

Arterial Blood Supply & Venous Drainage of the Brain

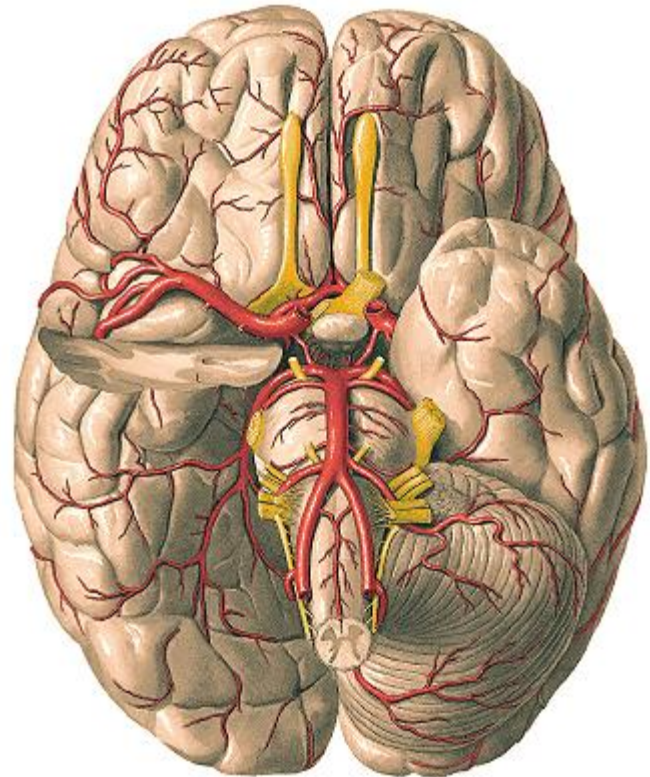
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Lecture outline

- Introduction
- Sources of Blood supply
- Internal carotid artery
- Vertebral artery
- Circle of Willis
- Blood supply to spinal cord
- Introduction to Venous Drainage
- Clinical Anatomy

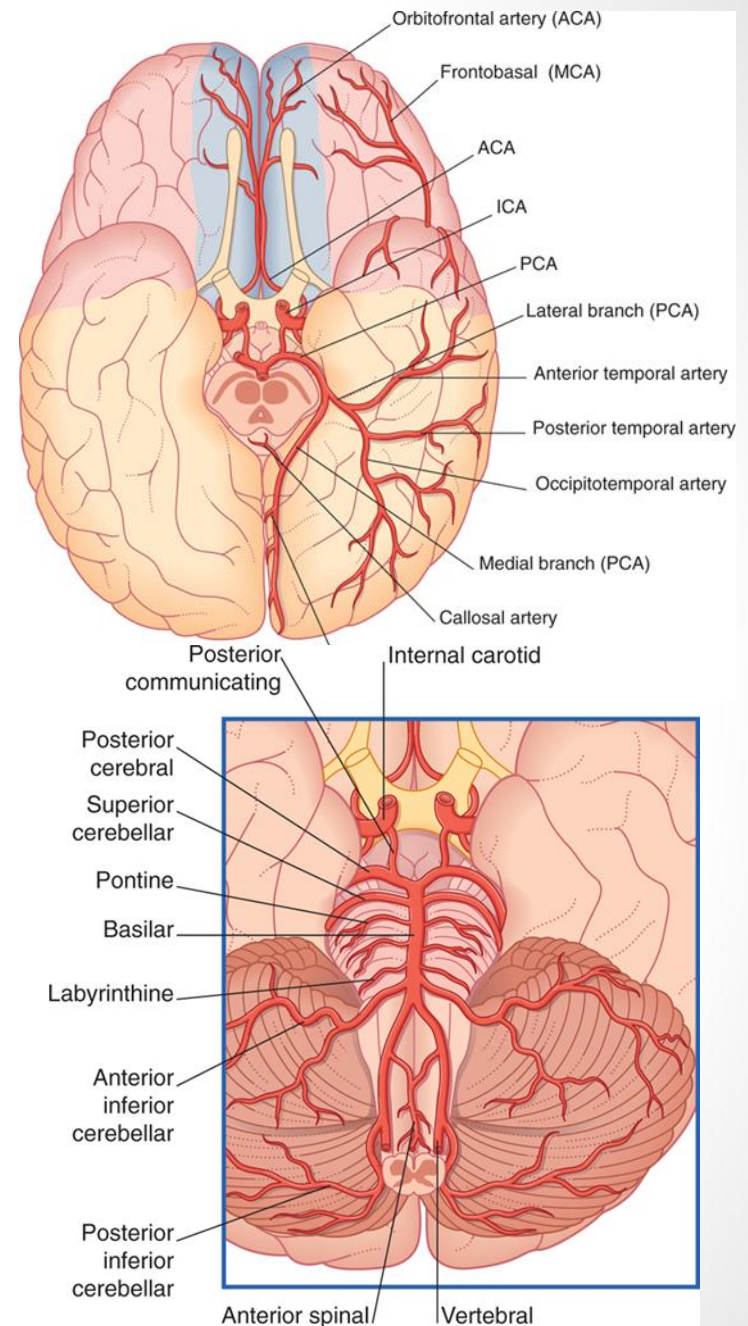
Human Brain

- Weight constitute 2 - 2.5% of body weight
- Receives about 15% or $\frac{1}{6}$ of cardiac output (approx. 750 ml of blood/minute)
- Utilizes approx. 20-25% or $\frac{1}{5}$ of total oxygen of whole body
 - High metabolic rate



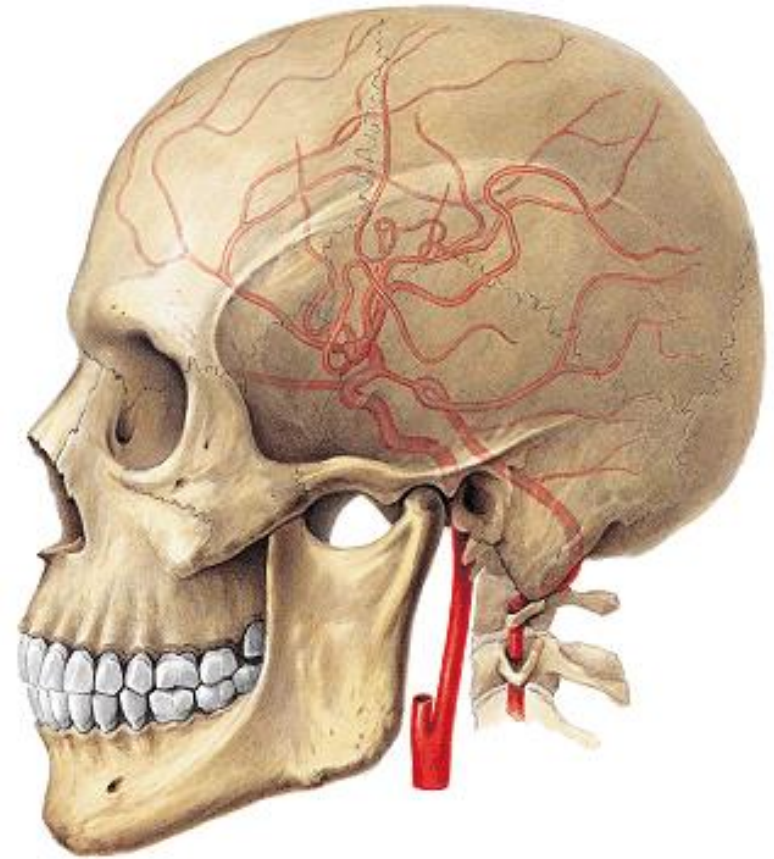
Sources of supply

- 2 pairs of arterial trunks which form a complex anastomosis (circle of Willis)
- Internal carotid artery
 - Forebrain & occipital lobe of cerebrum
- Vertebral artery
 - Occipital lobe, brainstem & cerebellum, upper spinal cord



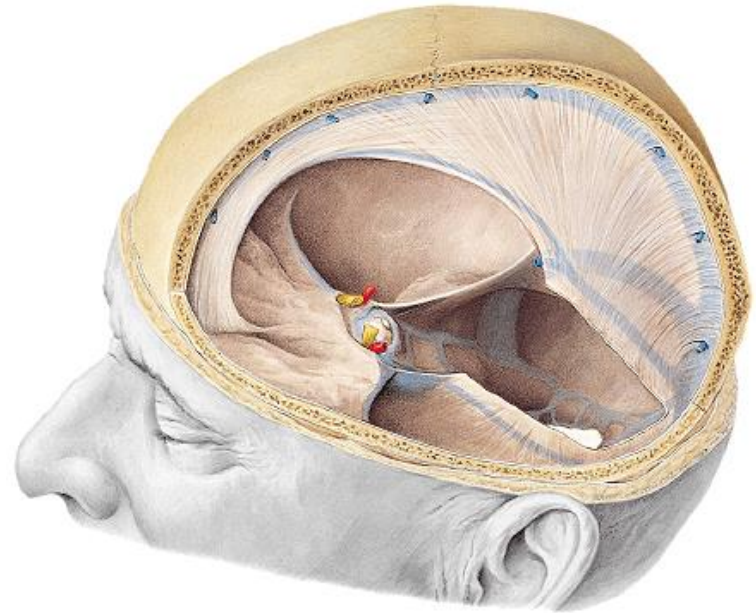
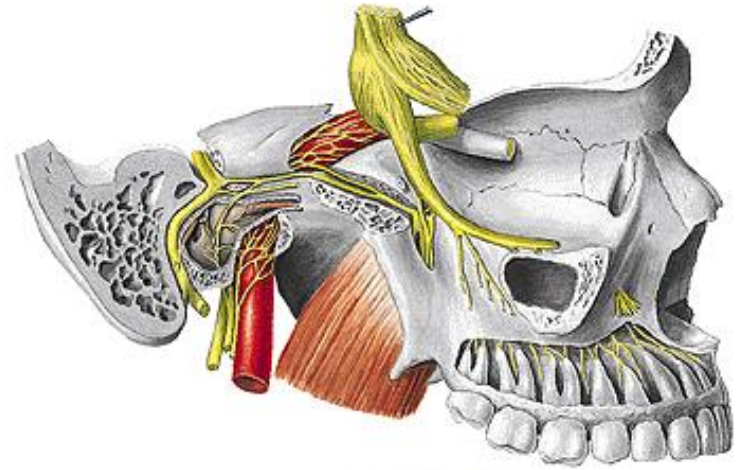
Internal Carotid Artery

- **Origin**
 - Bifurcation of common carotid artery
- **Course**
 - Extracranial part enters cranial cavity via carotid canal
 - Intracranial S-shape curve called carotid siphon
 - Petrous part of temporal bone
 - Side of sphenoid & within cavernous sinus in close relation with CN III, IV, V & VI, reaches base of brain lateral to optic chiasm
 - cerebral course pierces dura mater to reach anterior perforated space



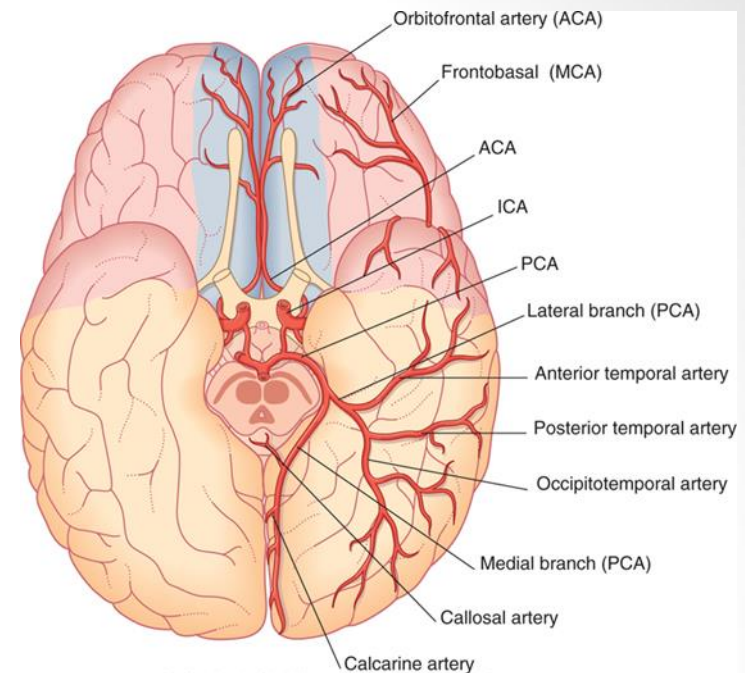
Extracerebral Branches of Internal Carotid Artery

- Petrous part
 - Caroticotympanic to tympanic cavity
 - Pterygoid artery to pterygoid canal
- Cavernous part
 - Cavernous brs
 - Meningeal brs
 - Hypophysial brs
- After cavernous course
 - Ophthalmic to contents of orbital cavity

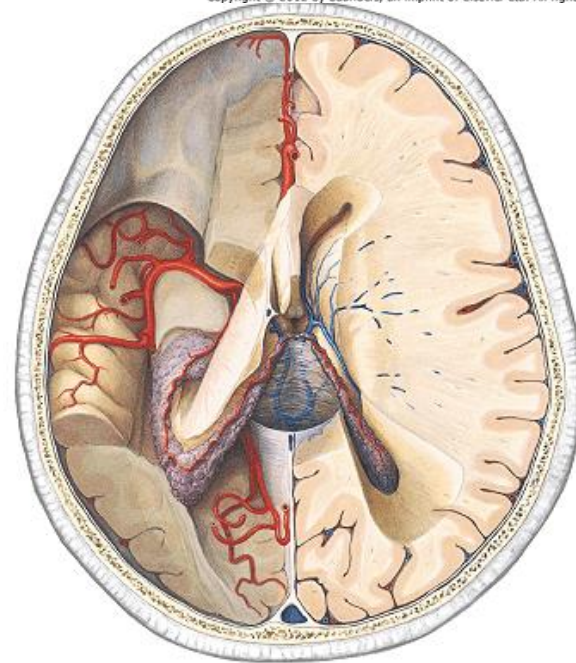


Cerebral branches

- Choroidal
- Anterior cerebral
- Middle cerebral
- **Choroidal**
 - Choroidal plexus, globus pallidus, posterior limb of internal capsule, optic tract and radiation, hippocampus

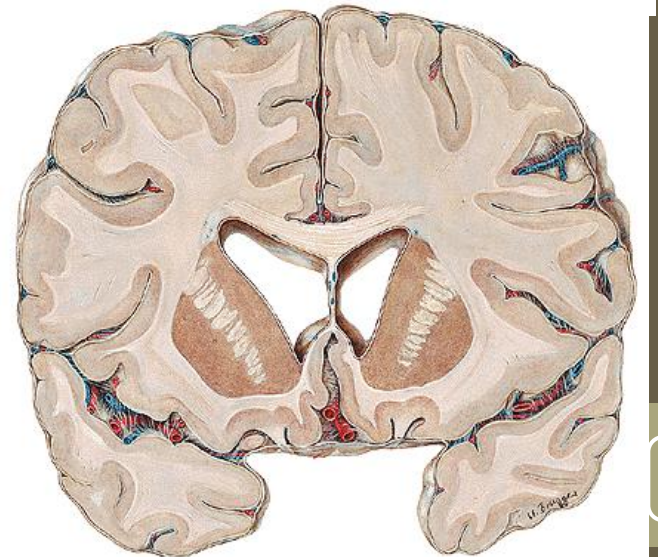
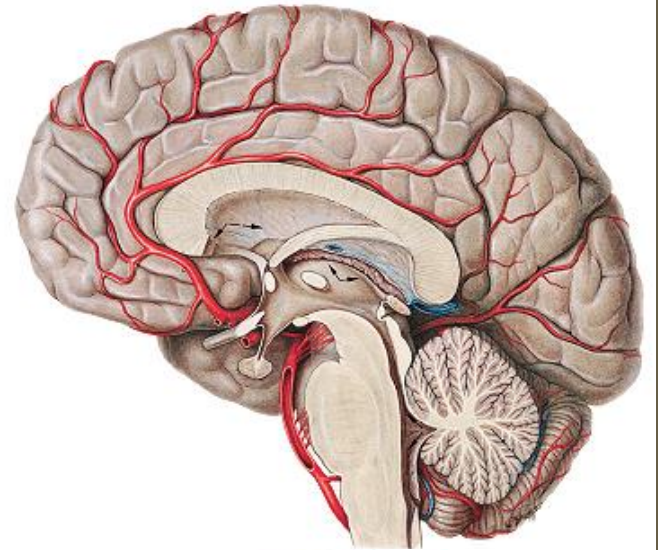


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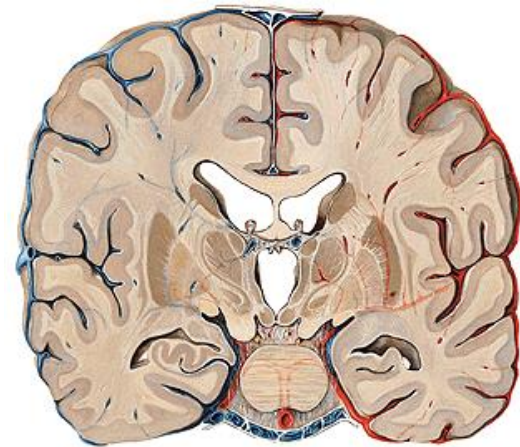
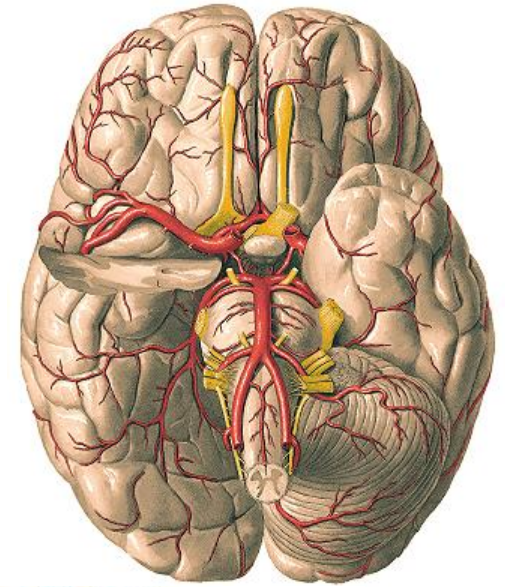
Anterior cerebral

- Smaller terminal br. of ICA
- Cortical branches
 - medial surface & marginal area of superolateral surfaces of cerebrum
- Central branches
 - rostrum of corpus callosum, septum pellucidum, putamen, head of nucleus



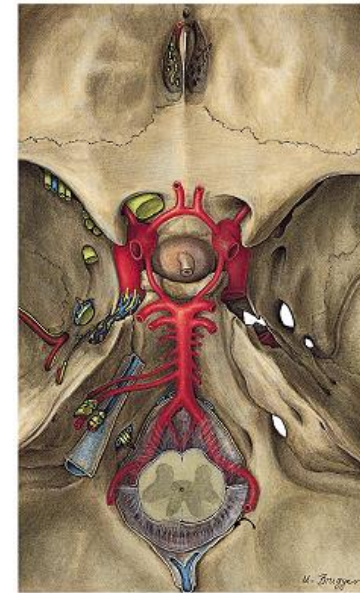
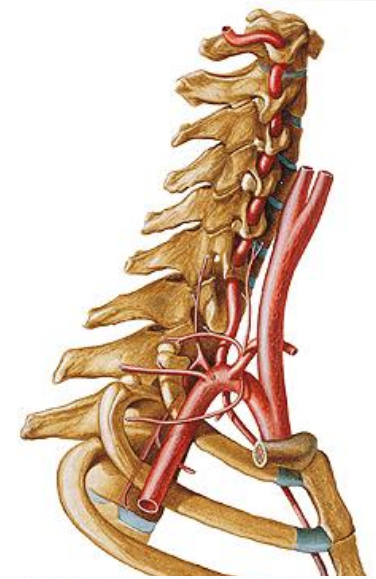
Middle cerebral artery

- Larger terminal branch of ICA
- Cortical:
 - superolateral surface & temporal pole
- Central: 2 sets
 - Medial striate: caudate nucleus, internal capsule, lentiform nucleus
 - Lateral striate: caudate nucleus
 - **Charcot's artery** of cerebral haemorrhage – largest & most frequently ruptured in *apoplexy*
- Posterior communicating



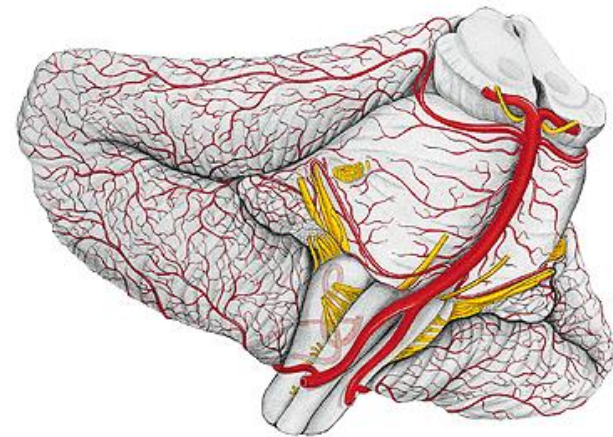
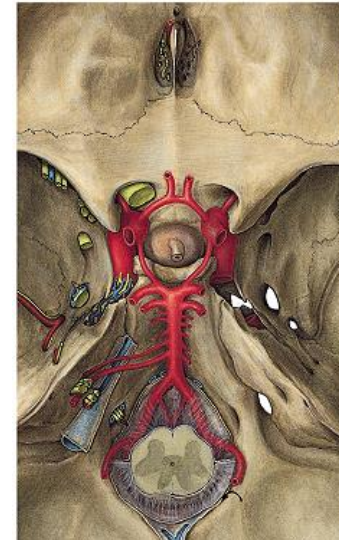
Vertebral Artery

- Origin
 - First part of subclavian artery
- Course
 - Prevertebral, vertebral, atlantic, intracranial
 - Transverse foramen of C6 to C1 vertebrae
 - Foramen magnum
 - Ends at lower border of pons by joining opposite vertebral artery to form basilar artery



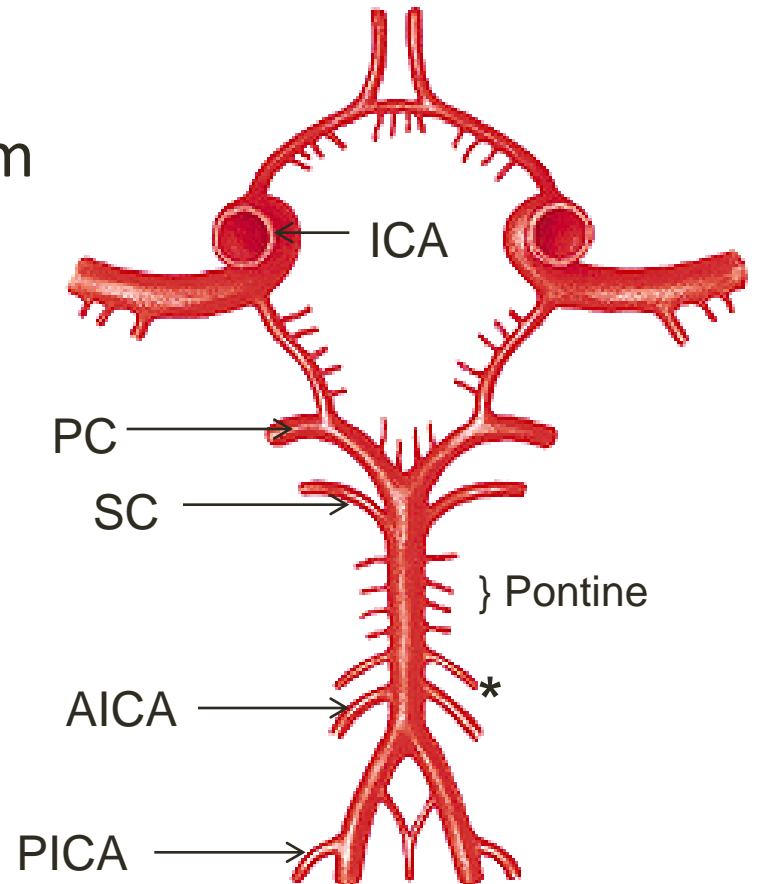
Branches of vertebral artery

- Posterior spinal
 - Dorsal 1/3rd spinal cord & DRGs
- Anterior spinal
 - Ventral 2/3rd spinal cord
- Posterior inferior cerebellar
 - Largest branch & supplies cerebellum
- Medullary
 - Medulla oblongata
- Basilar
 - Formed by union of vertebral arteries



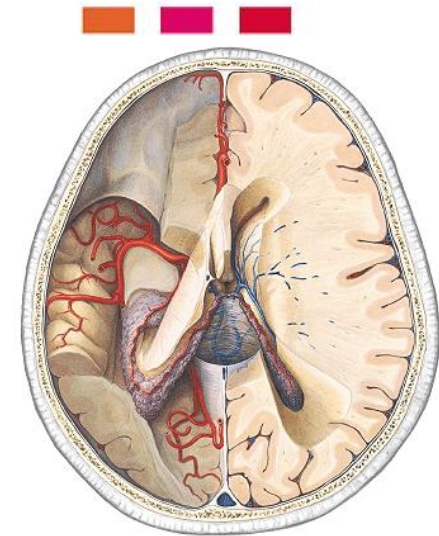
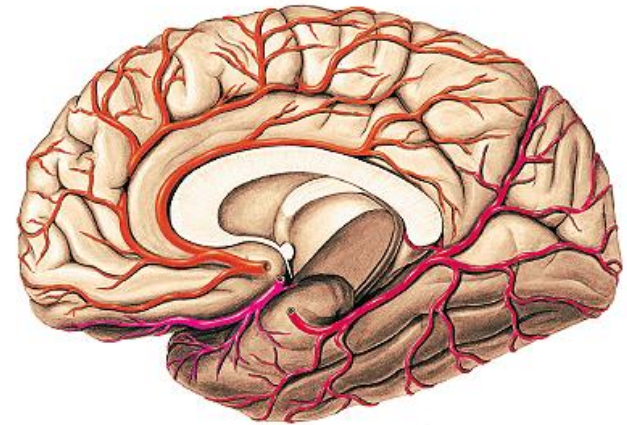
Branches of Basilar artery

- Anterior inferior cerebellar (AICA)
 - Inferior surface of cerebellum
- *Labyrinthine (internal auditory)
 - Internal ear
- Pontine
 - pons
- Superior cerebellar (SC)
 - Superior surface of cerebellum and anastomose with AICA
- Posterior cerebral (PC)



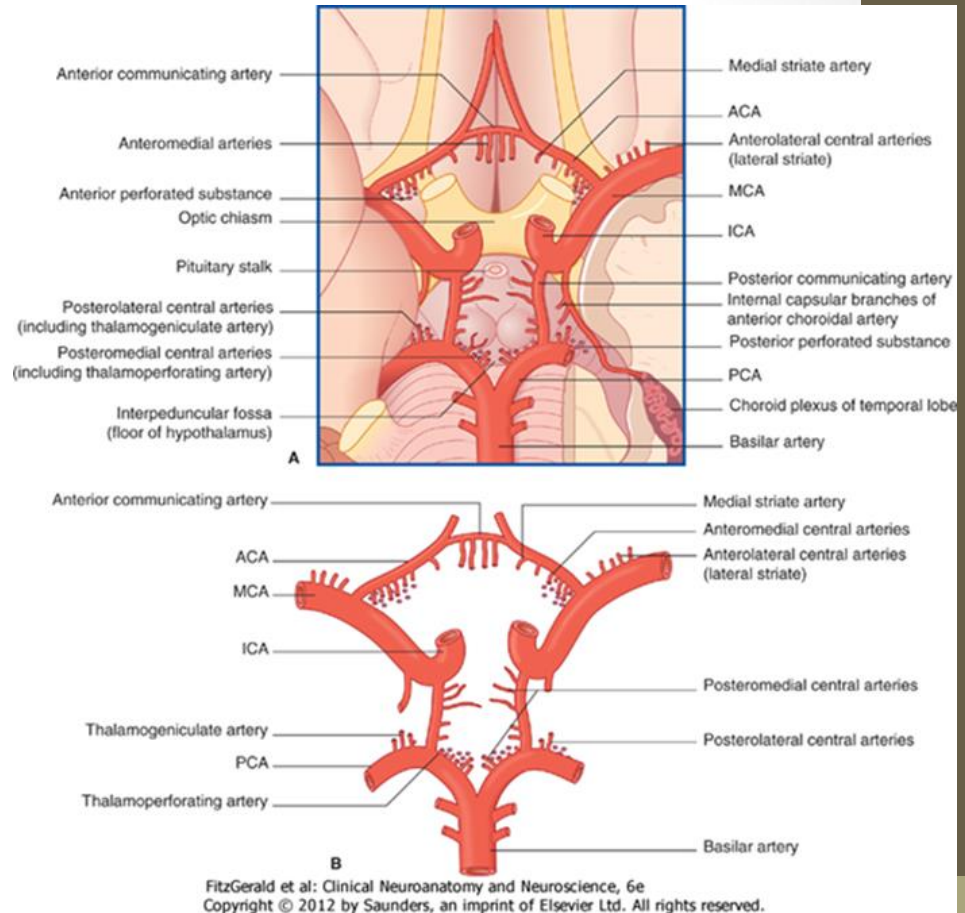
Posterior cerebral

- Terminal br. of basilar
- Cortical
 - inferior surface of cerebrum, occipital pole (visual cortex)
- Central
 - thalamus, 3rd ventricle, globus pallidus
- Posterior choroidal
 - choroid plexus of lateral ventricle, thalamus, fornix & tectum of midbrain



Circle of Willis

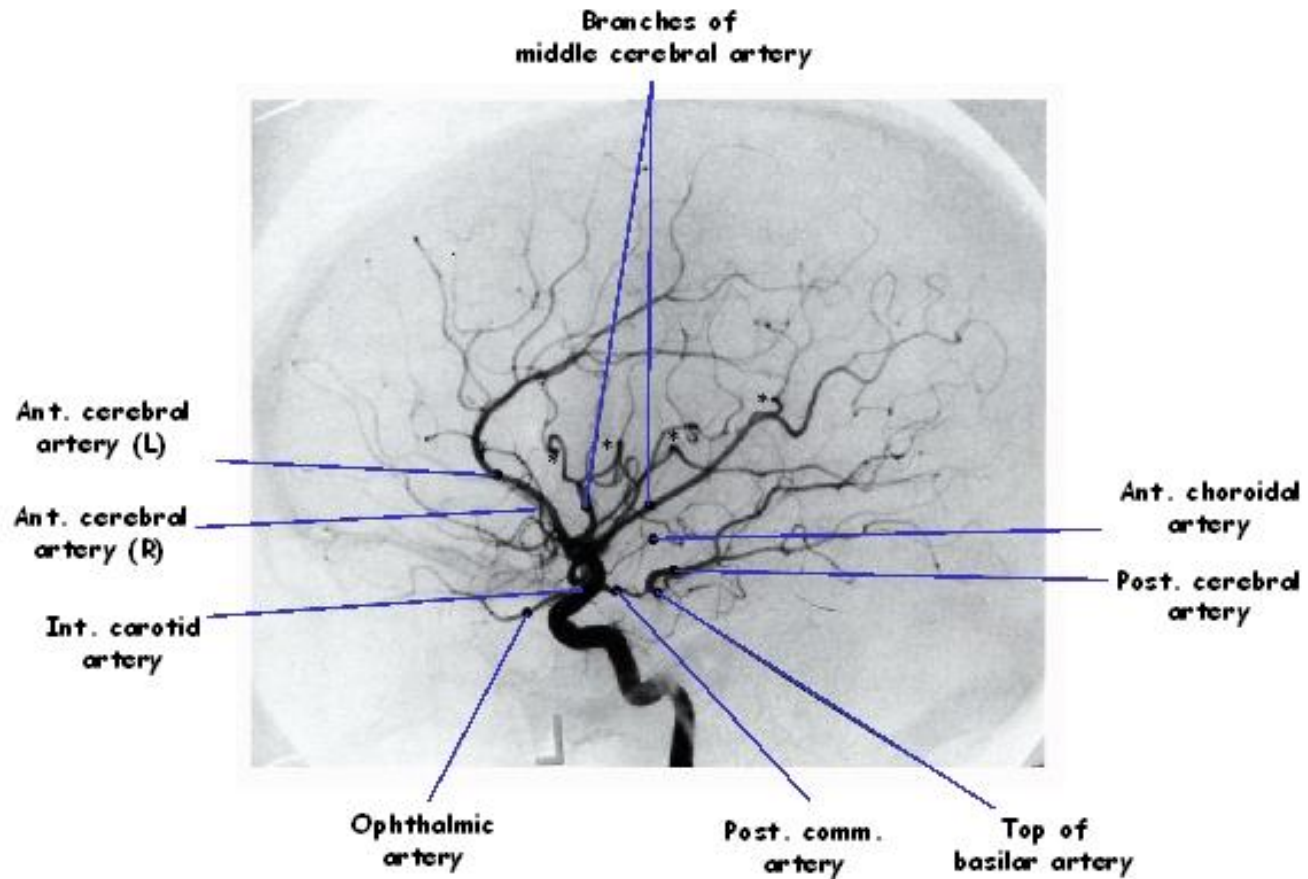
- Arterial anastomosis connecting vertebrobasilar & internal carotid systems
- Location:
 - Base of interpeduncular fossa
- Branches Involved
 - Anterior communicating
 - Anterior cerebral
 - Internal carotid
 - Posterior communicating
 - Posterior cerebral



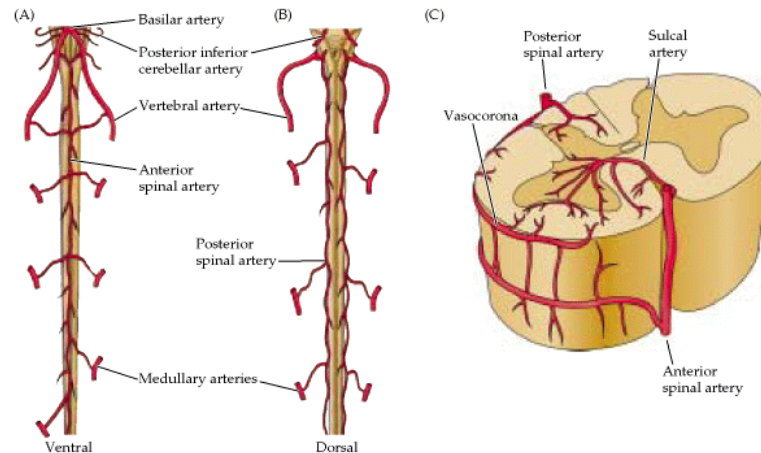
Importance of circle of Willis

- Serves to equalise blood flow to various parts of brain
 - maintaining a constant supply of oxygen & glucose even when a contributing artery is narrowed or in head movements
- Furnishes collateral circulation in cases of occlusion of one or more of arteries contributing to circle

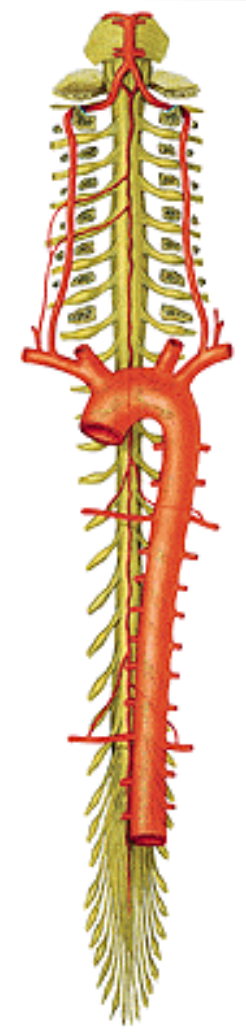
Brain angiogram



Blood supply to spinal cord

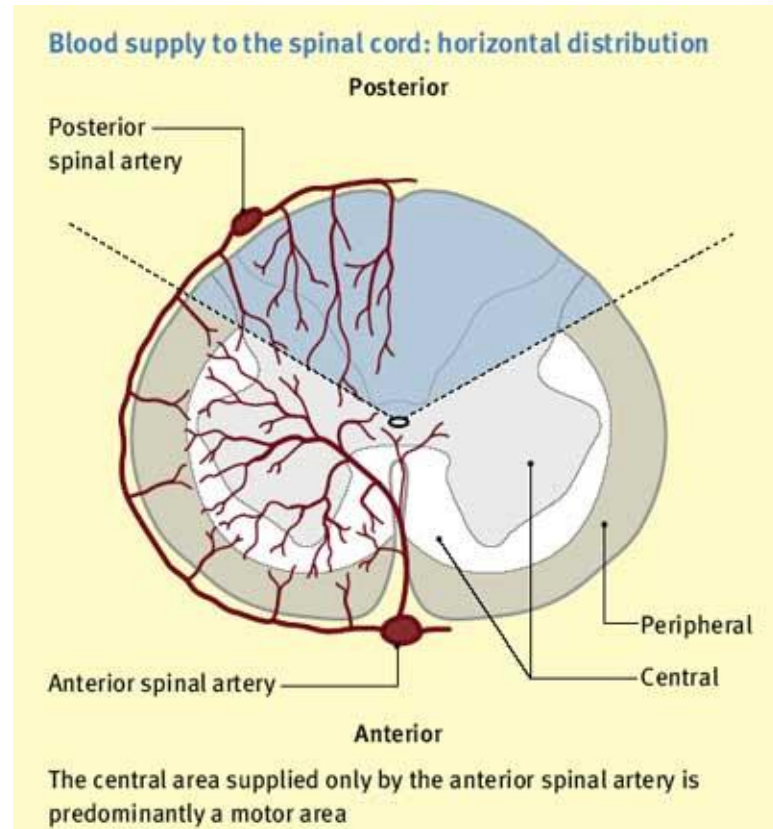


- At medulla, vertebral arteries give off anterior spinal artery (ASA)
- 10 to 12 segmental (medullary) arteries (brs of aorta) join anterior spinal artery
- Vertebral arteries (or PICA) give rise to paired posterior spinal arteries (PSA) that run along dorsal surface.



Disorder of blood supply to spinal cord

- Most vulnerable in thoracic region & anterior part of spinal cord
- Occlusion of anterior spinal artery leads to acute thoracic cord syndrome with paraplegia & incontinence



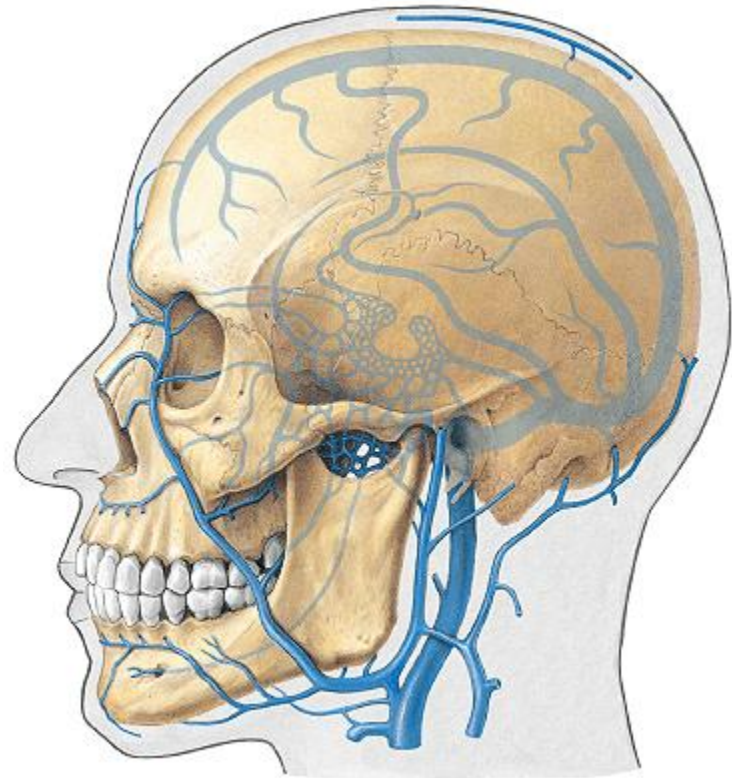
Venous Drainage of brain

Characteristic Features

- No valves
- Extremely thin walls
- Lack muscular tissue in tunica media
- Pierce arachnoid mater & inner layer of dura mater
- End in dural venous sinuses

Three sets of veins

- Superficial veins
- Deep veins
- Dural venous sinuses



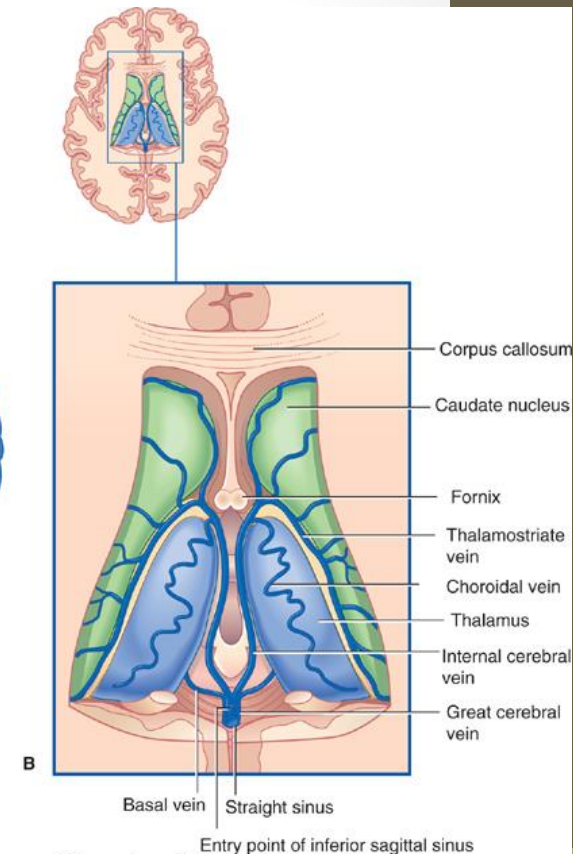
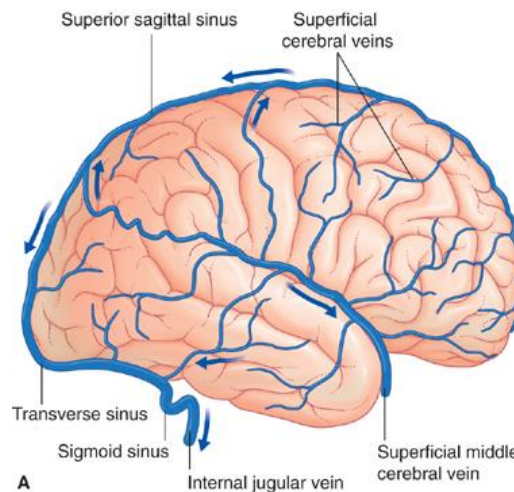
Superficial & Deep veins

- **Superficial veins** within subarachnoid space

- Superior cerebral - SSS
- Superficial middle cerebral – CS
- Inferior cerebral - empty into SSS, TrS & SS
- Superior & inferior cerebellar into TrS & SS

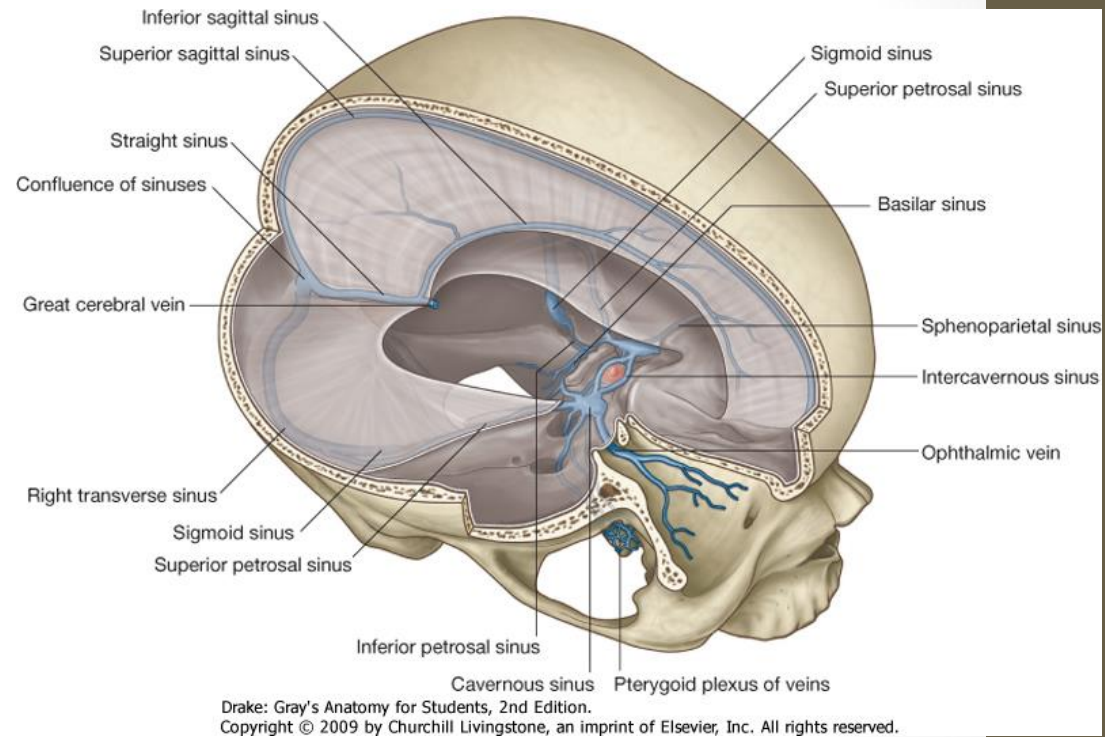
- **Deep veins**

- Thalamostriate + choroidal = internal cerebral (2) + basal = great cerebral (of Galen) + ISS = straight sinus



Dural Venous Sinus

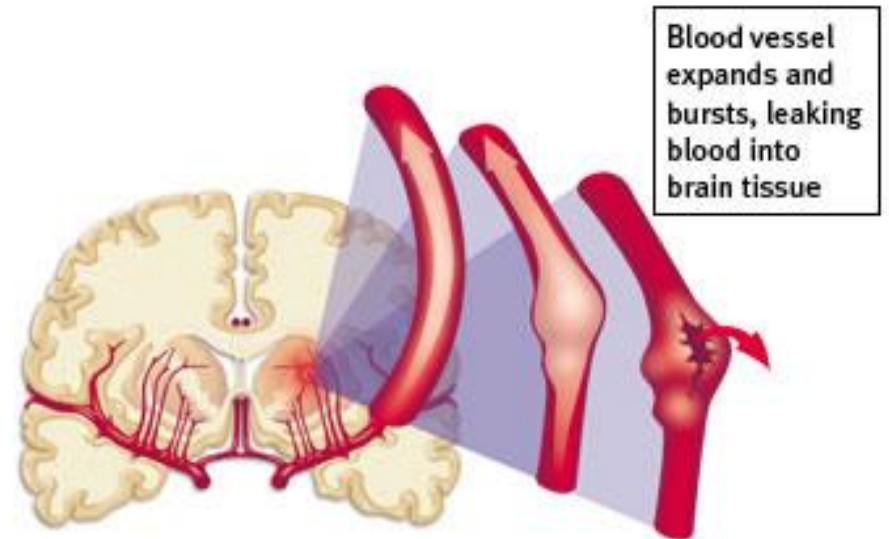
- Between the 2 layers of dura mater
- Namely
 - Superior sagittal sinus
 - Inferior sagittal sinus
 - Straight sinus
 - Transverse sinus
 - Occipital sinus
 - Cavernous & intercavernous sinus
 - Superior petrosal sinus
 - Inferior petrosal sinus



Review location, termination and whether single or paired

Clinical Anatomy

- One of the most common cause of neurological disability is **Stroke** (Ischemic or hemorrhagic)
 - Sudden occlusion of a cerebral artery leading to death of brain tissue (Infarction)
- Cerebral haemorrhage
- **Aneurysm** – abnormal balloon-like swelling of an artery which may rupture & blood enters subarachnoid space (subarachnoid haemorrhage) or into brain (intracerebral haemorrhage)



Questions

- Use a well labelled diagram to show the branches of the arterial blood supply to the brain
- Enumerate the branches involve in the 'Circle of Willis'. Add a note on the clinical significance of the Circle of Willis
- Draw a diagram of the cerebral hemispheres showing the areas supplied by the cerebral arteries
- Describe the blood supply to the spinal cord
- What are the characteristic features of the veins of the brain.
- How is the great cerebral vein (of Galen) formed and where does it terminate
- List the dural venous sinuses