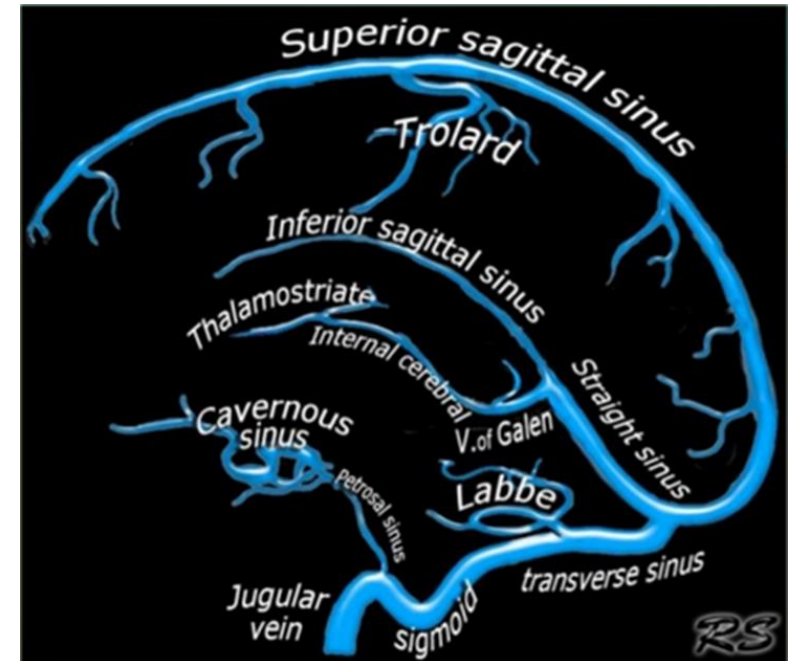
- Found in the subarachnoid space
- Drain the cortical surface

II. Deep veins

- Drain the deep structures

These veins ultimately drain into:

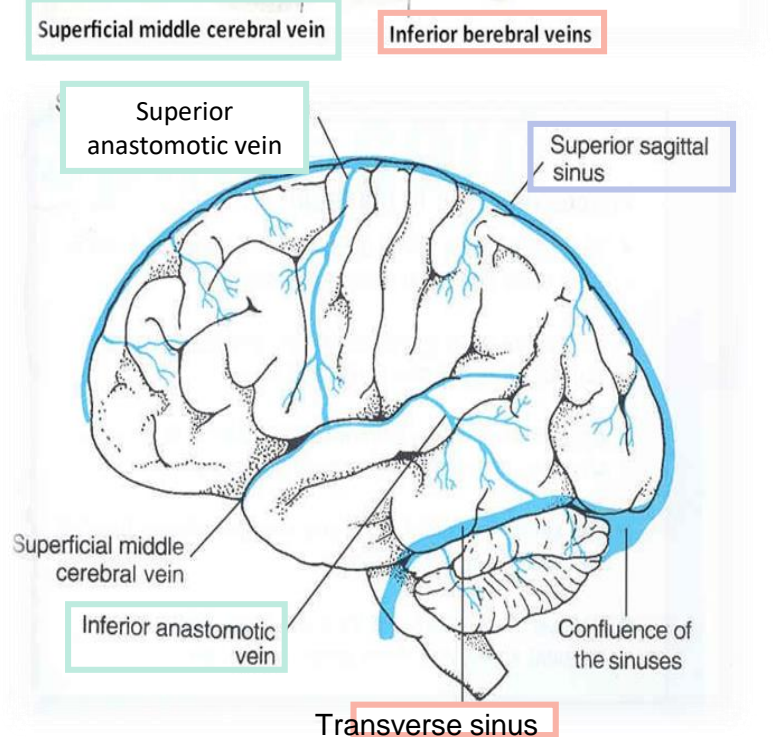
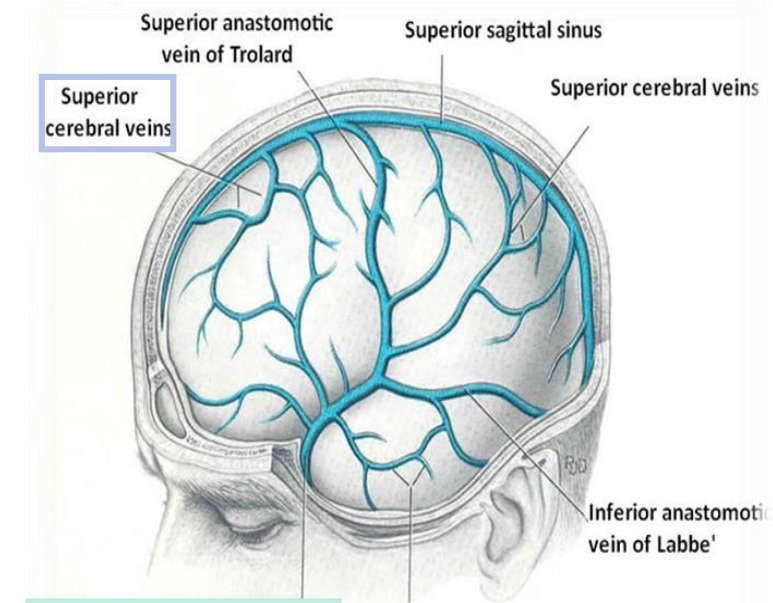
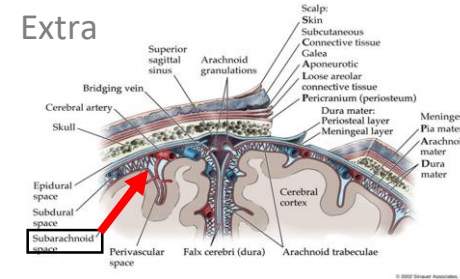
Dural venous sinuses



Cerebral Venous Drainage

I. Superficial Cortical Veins

They lie on the brain surface, in the **subarachnoid space**.
They are divided into:



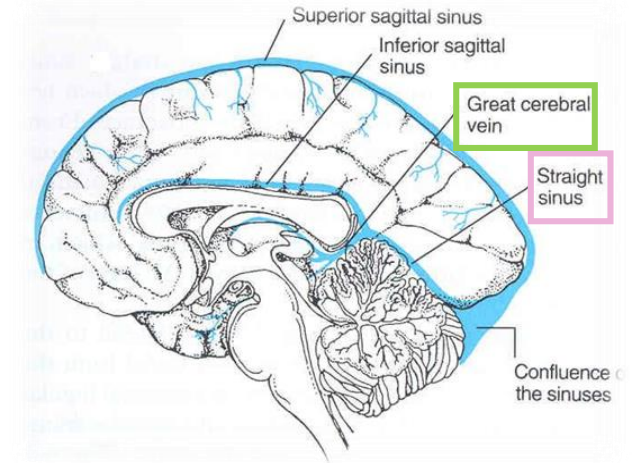
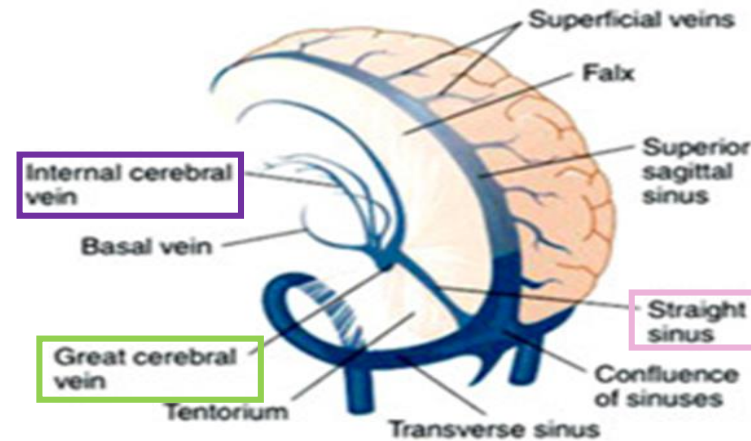
	<i>Course</i>	<i>Termination</i>	<i>Notes</i>
Superior cerebral veins	<ul style="list-style-type: none"> Drain lateral surface of brain above the lateral sulcus 	<ul style="list-style-type: none"> Terminate mainly into the Superior Sagittal sinus, and <u>partly</u> into <i>superficial middle cerebral vein</i>. 	<ul style="list-style-type: none"> 6 to 12 veins
Inferior cerebral veins	<ul style="list-style-type: none"> Run below the lateral sulcus 	<ul style="list-style-type: none"> Terminate <u>partly</u> into <i>superficial middle cerebral vein</i> & <u>partly</u> into Transverse sinus. 	<ul style="list-style-type: none"> Drain the lateral surface of the temporal lobe
Superficial middle cerebral veins	<ul style="list-style-type: none"> Runs along the lateral sulcus 	<ul style="list-style-type: none"> Terminates into the Cavernous sinus 	<ul style="list-style-type: none"> Connected posteriorly by Superior & Inferior anastomotic veins to Superior Sagittal & Transverse sinuses respectively

Cerebral Venous Drainage

II. Deep Cortical Veins

They drain the internal structures:

- Basal ganglia
- Internal capsule
- Thalamus



They merge to form:

Deep cerebral veins



Internal cerebral veins

The two veins unit in the midline to form:



Great cerebral vein

This short vessel joins the **Inferior Sagittal sinus** to form:



Straight sinus

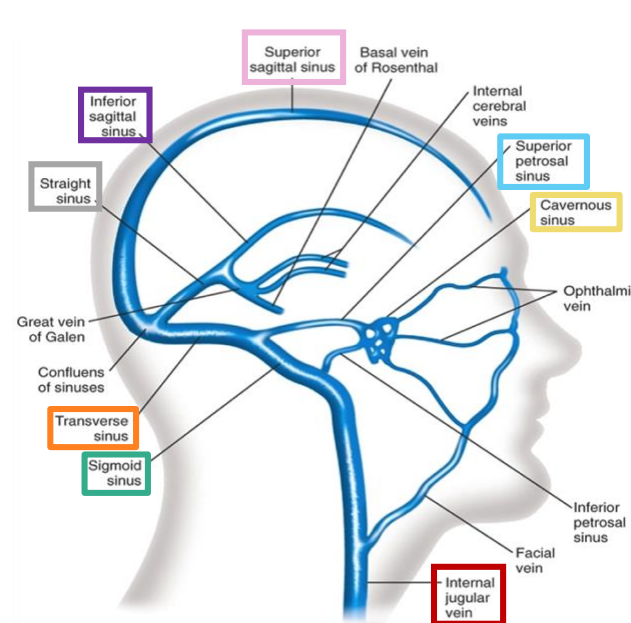
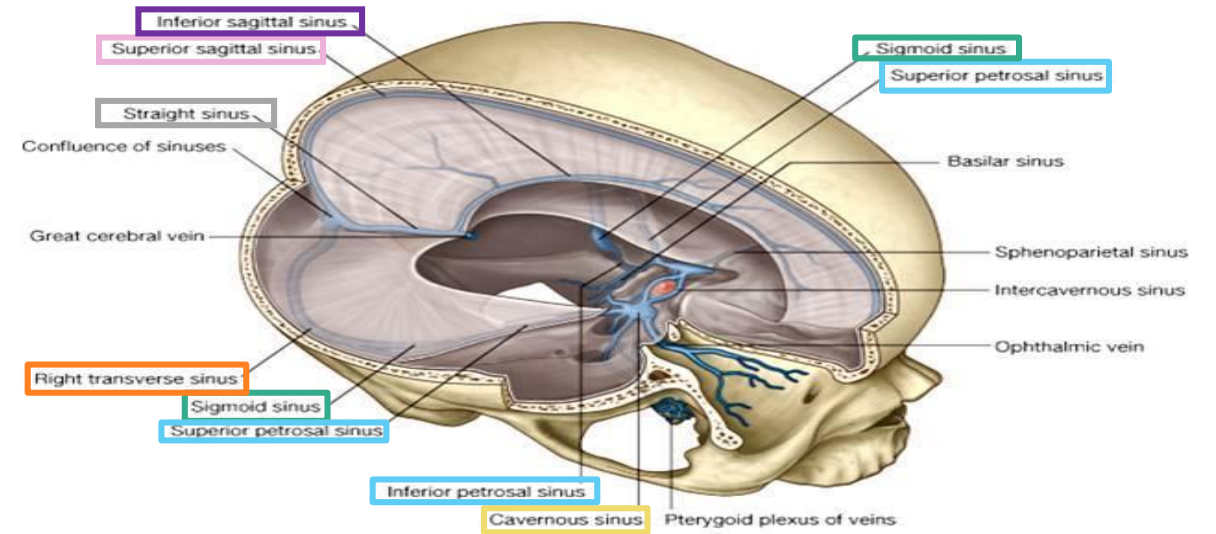
Cerebral Venous Drainage

Dural venous sinuses

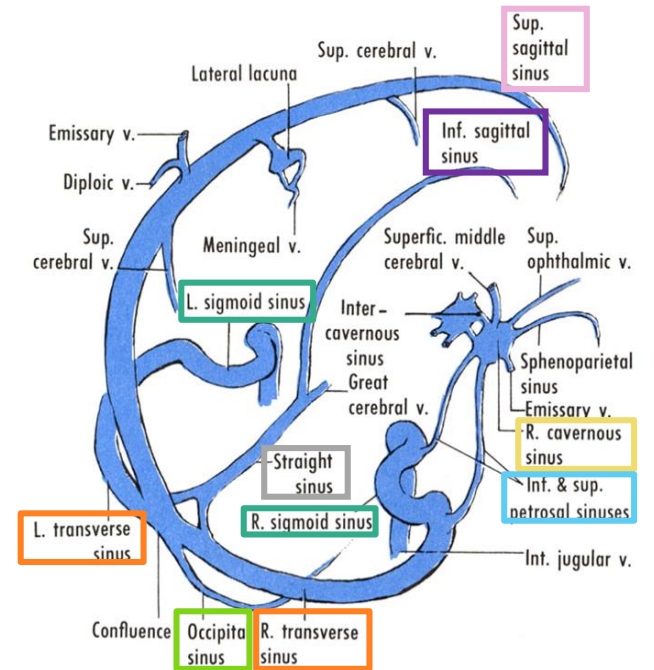
- The dural venous sinuses are grouped into:

Paired:	Single:
Transverse	Superior sagittal
Sigmoid	Inferior sagittal
Cavernous	Straight
Petrosal (superior & inferior)	Occipital

- Blood flows from **transverse & sigmoid sinuses** into IJV **Internal Jugular Vein.**



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Venous Disorders

Infarction

- refers to tissue death (necrosis) that is caused by a local lack of oxygen due to obstruction of the tissue's blood supply

Sinus thrombosis

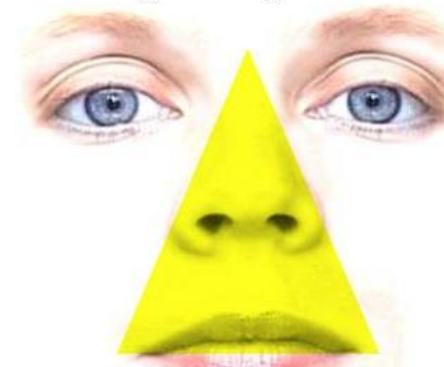
- SSS (superior sagittal sinus) thrombosis*: can complicate ear infection
- Cavernous sinus thrombosis: As a complication of infection in the dangerous area of the face**

- Obstruction of venous drainage of the brain leads to Cerebral swelling (**edema**) and **raised Intracranial Pressure**.

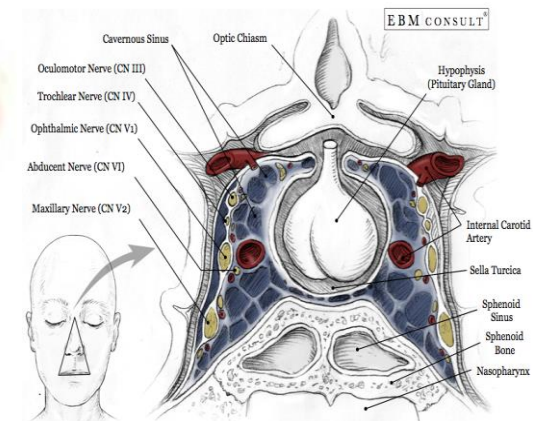
***Superior sagittal sinus thrombosis (SSST)** is the most common type of dural venous sinus thrombosis and is potentially devastating



**
Danger Triangle of Face



<http://medchrome.com>



Extra

These 2 videos summarize the lecture:
(to view them download the ppt version)

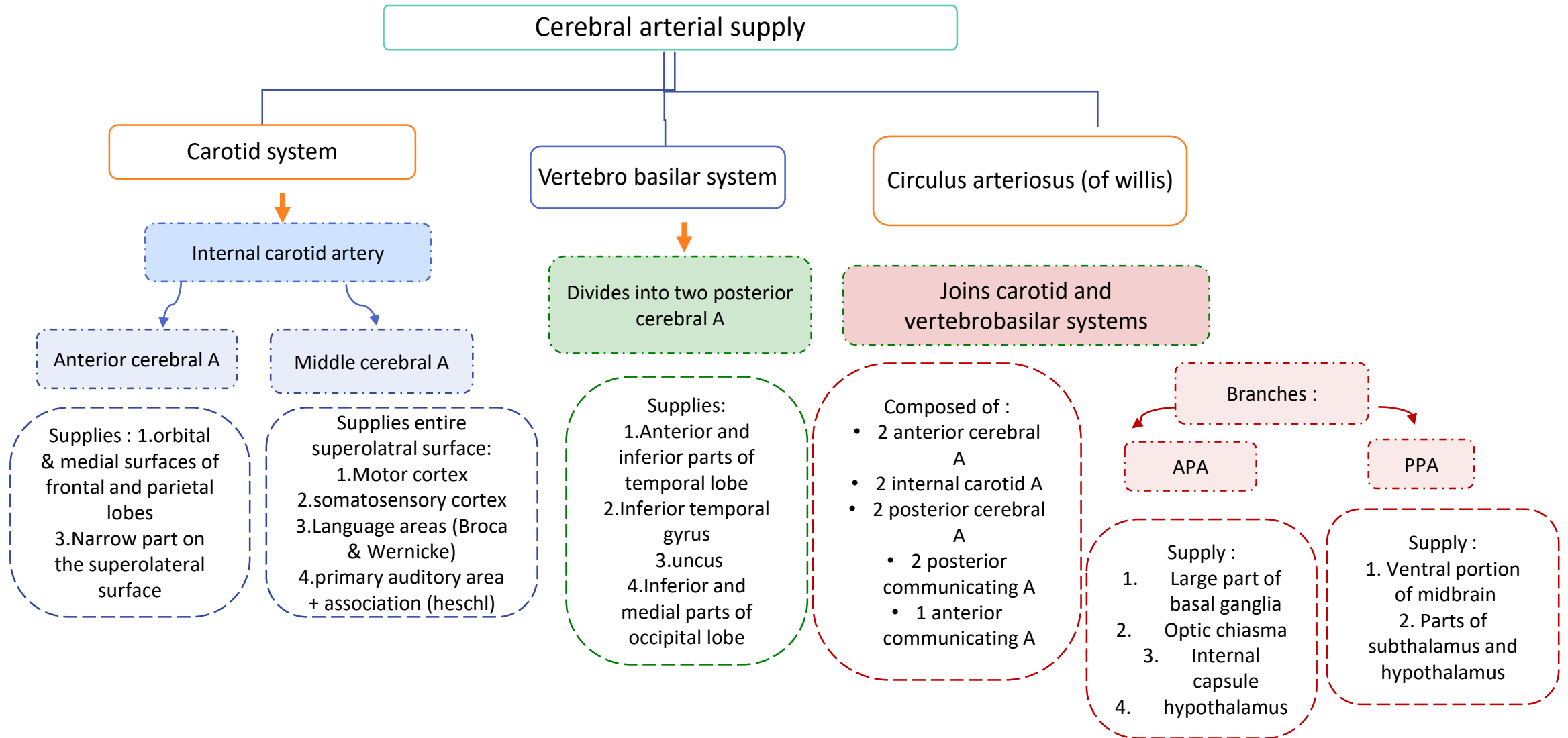


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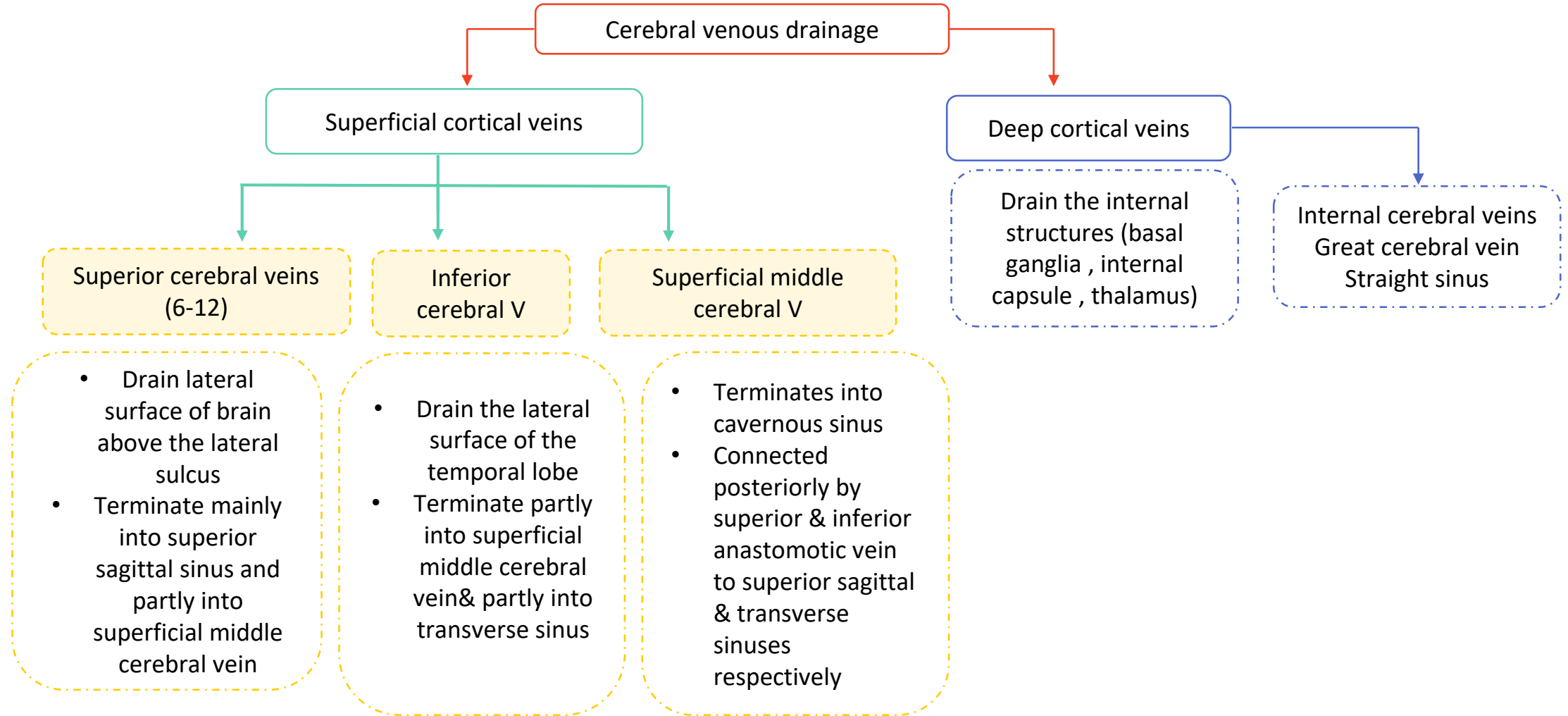


Duration: 01:18

Summary



Summary



MCQS

Q1. What does the basilar artery supply?

- A. Mid brain
- B. cerebellum
- C. A&B
- D. motor cortex

Q2. Which of the following are paired Dural sinuses?

- A. Inferior sagittal
- B. Straight
- C. Cavernous
- D. Occipital

Q3. Which of the following is the one of the effects that occur when the posterior cerebral artery is occluded?

- A. Visual disturbances
- B. Language disturbances
- C. Motor disturbance in the contralateral distal leg
- D. Contralateral sensory loss of face

Q4. Which of the following supplies the Optic chiasma:

- A. Anterior Perforating Arteries
- B. Posterior Perforating Arteries
- C. Middle Perforating Arteries
- D. Anterior Cerebral Artery

Q5. Which of the following is not a branch of the basilar artery

- A. Anterior inferior cerebellar artery.
- B. Pontine branches.
- C. Superior cerebellar artery
- D. Middle cerebral artery

Q6. What does the the circle of Willis NOT encircle?

- A. Optic chiasma.
- B. Hypothalamus.
- C. Midbrain
- D. Cerebellum

Q7. What do the cerebral veins NOT drain?

- A. Basal ganglia
- B. Internal capsule
- C. Thalamus
- D. Hypothalamus

Q8. Which of the following runs below the lateral sulcus:

- A-Superficial cerebral veins
- B-Inferior cerebral veins
- C-Superficial cerebral artery
- D-Inferior cerebral artery

1.C
2.C
3.A
4.A
5.D
6.D
7.D
8.B

SAQ

Q1. From which arteries do the anterior perforating arteries arise from?

- a. Anterior cerebral artery.
- b. Anterior communicating artery.
- c. Middle cerebral artery.

Q2. Which parts do the posterior perforating arteries supply?

- a. Ventral portion of Midbrain.
- b. Parts of Subthalamus and Hypothalamus.

Q3. A 35 year old man came to the hospital complaining of impaired memory and cortical blindness.

Which cerebral artery is affected?

Posterior cerebral artery

Which side is most likely affected?

Bilateral lesion (affecting both sides) which will lead to Anton's syndrome



Leaders:

Nawaf AlKhudairy

Jawaher Abanumy

Members:

Abdulmalek alhadlaq

Abdullah jammah

AbdulMohsen alghannam

Mohammed habib

Majed alzain

Abdulrahman almalki

Abdulmohsen alkhalf

Alanoud Abuhaimed

Anwar Alajmi

Nourah Al Hogail

Nouf Aloqaili



Feedback



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[Anatomy Team](#)

References:

1- Girls' & Boys' Slides

2- Greys Anatomy for Students

3- TeachMeAnatomy.com