CEREBRAL BLOOD CIRCULATION

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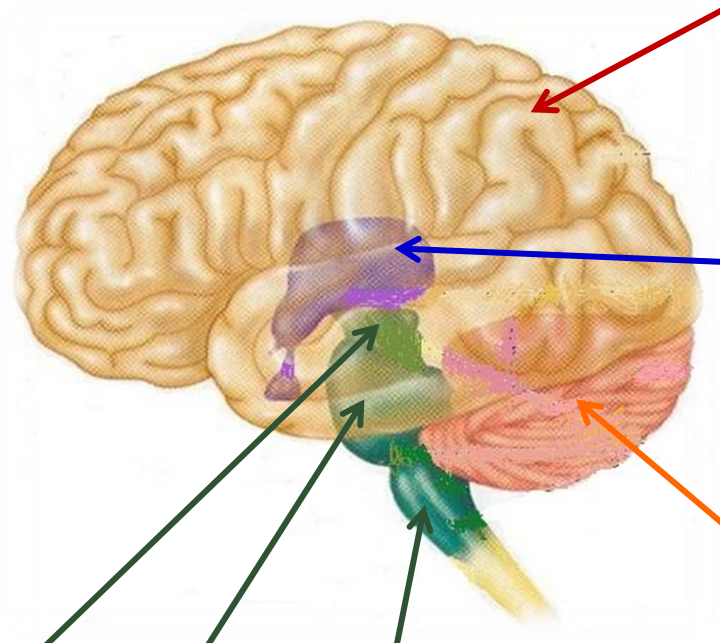
OBJECTIVES

At the end of the lecture, students should be able to:

- **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.**

Review: THE BRAIN

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



Cerebrum
(Cerebral hemispheres)

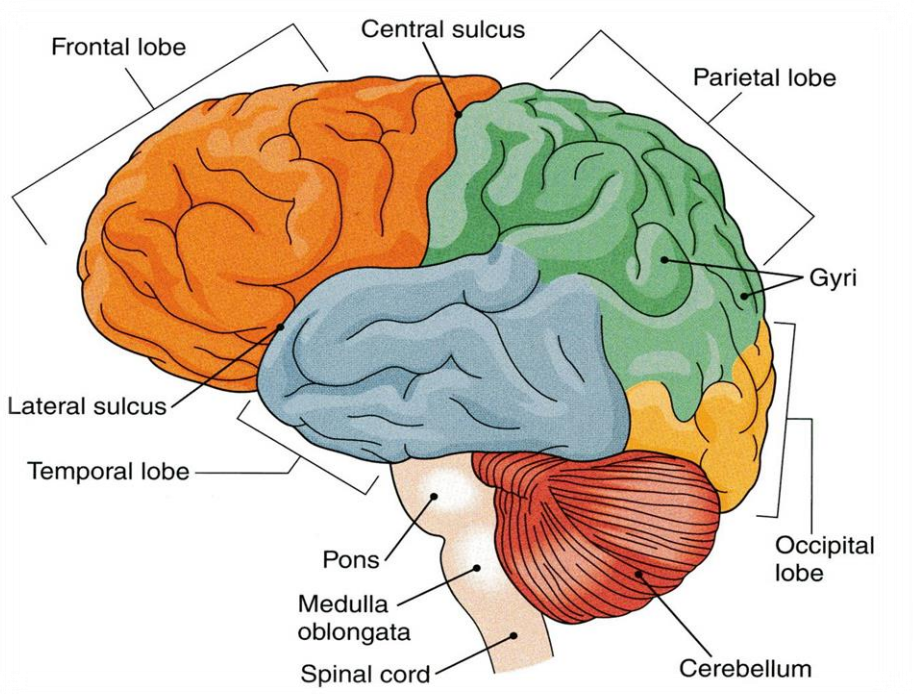
Diencephalon:
Thalamus,
Hypothalamus,
Subthalamus &
Epithalamus

Cerebellum

Brainstem: Midbrain, Pons & Medulla oblongata

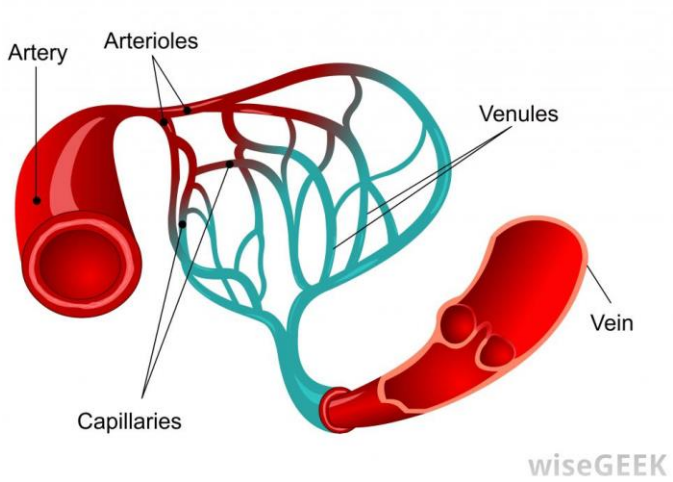
Review: CEREBRUM

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



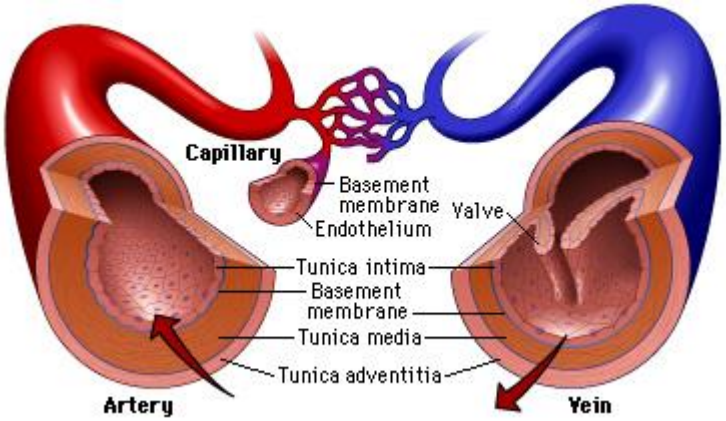
Review: BLOOD VESSELS

- **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.**



Review: HISTOLOGY

- **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.**

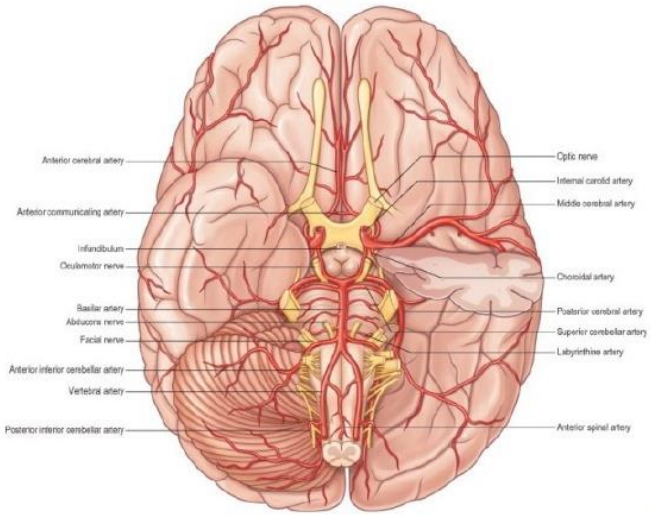


Review: BLOOD

- 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

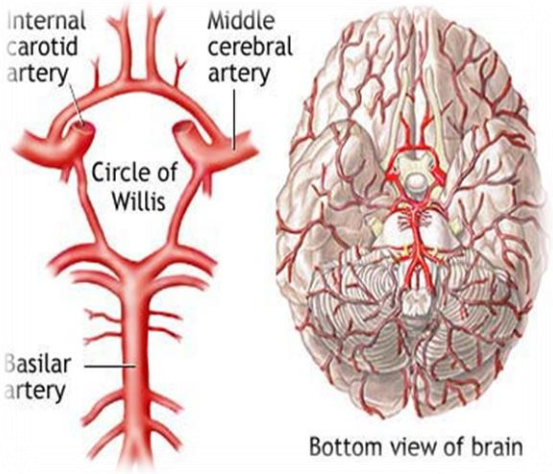
- The movement of blood through the network of blood vessels to supply the brain.
- The arteries carry oxygenated blood and other nutrients to the brain.
- The veins carry deoxygenated blood back to the heart removing carbon dioxide and other metabolic products.
- The movement of blood in the cerebral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



WATCH

CEREBRAL ARTERIAL SUPPLY

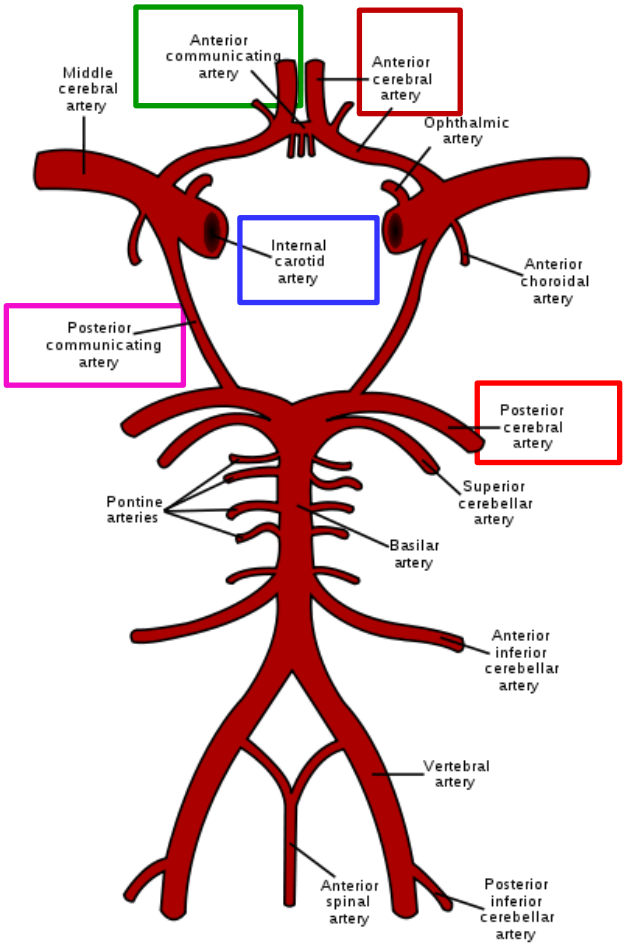
- The arterial cerebral circulation is divided into anterior and posterior cerebral circulations.
- The anterior and posterior cerebral circulations are interconnected via bilateral posterior communicating arteries.
  - Posterior communicating arteries are part of Circle of Willis.
    - ✓ Located on 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.



CIRCULUS ARTERIOSUS
(CIRCLE OF WILLIS)

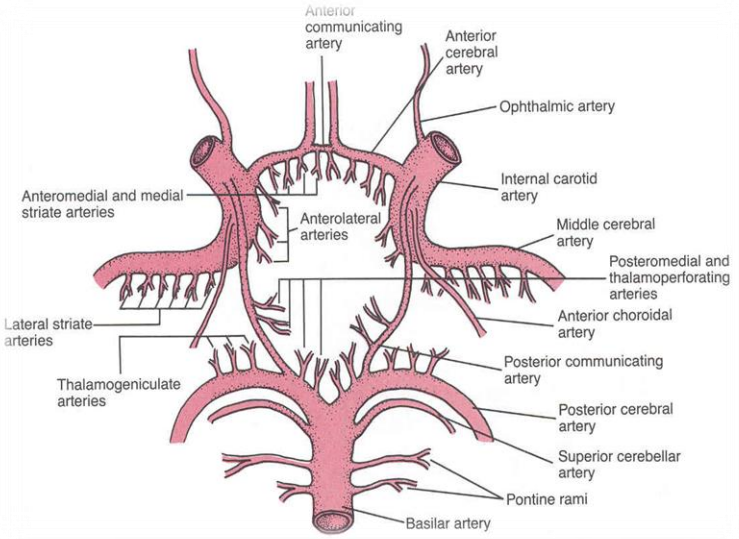
Named after Thomas Willis (1621–1675), an English physician

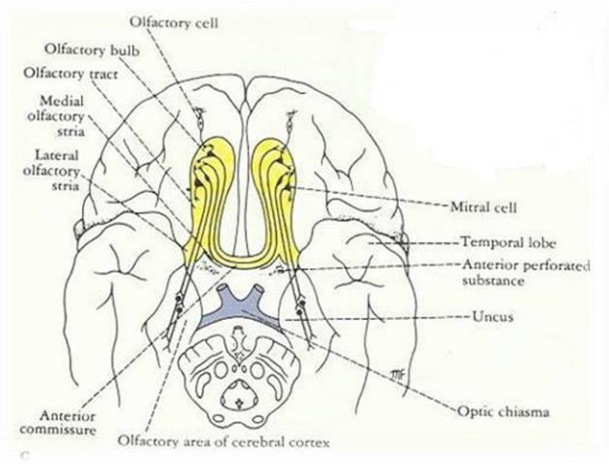
- **It is Formed by:**
  - **Two Anterior cerebral arteries**
  - **Two Internal carotid arteries**
  - **Two Posterior cerebral arteries**
  - **Two Posterior communicating arteries**
  - **One Anterior communicating artery**
- **It Gives numerous small vessels that penetrate the surface of the brain**
  - **Perforating arteries**
- They are divided into:
  - **Anterior perforating arteries**
  - **Posterior perforating arteries**



ANTERIOR PERFORATING ARTERIES

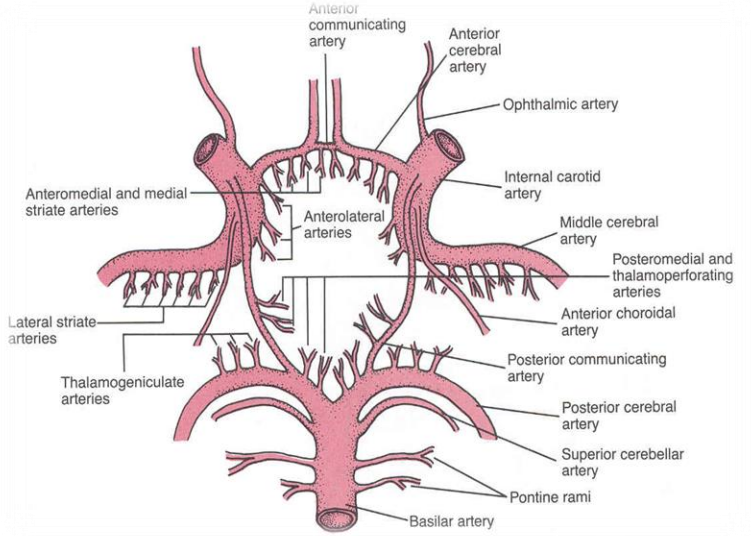
- **Arise from:**
  - **Anterior cerebral artery**
  - **Anterior communicating artery**
  - **Middle cerebral artery**
- **Enter brain through:**
  - **Anterior perforated substance**
    - **irregularly quadrilateral area in front of the optic tract and behind the olfactory trigone.**
- **Supply:**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

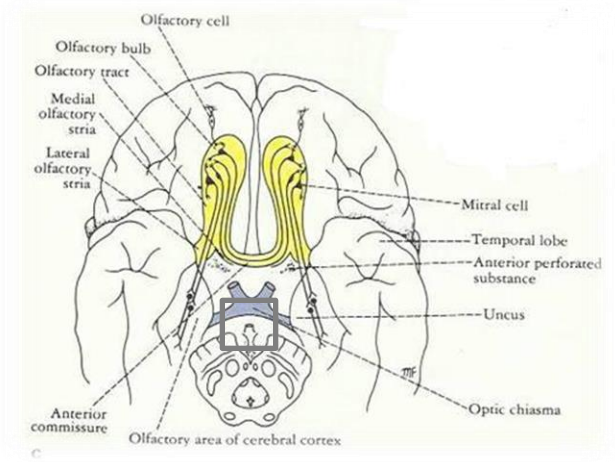




POSTERIOR PERFORATING ARTERIES

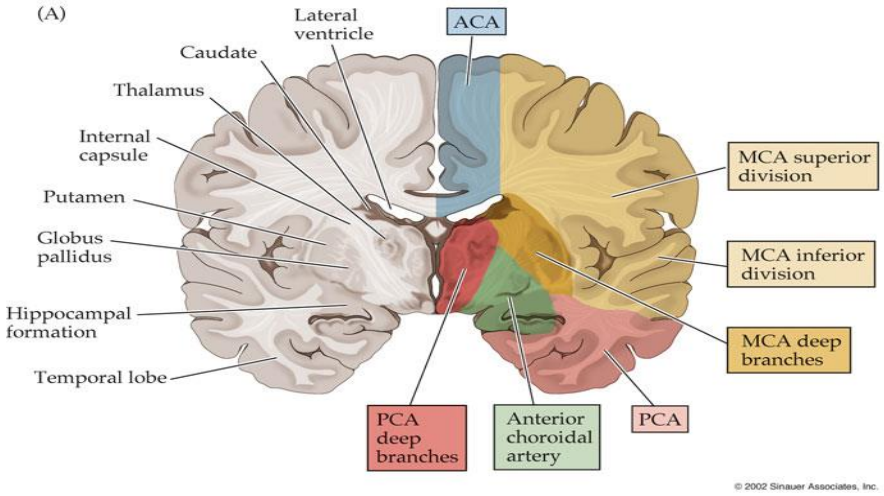
- **Arise from:**
  - **Posterior cerebral artery**
  - **Posterior communicating artery**
- **Enter brain through:**
  - **Posterior Perforated substance**
- **Supply:**
  - **Ventral portion of Midbrain**
  - **Parts of Subthalamus and Hypothalamus**

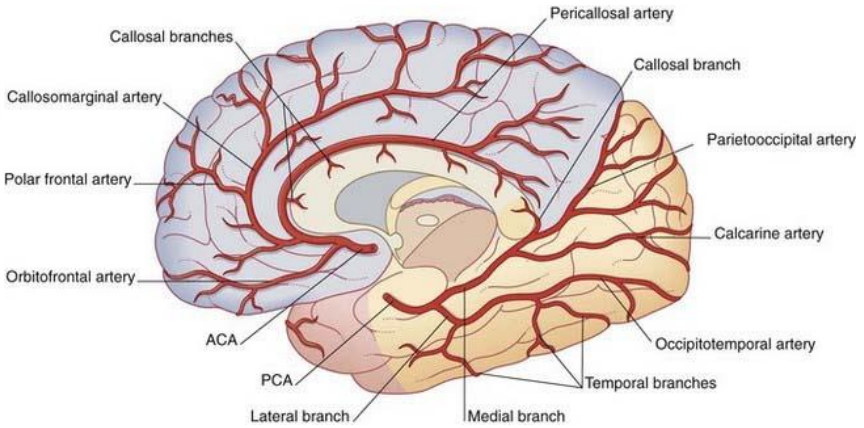




ANTERIOR CEREBRAL ARTERY

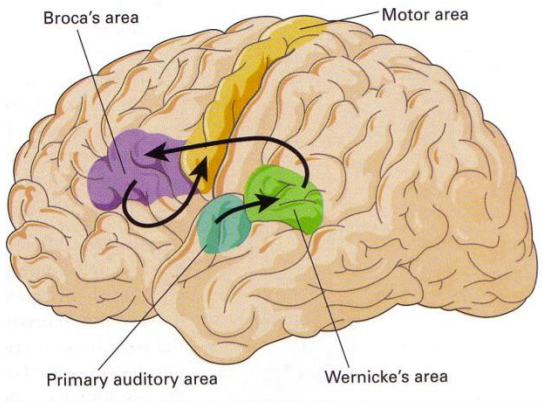
- **Supplies:** **Orbital and medial surfaces of frontal and parietal lobes**

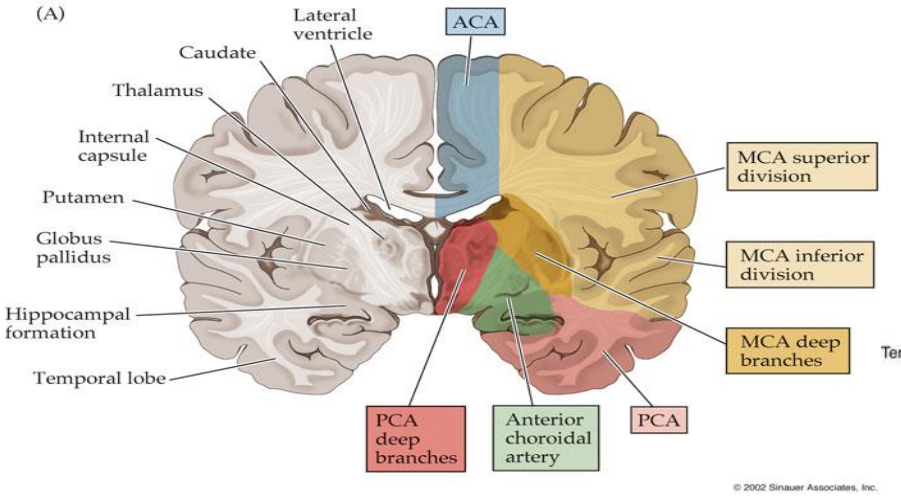


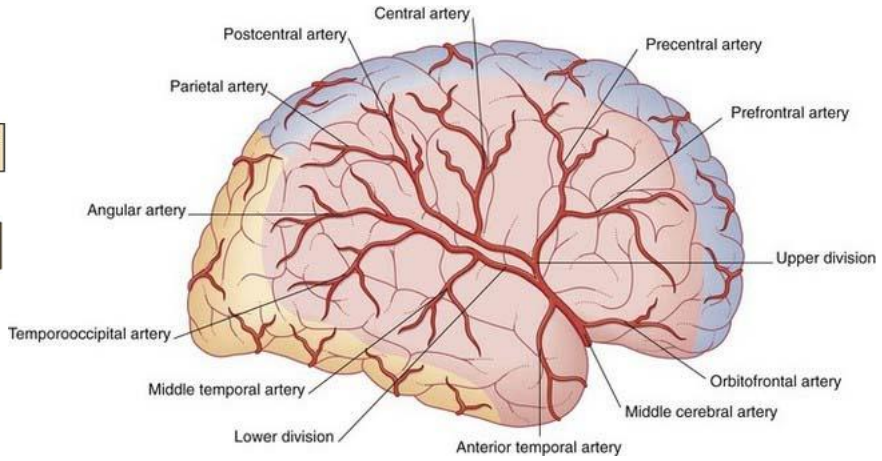


MIDDLE CEREBRAL ARTERY

- **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**

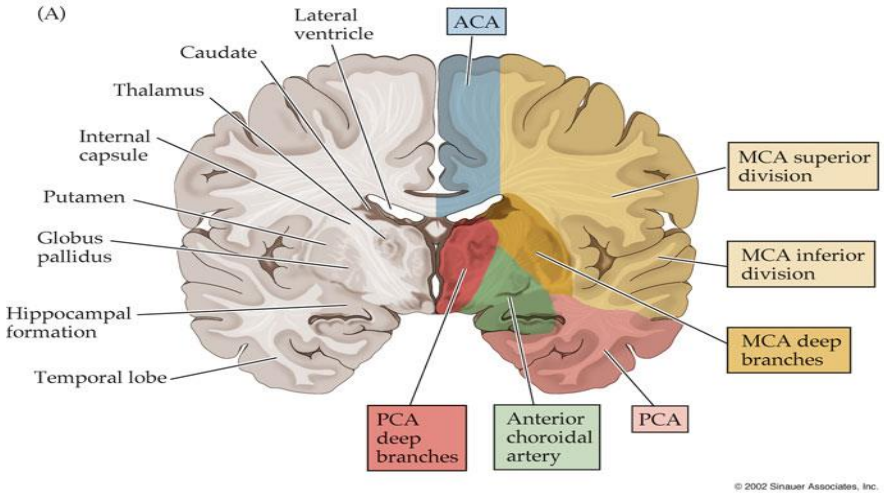


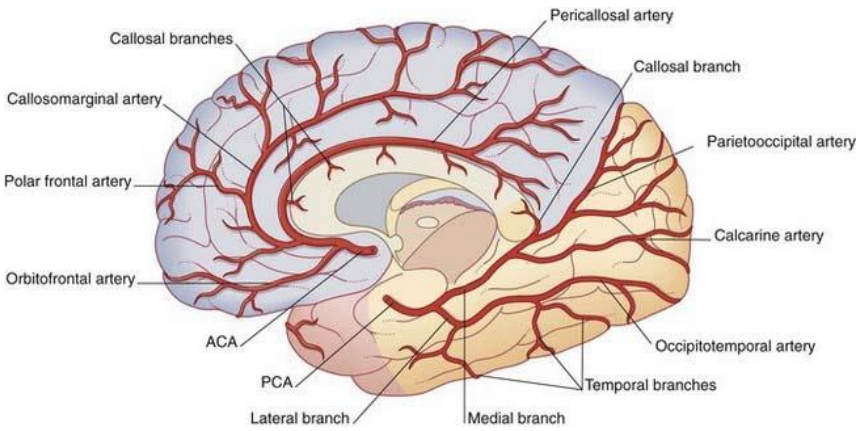




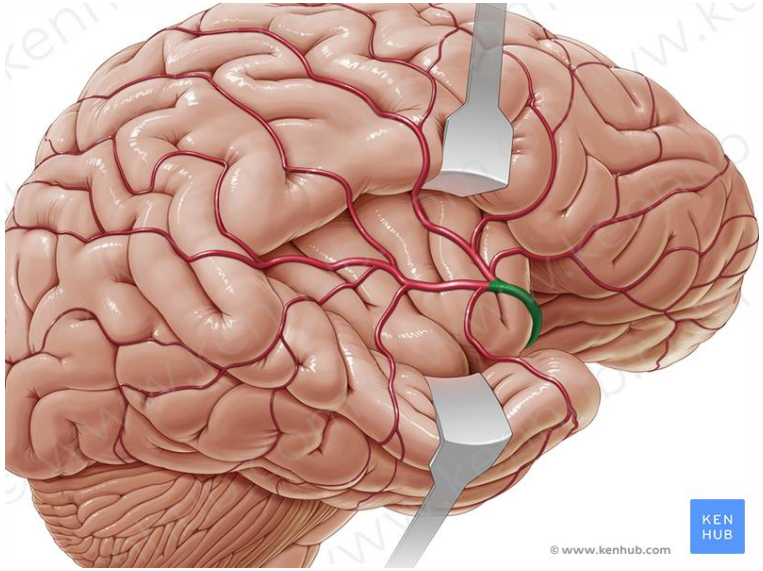
POSTERIOR CEREBRAL ARTERY

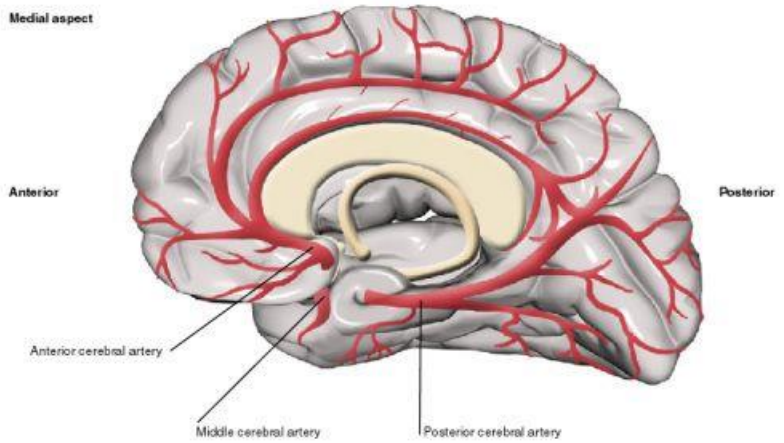
- **Supplies:**
  - **Anterior and inferior temporal lobes**
  - **Uncus**
    - **Located on the tip end of the medial surface of the parahippocampal gyrus.**
    - **Part of the olfactory cortex that processes information from the sense of smell.**
  - **Inferior temporal gyri**
  - **Inferior and Medial Occipital lobe**



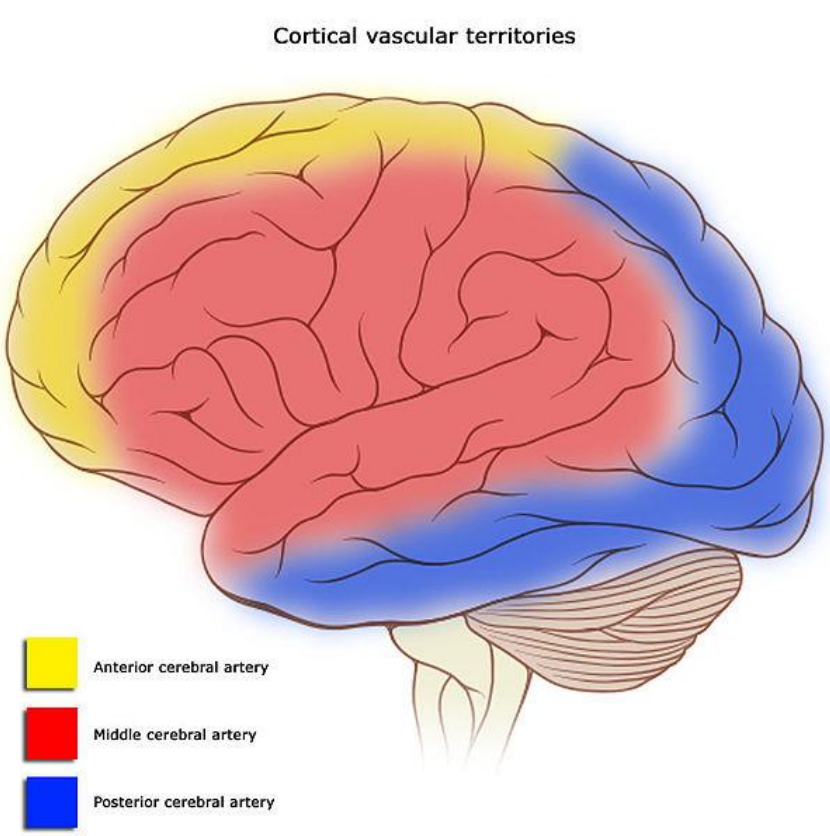


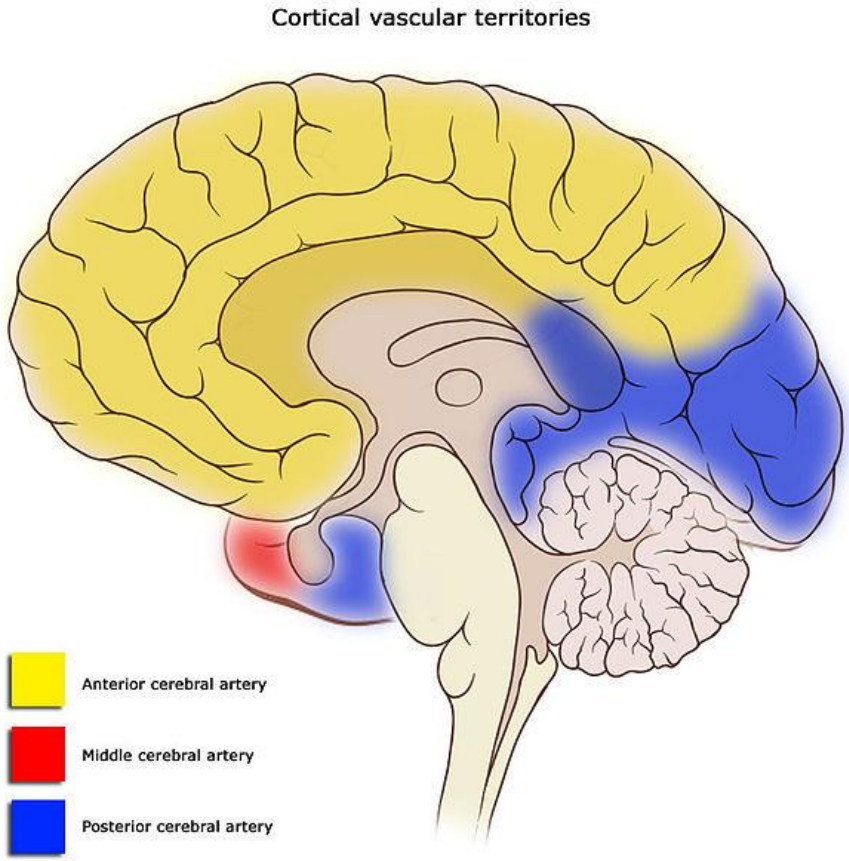
CEREBRAL ARTERIES





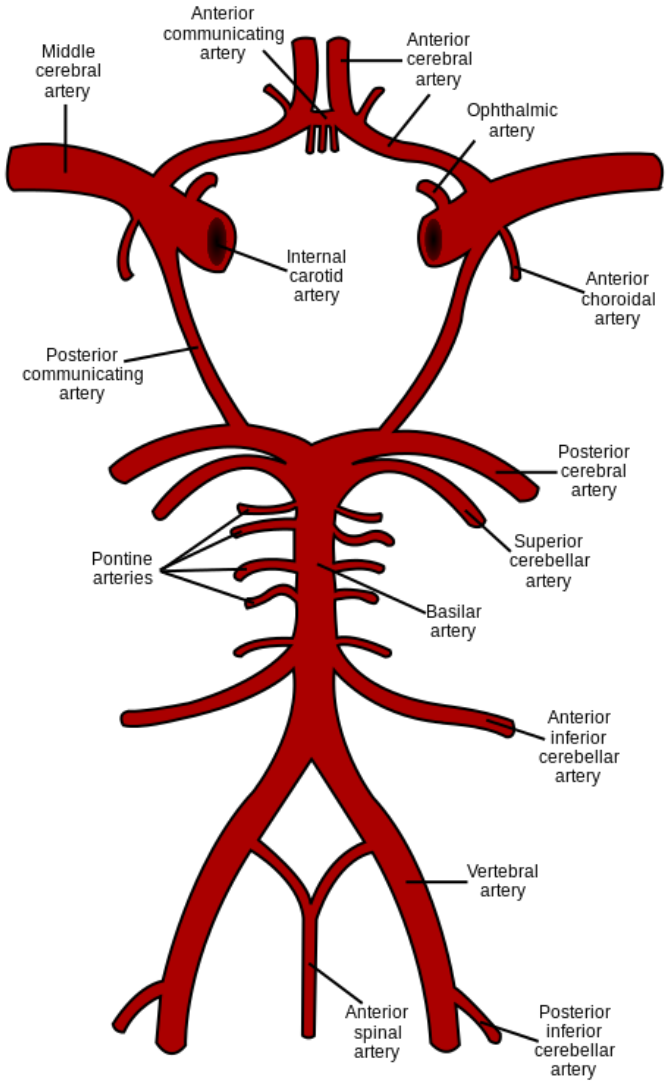
DISTRIBUTION OF CEREBRAL ARTERIES





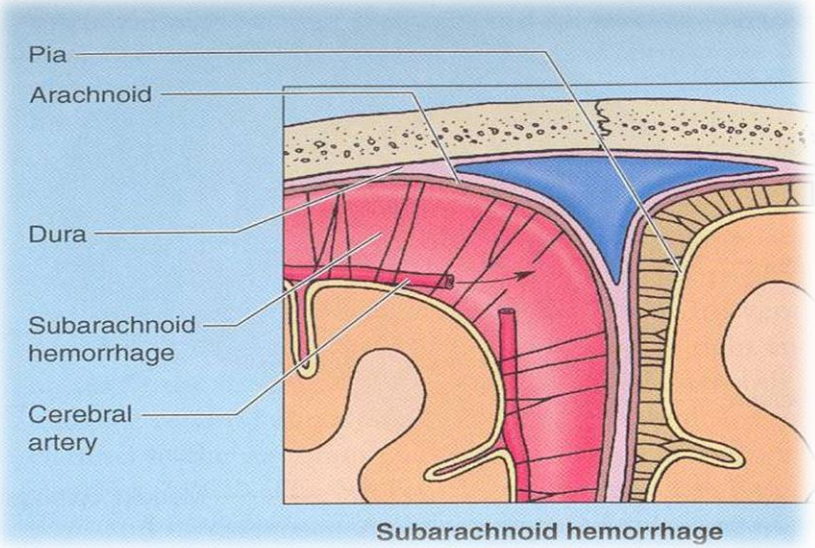
BASILAR ARTERY

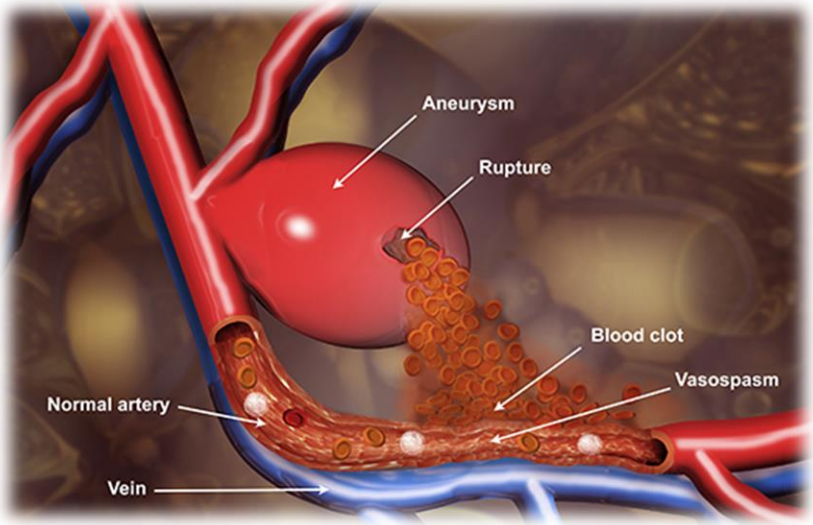
- **Supplies:** Midbrain and Cerebellum.
- **Branches:**
  - Anterior inferior cerebellar artery
  - Pontine branches
  - Superior cerebellar artery



ARTERIAL DISORDER

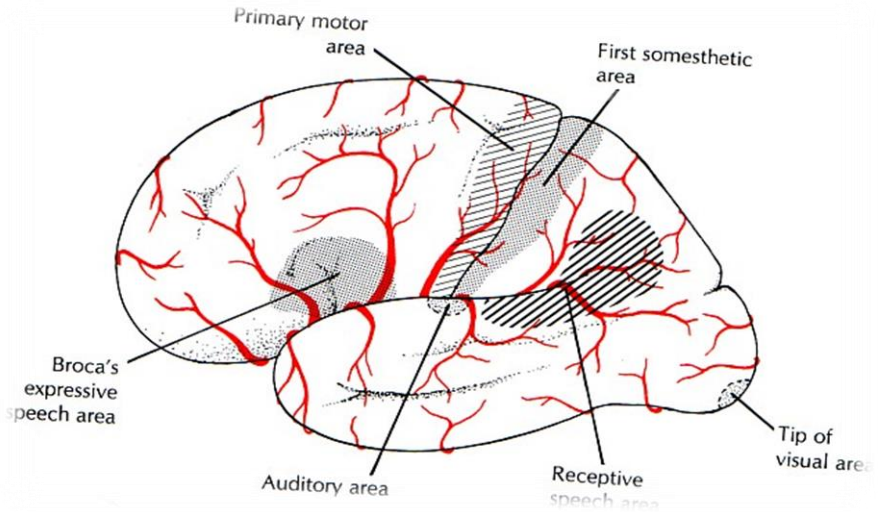
- **Stroke**
  - **Sudden occlusion**
  - **Hemorrhage**
- **Aneurysm**
  - **localized, blood-filled balloon-like bulge in the wall of a blood vessel.**
- **Angioma**
  - **is benign tumors derived from cells of the vascular or lymphatic vessel walls (epithelium) or derived from cells of the tissues surrounding these vessels.**

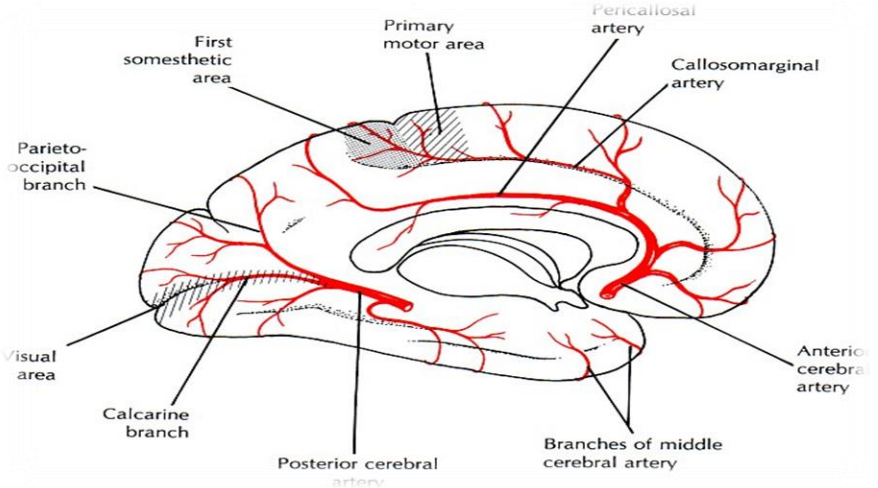




ACCLUSION OF ACA

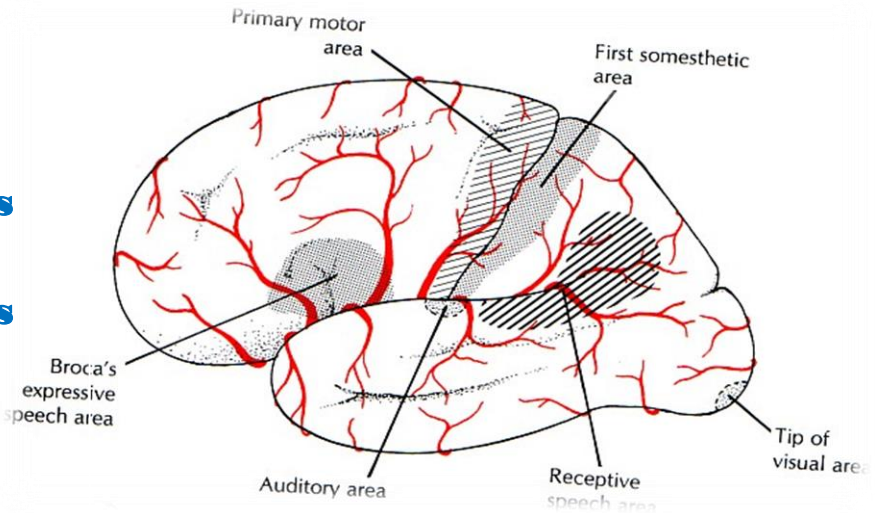
- **Manifestations:**
  - **Motor disturbance in contralateral distal leg**
  - **Difficulty in Prefrontal lobe Functions:**
    - **Cognitive thinking**
    - **Judgment**
    - **Motor initiation**
    - **Self monitoring**

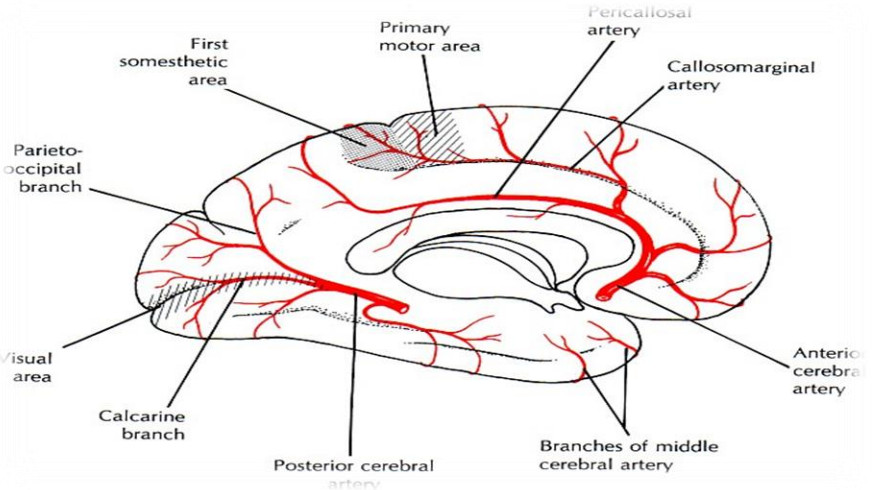




ACCLUSION OF MCA

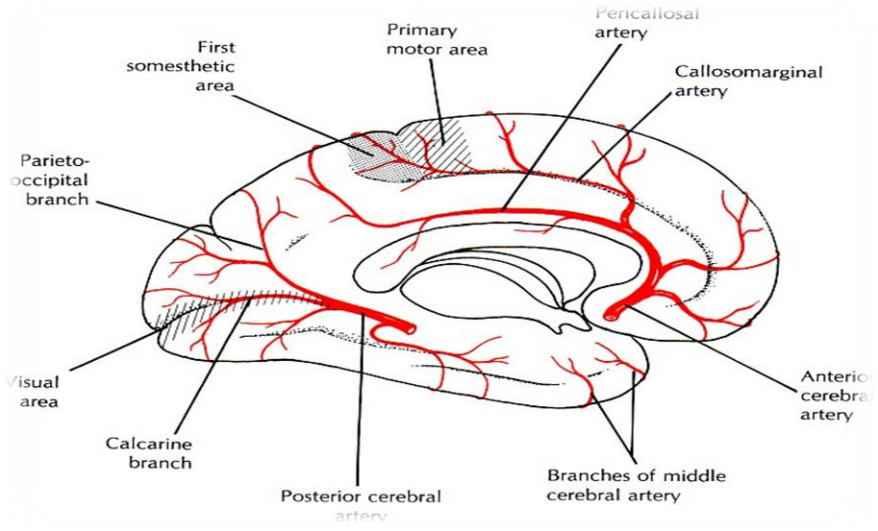
- **Manifestations:**
  - **Contralateral weakness of:**
    - face, arm, and hand more than legs
  - **Contralateral sensory loss of:**
    - face, arm, and hand more than legs
    - visual field cut (damage to optic radiation)
  - **Aphasia: language disturbances**
    - Broca's: production
    - Wernicke's: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

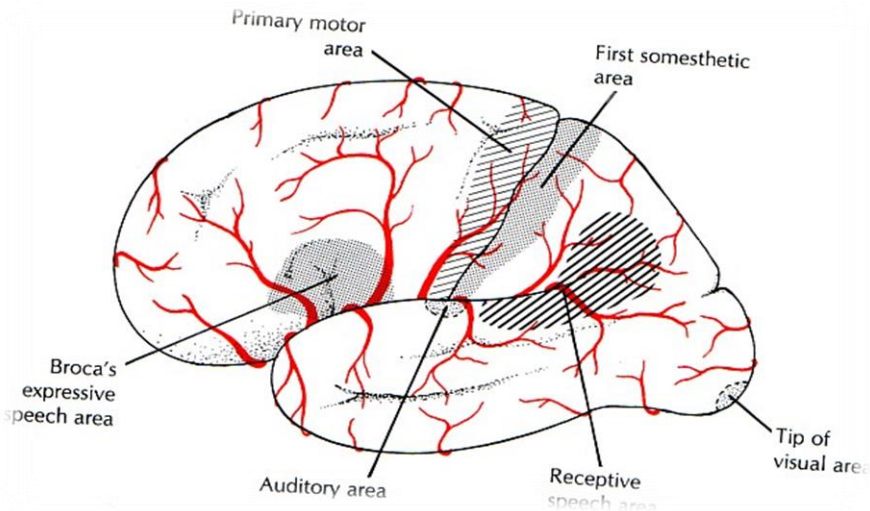




ACCLUSION OF PCA

- **Manifestations:**
  - **Visual disturbances**
    - **Contralateral homonymous hemianopsia**
    - **Bilateral lesions: cortical blindness**
      - ✓ **patients unaware they cannot see (Anton's syndrome)**
  - **Memory impairment**
    - **If temporal lobe is affected**





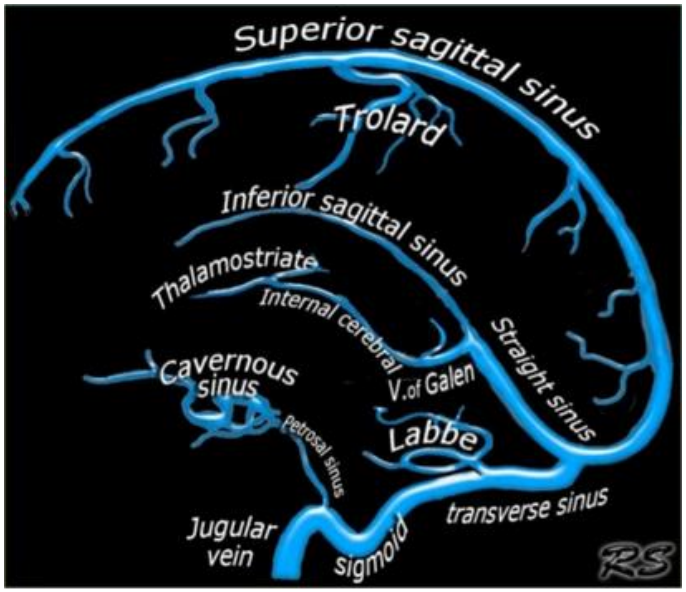
HOW WE ARE DOING ..?

- **Which statement(s) of the following is NOT Wrong?**

- **Anterior cerebral arteries supply Broca's and Wernicke's Area..!!**
- **Occlusion of MCA causes difficulty in Prefrontal lobe's functions..!!**
- **Middle cerebral arteries are part of Willis Circle..!!**
- **Aneurysm is benign tumors derived from cells of the vascular or lymphatic vessel walls..!!**
- **Posterior cerebral arteries supply anterior and inferior temporal lobes..!!**

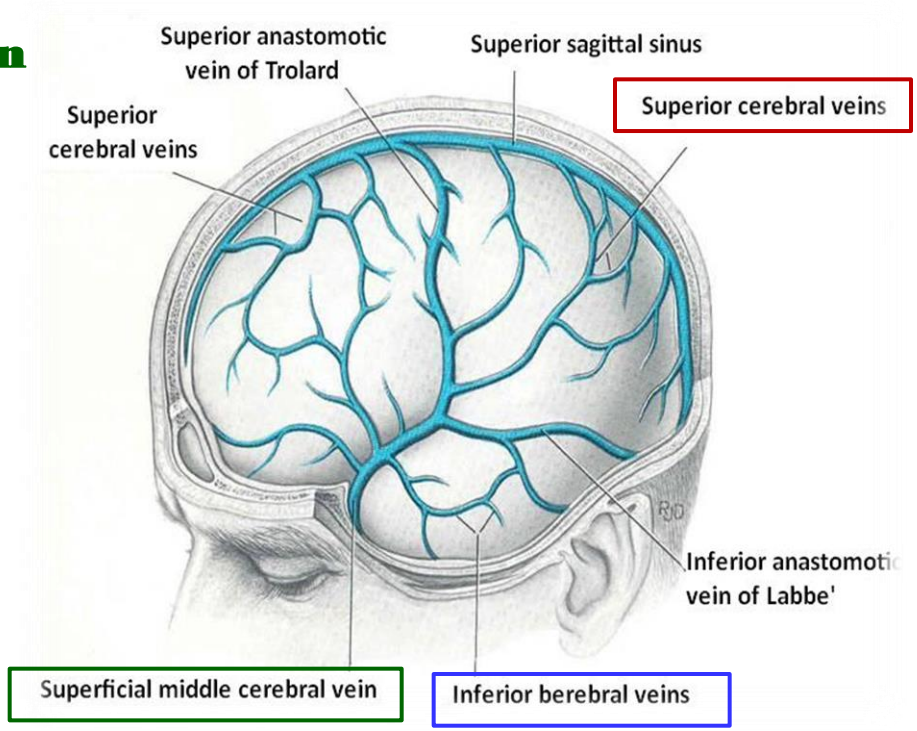
CEREBRAL VENOUS DRAINAGE

- **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.**



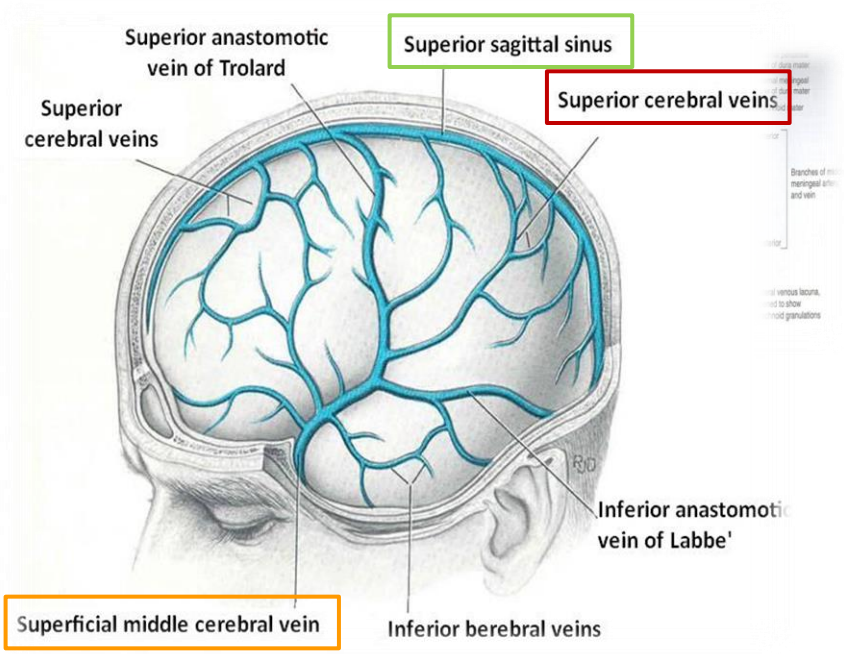
SUPERFICIAL CORTICAL VEINS

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



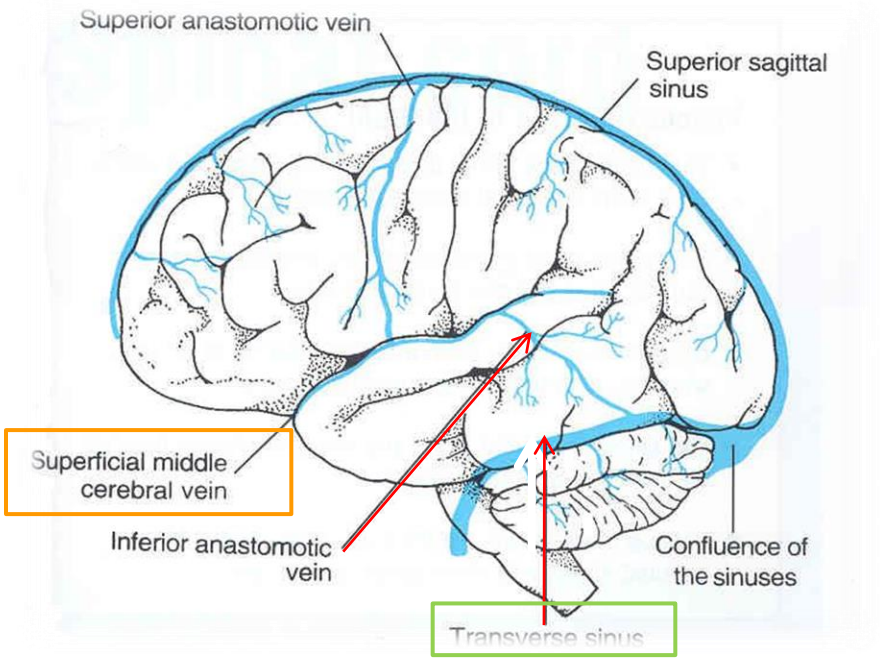
SUPERFICIAL CORTICAL VEINS

- **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.**



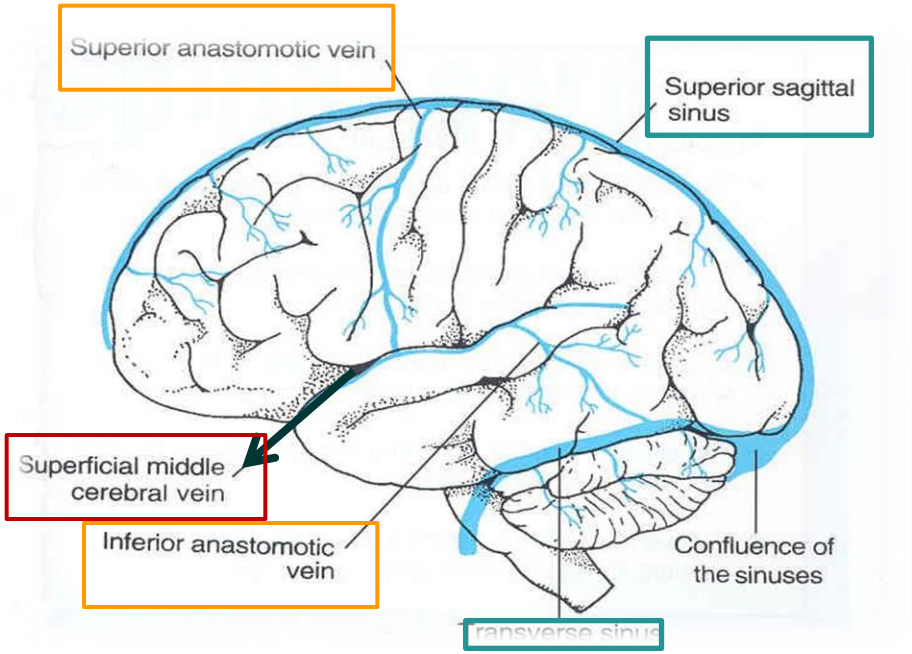
SUPERFICIAL CORTICAL VEINS

- **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.**



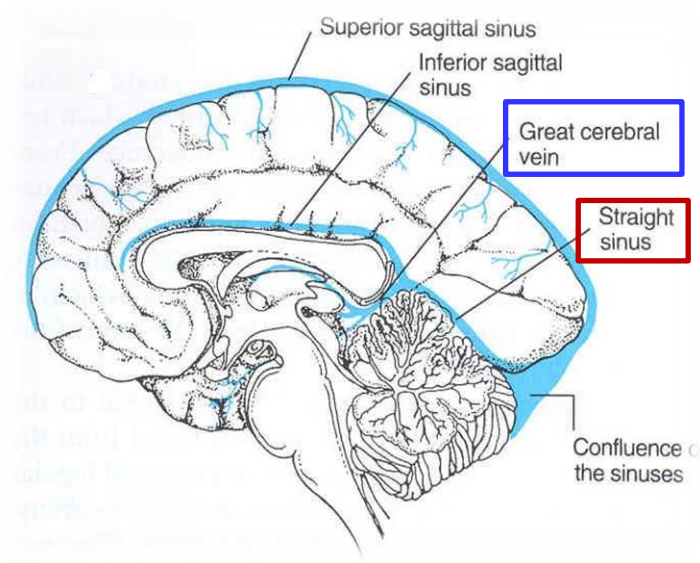
SUPERFICIAL CORTICAL VEINS

- **Superficial Middle Cerebral Vein**
  - **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

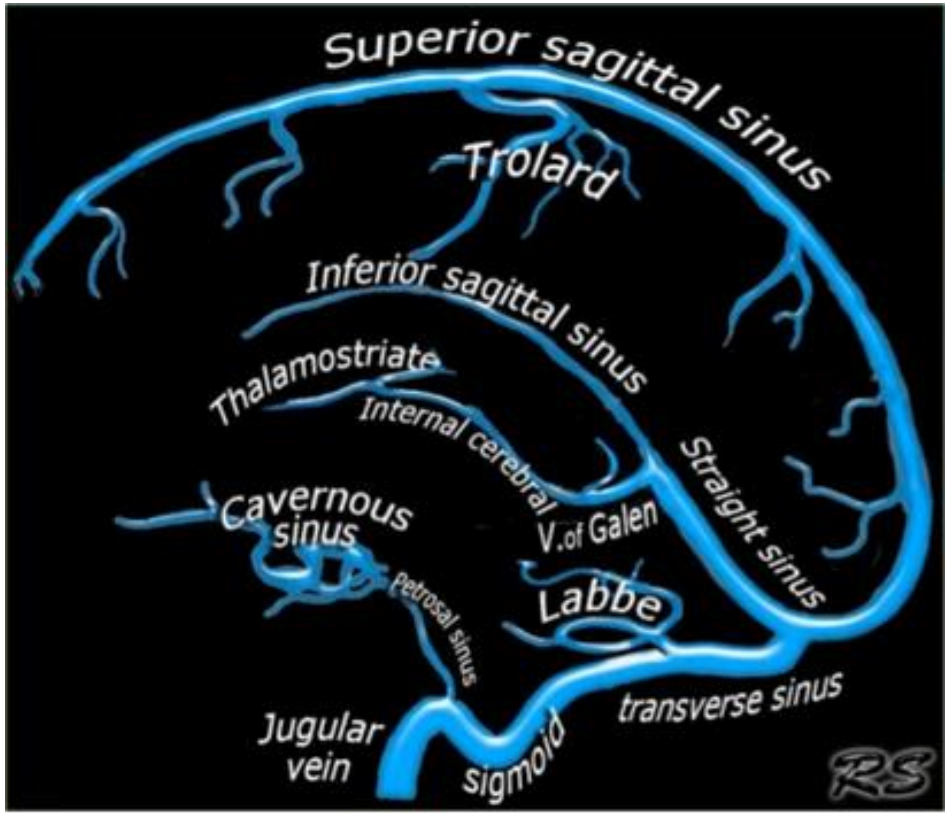
- They drain the internal structures;
  - Basal ganglia
  - Internal capsule
  - Thalamus
- They merge to form the Internal Cerebral Veins.
- The two veins unite in the midline to form the Great Cerebral vein.
- This short vessel is continuous with the Straight Sinus.



DURAL VENOUS SINUSES

Paired

- Transverse
- Sigmoid
- Cavernous
- Petrosal



Single

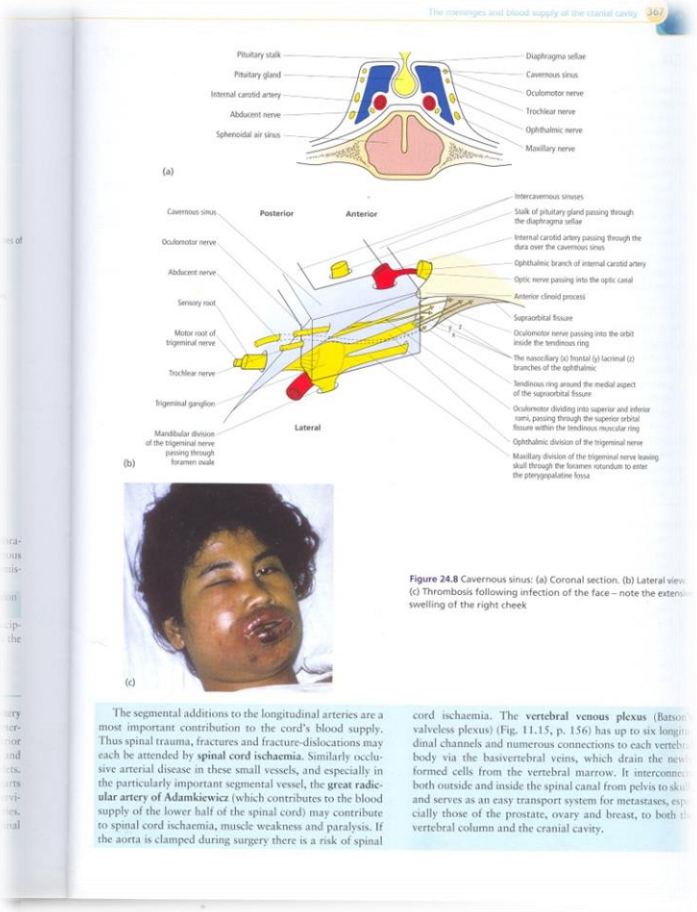
- Superior sagittal
- Inferior sagittal
- Straight
- Occipital

Blood flows from transverse & sigmoid sinuses into IJV

WATCH

VENOUS DISORDER

- **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 thrombosis**
    - Superior Sagittal Sinus
    - Can complicates 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.**



ALSO, HOW WE ARE DOING ..?

- **Which statement(s) of the following is Wrong?**

1. **Superior Cerebral Veins terminate mainly into the Superior Sagittal sinus, and partly into superficial middle cerebral vein..!!**
2. **Infarction refers to tissue death (necrosis)..!!**
3. **Superior Cerebral Veins drain lateral surface of brain above the lateral sulcus..!!**
4. **Inferior Cerebral Veins terminate partly into superficial middle cerebral vein & partly into Transverse sinus..!!**
5. **Superficial Middle Cerebral Vein drains the lateral surface of the temporal lobe..!!**

QUESTION?