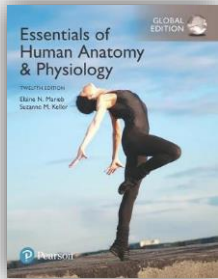


CEREBRAL BLOOD CIRCULATION

Khaleel Alyahya, PhD, MEd

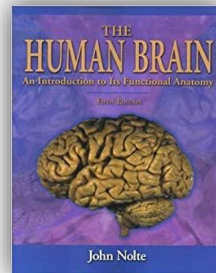
www.khaleelalyahya.net

Resources



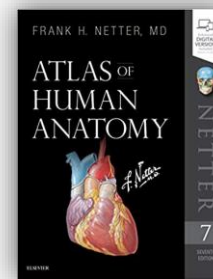
Essential of Human Anatomy & Physiology

By Elaine Marieb and Suzanne Keller



The Human Brain

By John Nolte



Atlas of Human Anatomy

By Frank Netter



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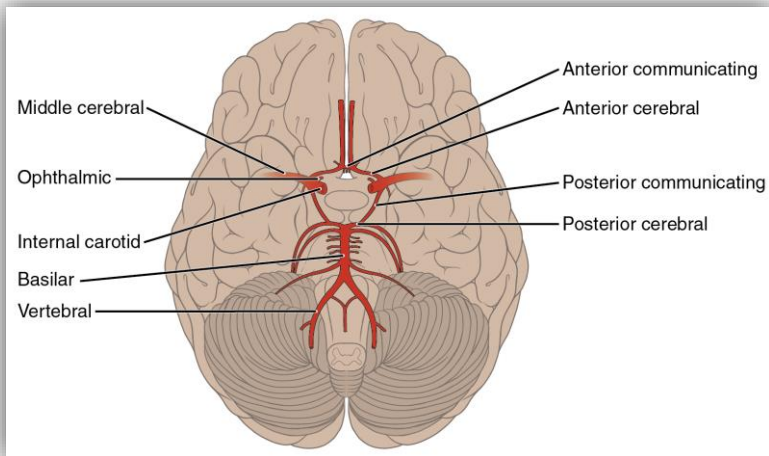
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Objectives

- 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.

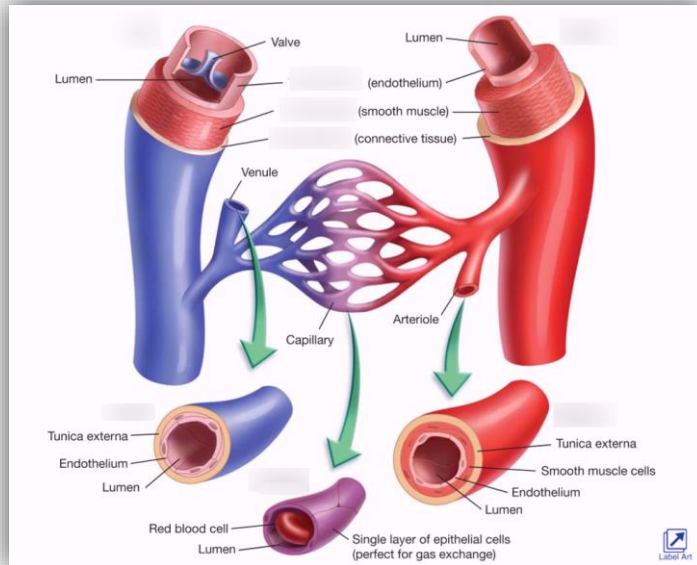


Introduction



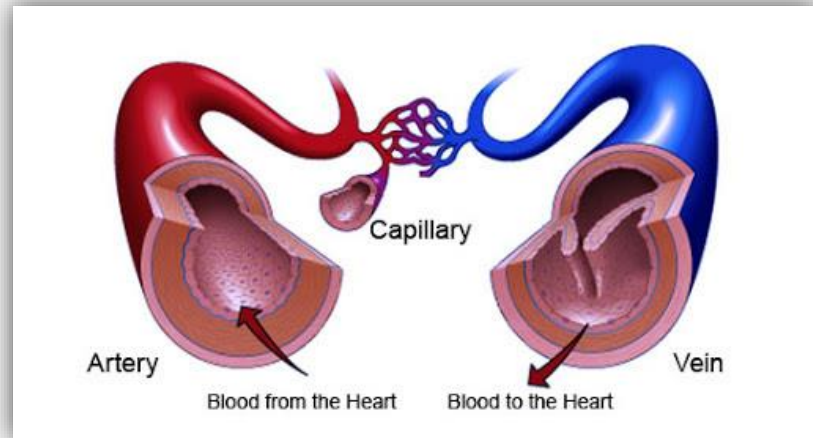
- The cerebral blood circulation is the movement of blood through the network of blood vessels to supply the brain.
- The arteries carry oxygenated blood and other nutrients to the brain.
- The veins carry deoxygenated blood back to the heart removing carbon dioxide and other metabolic products.
- The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

Types of Blood Vessels



- 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.

Walls of Blood Vessels



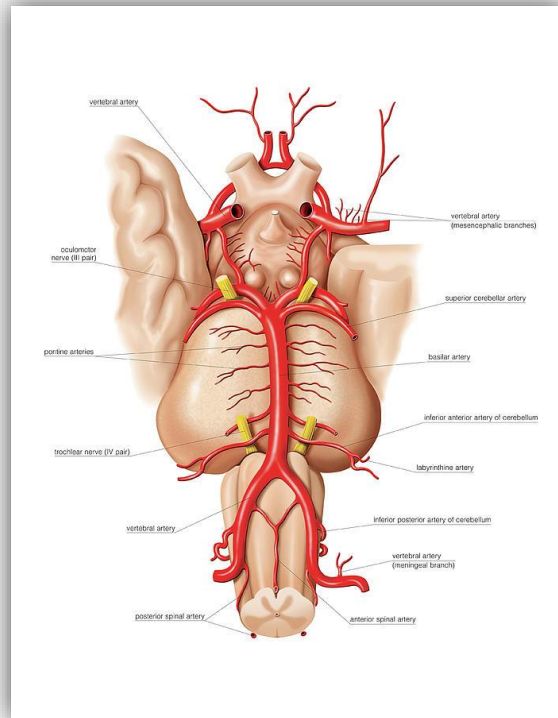
- The arteries and veins have three layers, but the middle layer is thicker in the arteries than it is in the veins:
 - **Tunica Intima** (the thinnest layer): a single layer of simple squamous endothelial cells.
 - **Tunica Media** (the thickest layer in arteries): is made up of smooth muscle cells and elastic tissue.
 - **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.

Blood



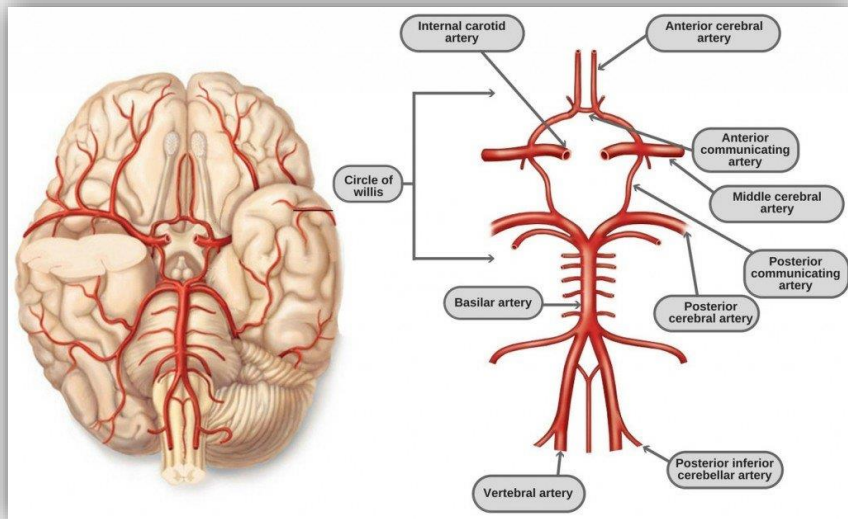
- Blood is the actual carrier of the oxygen and nutrients into arteries.
- Blood is made mostly of plasma, which is a yellowish liquid that is 90% water.
- Plasma contains also salts, glucose and other substances.
- Most important, plasma contains proteins that carry important nutrients to the body's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

Cerebral Arterial Supply



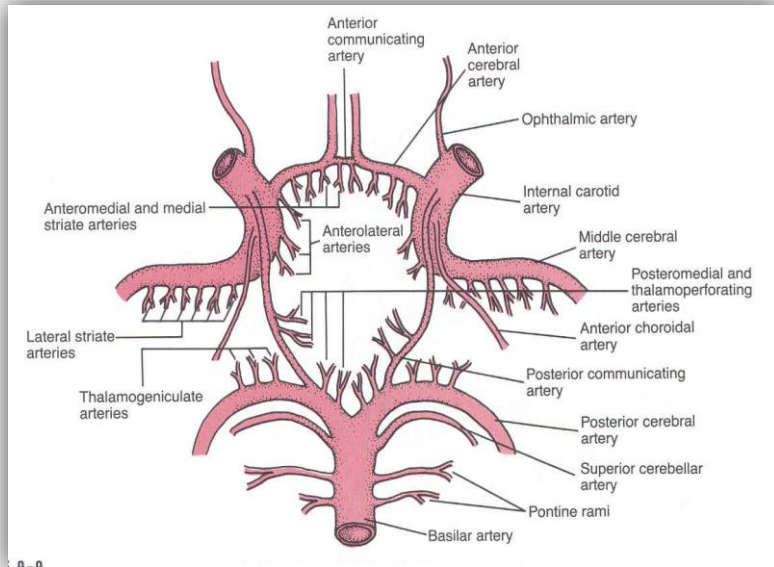
- The arterial cerebral circulation is divided into **anterior** and **posterior** cerebral circulations.
- The **anterior** and **posterior** cerebral circulations are interconnected via bilateral posterior communicating arteries.
 - **Posterior communicating arteries are part of Circle of Willis.**
 - Located on the base of the brain.
 - It Encircles:
 - Optic chiasma
 - Hypothalamus
 - Midbrain
- The cerebral arterial supply is provided by two systems:
 - **Carotid System**
 - Supply anterior portion of the brain.
 - **Vertebro-Basilar System**
 - Supply posterior portion of the brain.

Circle of Willis



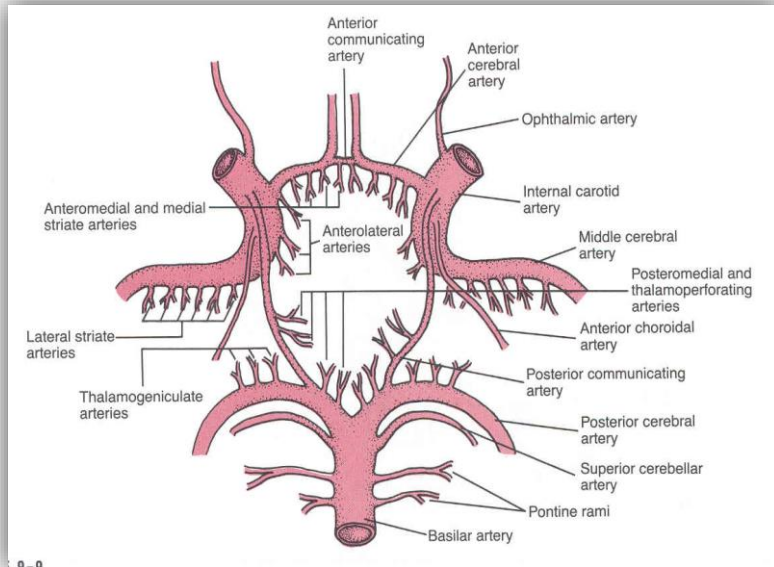
- Named after Thomas Willis (1621–1675), an English physician.
- Formed by:
 - Two Anterior cerebral arteries
 - Two Internal carotid arteries
 - Two Posterior cerebral arteries
 - Two Posterior communicating arteries
 - One Anterior communicating artery
- It Gives numerous small vessels that penetrate the surface of the brain.
 - Perforating arteries
- They are divided into:
 - Anterior perforating arteries
 - Posterior perforating arteries

Anterior Perforating Arteries



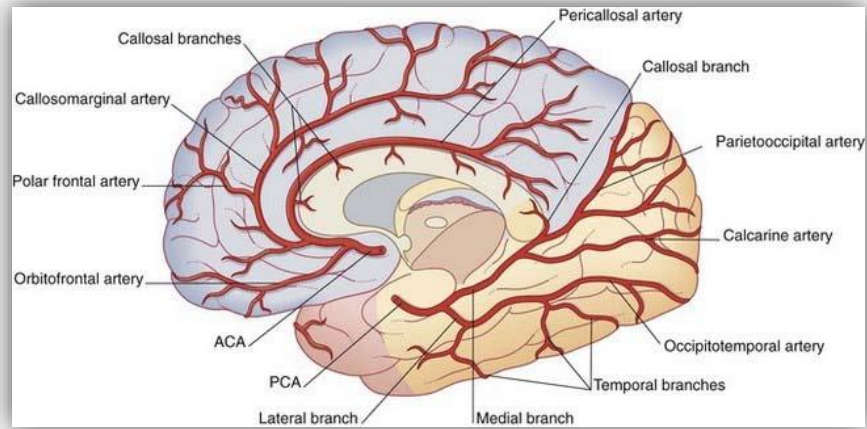
- Arise from:
 - Anterior cerebral artery
 - Anterior communicating artery
 - Middle cerebral artery
- Enter brain through:
 - Anterior perforated substance
 - irregularly quadrilateral area in front of the optic tract and behind the olfactory trigone.
- Supply:
 - Large part of basal ganglia
 - Optic chiasma
 - Internal capsule
 - Hypothalamus

Posterior Perforating Arteries



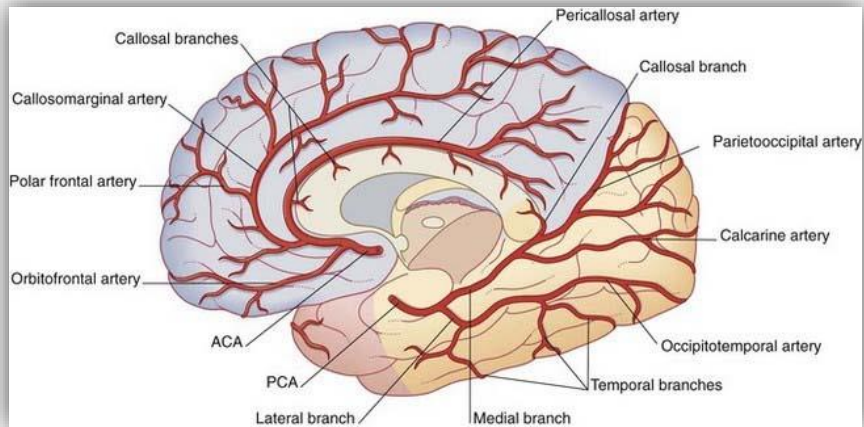
- Arise from:
 - Posterior cerebral artery
 - Posterior communicating artery
- Enter brain through:
 - Posterior Perforated substance
- Supply:
 - Ventral portion of Midbrain
 - Parts of Subthalamus and Hypothalamus

Anterior Cerebral Arteries



- Supplies: Orbital and medial surfaces of frontal and parietal lobes.

Posterior Cerebral Arteries



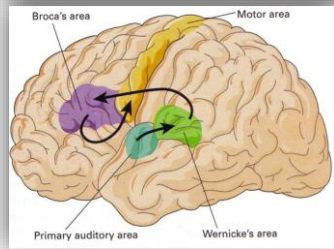
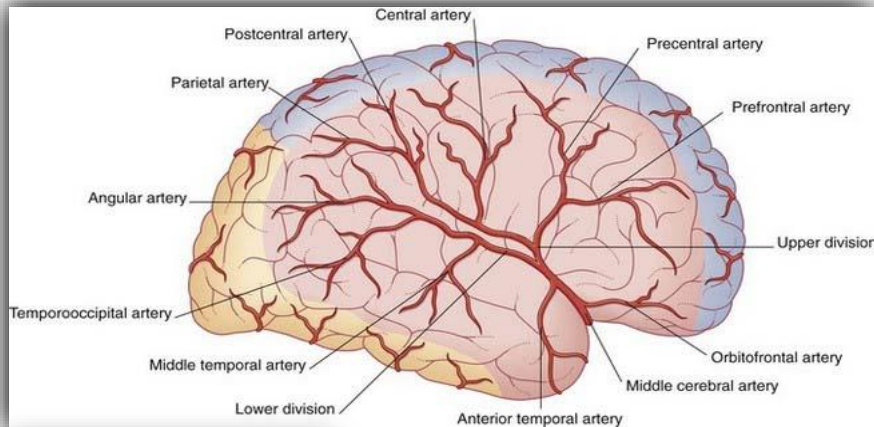
■ Supplies:

- Anterior and inferior temporal lobes.
- Uncus.
 - 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.

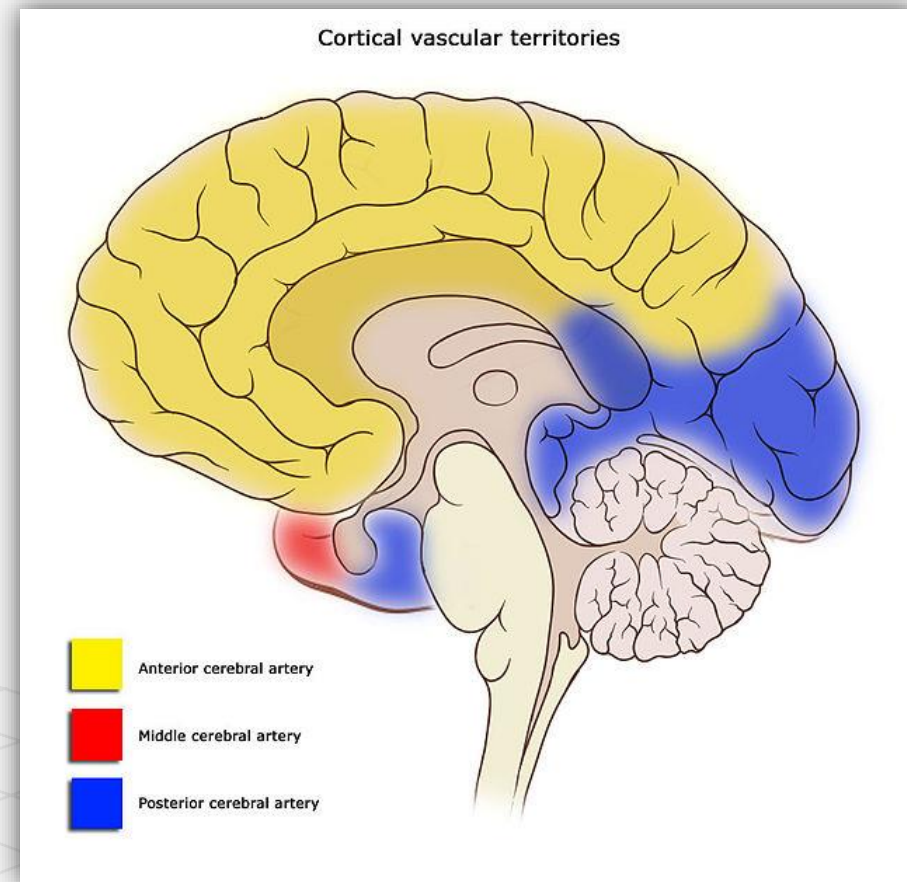
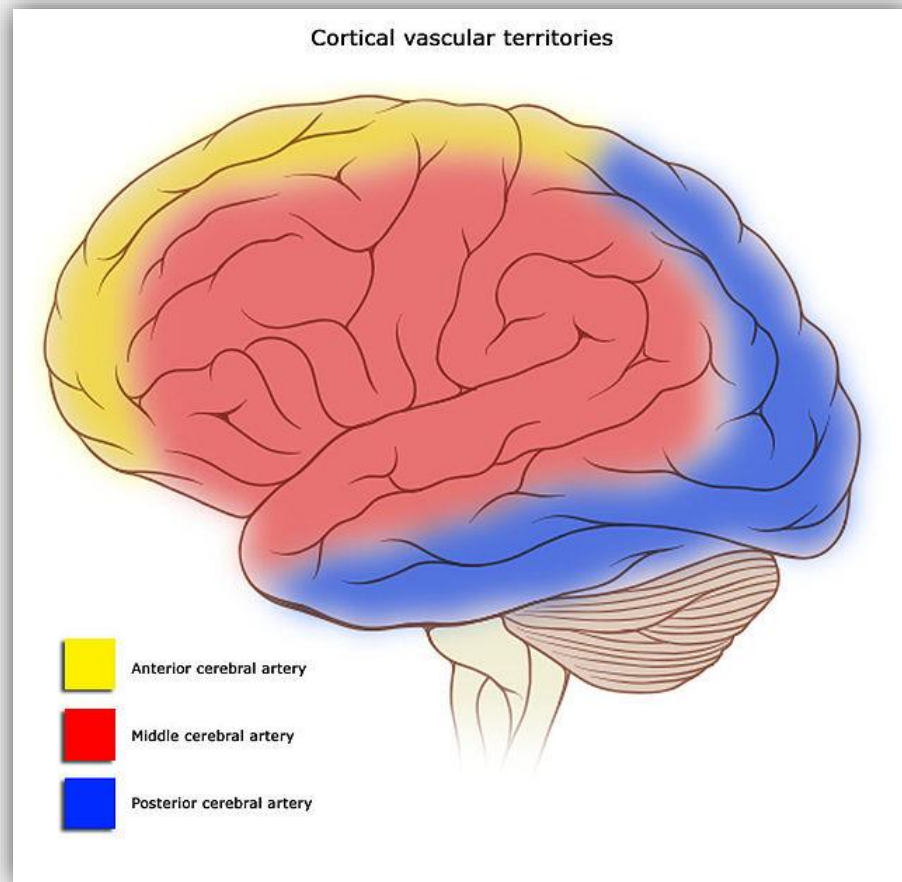
Middle Cerebral Arteries

- Supplies: Entire Superolateral surface:

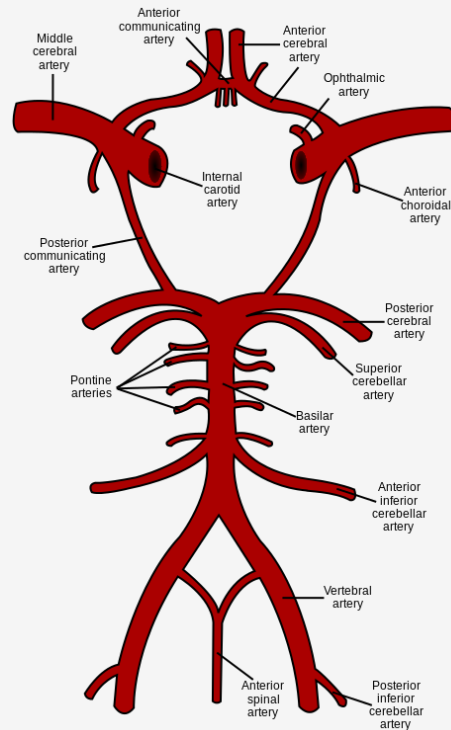
- Somatosensory Cortex
- Motor Cortex
- Broca's Area
 - linked to speech production.
- Heschl's Gyrus
 - to process incoming auditory information
- Wernicke's Area
 - It is involved in the understanding of written and spoken language



Distribution of Cerebral Arteries

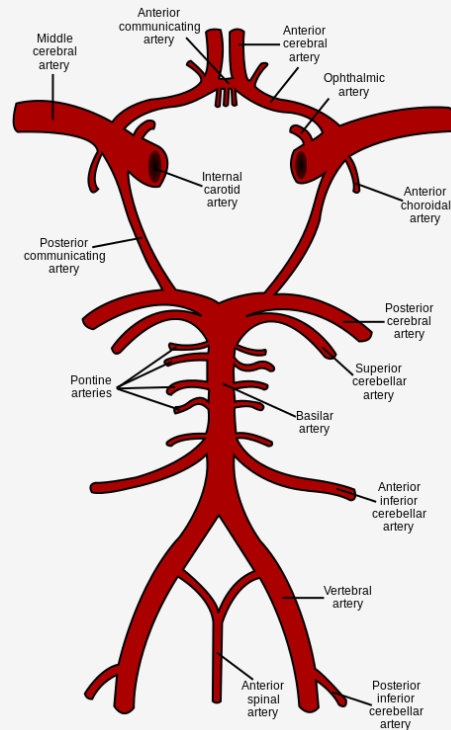


Basilar Artery



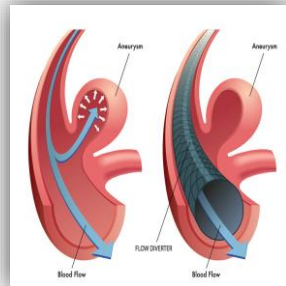
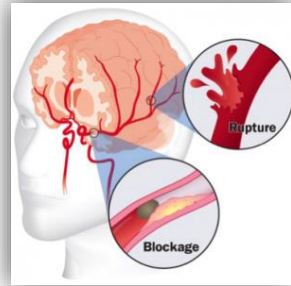
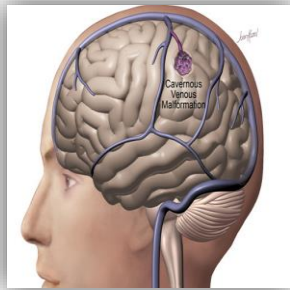
- Supplies: Midbrain and Cerebellum.
- Branches:
 - Anterior inferior cerebellar artery.
 - Pontine branches.
 - Superior cerebellar artery.

Vertebral Arteries



- It originates from the subclavian arteries.
- Supplies: Spinal Cord and Cerebellum.
- Branches:
 - Anterior and posterior spinal arteries.
 - Posterior inferior cerebellar artery.

Arterial Disorder



- **Stroke**

- Sudden occlusion
- Hemorrhage

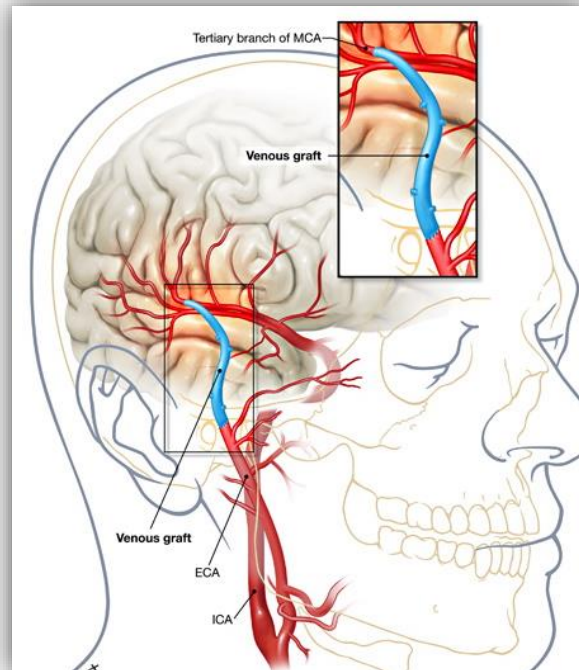
- **Aneurysm**

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

- **Angioma**

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

Arterial Occlusion



■ Occlusion of ACA

- Motor disturbance in contralateral distal leg
- Difficulty in Prefrontal lobe Functions:
 - Cognitive thinking
 - Judgment
 - Motor initiation
 - Self monitoring

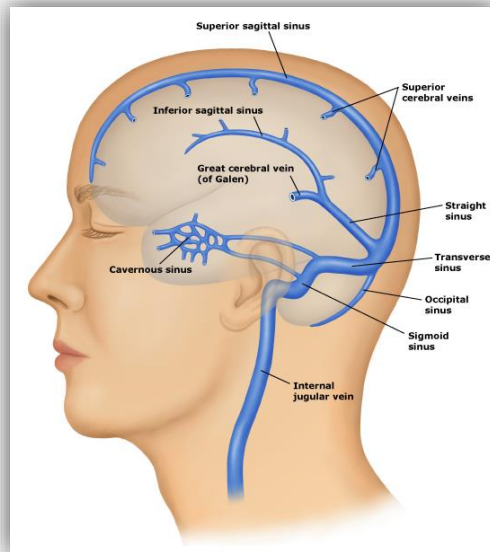
■ Occlusion of PCA

- Visual disturbances
 - Contralateral homonymous hemianopsia
 - Bilateral lesions: cortical blindness
- Memory impairment
 - If temporal lobe is affected

■ Occlusion of MCA

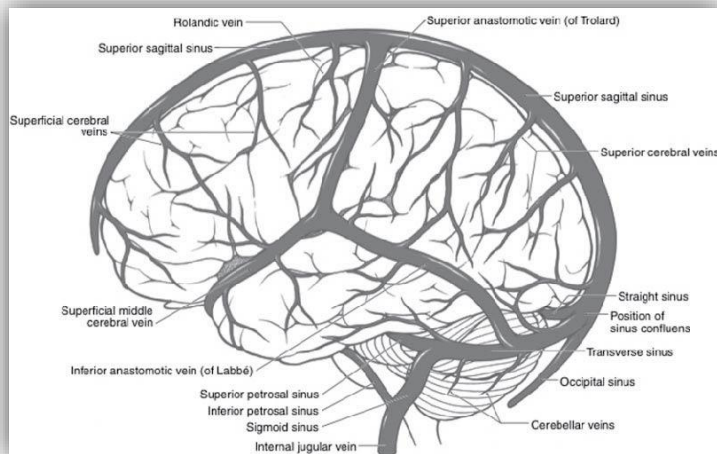
- Contralateral weakness of:
 - face, arm, and hand more than legs
- Contralateral sensory loss of:
 - face, arm, and hand more than legs
 - visual field cut (damage to optic radiation)
- Aphasia: language disturbances
 - Broca's: production
 - Wernicke's: comprehension

Cerebral Venous Drainage



- It involves:
 - Superficial (cortical) veins:
 - Drain the cortical surface
 - Deep veins:
 - Drain the deep structures
- These veins ultimately drain into:
 - Dural Venous Sinuses
- The Veins are thin walled and are devoid of valves.

Superficial Cortical Veins



- Lie on the brain surface, in the subarachnoid space.
- They are divided into:
 - Superior cerebral veins
 - Inferior cerebral veins
 - Superficial middle cerebral vein

Superior Cerebral Veins



- 6 to 12 veins.
- Drain lateral surface of brain above the lateral sulcus.
- Terminate mainly into the Superior Sagittal sinus, and partly into superficial middle cerebral vein.

Inferior Cerebral Veins



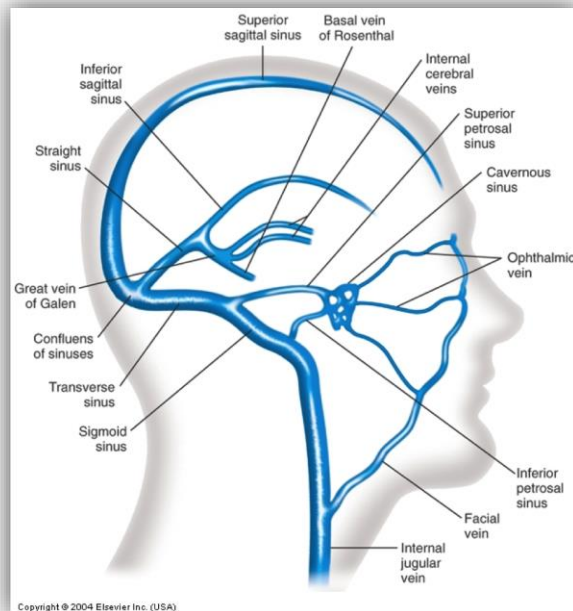
- Run below the lateral sulcus.
- Drain the lateral surface of the temporal lobe.
- Terminate partly into superficial middle cerebral vein & partly into Transverse sinus.

Superficial Middle Cerebral Veins



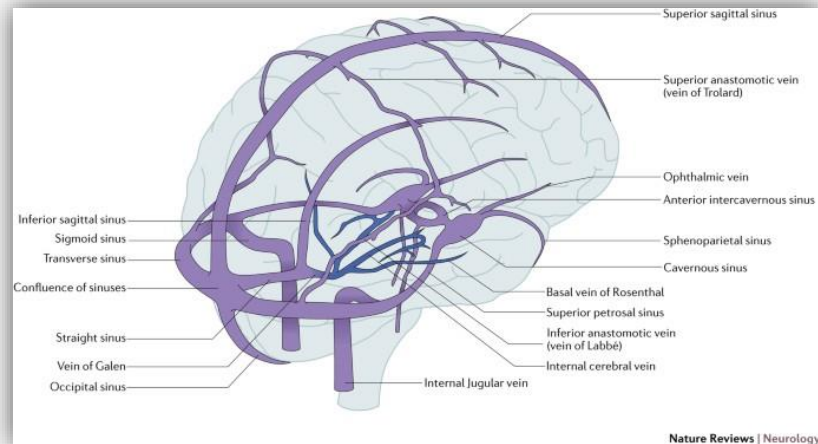
- Runs along the lateral sulcus.
- Terminates into the Cavernous sinus.
- Connected posteriorly by Superior & Inferior anastomotic veins to Superior Sagittal & Transverse sinuses, respectively.

Deep Cerebral Veins



- They drain the internal structures:
 - Basal ganglia
 - Internal capsule
 - Thalamus
- They merge to form the **Internal Cerebral Veins**.
- The two veins unite in the midline to form the **Great Cerebral vein**.
- This short vessel is continuous with the **Straight Sinus**.

Cerebral Sinuses



■ The Superior Sagittal Sinus

- Lies along the superior border of the falx cerebri and empties into the confluence of sinuses.

■ The Inferior Sagittal Sinus

- Lies in the inferior border of the falx cerebri.
- The great cerebral vein of Galen joins the inferior sagittal sinus to form the straight sinus.

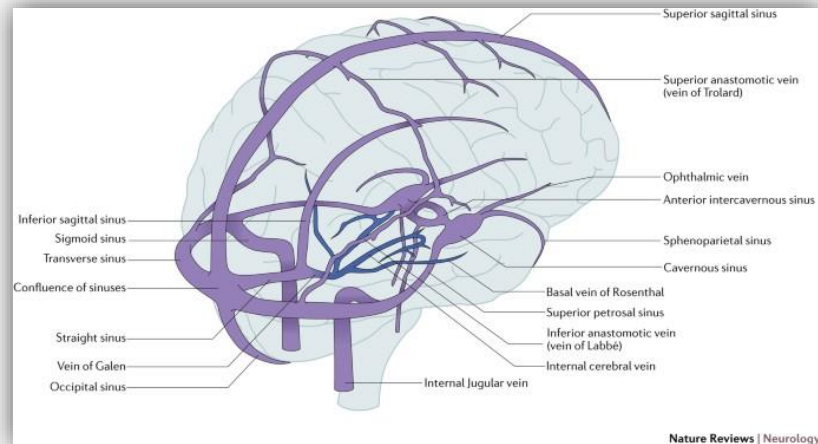
■ The Transverse Sinuses

- Originate on each side of the confluence of sinuses.
- Each transverse sinus travels laterally, and curves downward to form the sigmoid sinus that empties into the internal jugular vein on the same side.

■ The Confluence of Sinuses

- At the confluence of sinuses, the superior sagittal, straight, transverse, and occipital sinuses join.

Cerebral Sinuses



■ The Cavernous Sinuses

- Located on each side of the sphenoid bone.
- Ophthalmic and superficial middle cerebral veins drain into these sinuses.

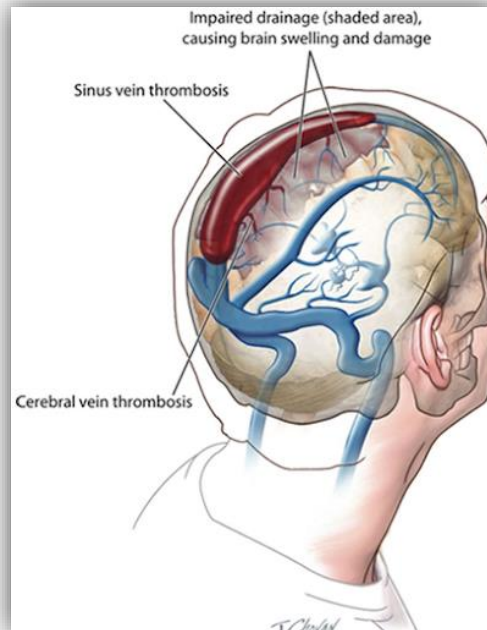
■ The Sphenoparietal Sinuses

- Located below the sphenoid bone and drain into the cavernous sinus.

■ The Sigmoid Sinuses

- Receive blood from posterior dural venous sinus veins.

Cerebral Venous Sinus Thrombosis



- Cerebral venous sinus thrombosis is the presence of a **thrombus** within one of the dural venous sinuses.
- The thrombus block venous return through sinuses and causes **accumulation** of deoxygenated blood within the brain.
- This may lead to venous **infarction** (tissue death, necrosis) that is caused by a local lack of oxygen.
- The situation is **complicated** by the accumulation of cerebrospinal fluid, which can no longer drain through the venous sinus with thrombosis.
- Common clinical symptoms include **headache, nausea, vomiting, and neurological defects**.
- The diagnosis can be made by **CT** or **MRI** scan with contrast.
- Treatment by **anticoagulation**.

Questions?

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