



Revised & Approved



Abdullah Alsubaihi  
Rania Almutiri



MED439  
KING SAUD UNIVERSITY

Anatomy Team  
MED 439

# Anatomy of the Cerebral Blood Circulation

CNS Block

Color index:

Content  
Male slides  
Female slides  
Important  
Doctors notes

Extra information, explanation

Don't forget to check the [Editing File](#)

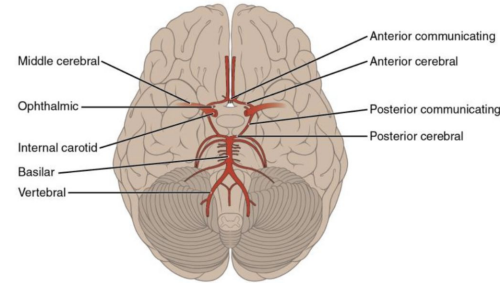
Contact us:  
[Anatomy439@gmail.com](mailto:Anatomy439@gmail.com)

# 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.
- Clinical manifestations of arterial & venous vascular disorders.

- ❖ 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.



## Blood Vessels

### 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.

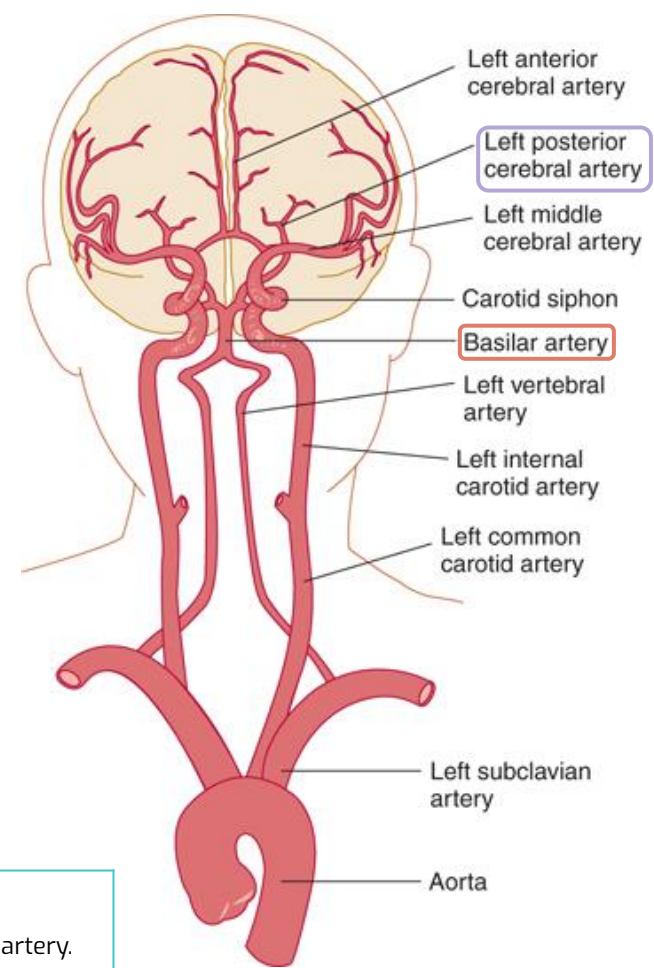
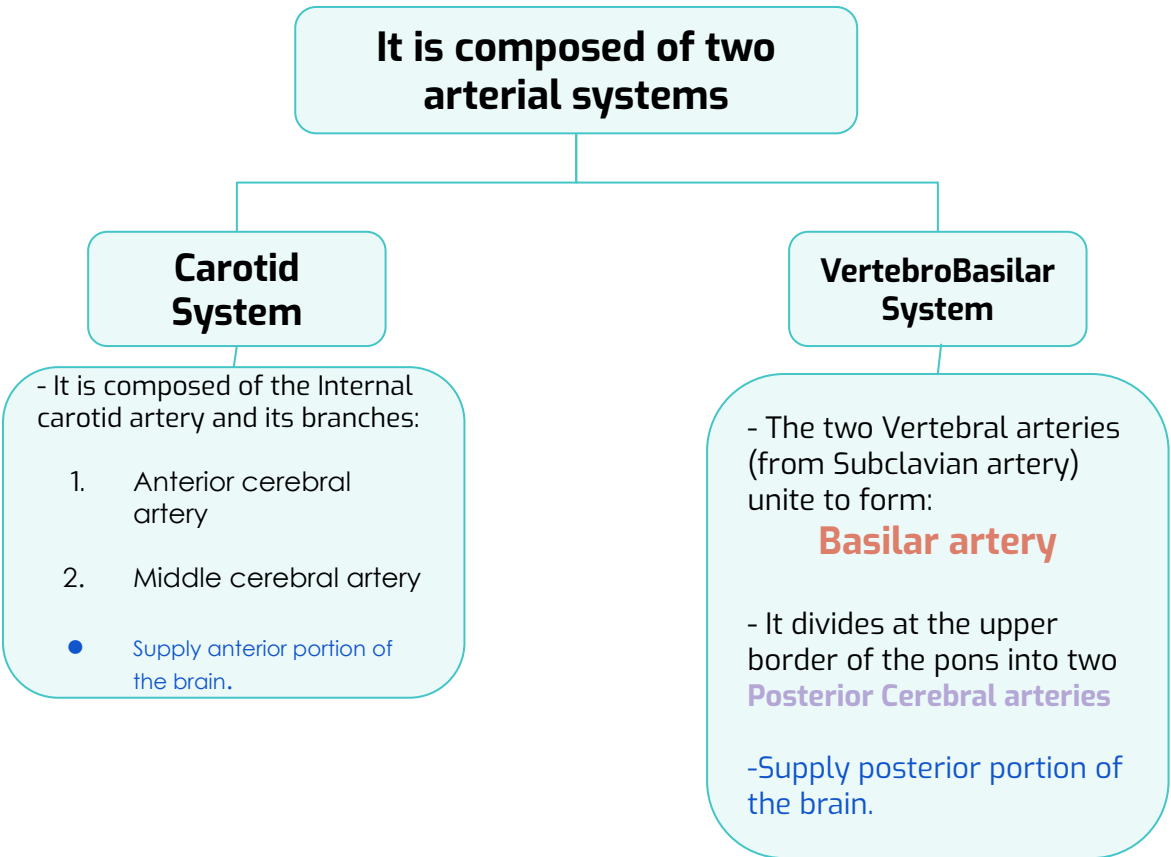
### Blood

. 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.

Most important, plasma contains proteins that carry important nutrients to the body's cells and strengthen the body's immune system.

. Plasma contains also salts, glucose and other substances.  
. Capillaries consist of little more than a layer of endothelium and occasional connective tissue.

# Cerebral Arterial Supply



## Only Boys slides

<b>Basilar Artery</b>	<p><b>Supplies:</b> Midbrain and Cerebellum</p> <p><b>Branches:</b> Anterior inferior cerebellar artery. -Pontine branches. -Superior cerebellar artery.</p>
<b>Vertebral Arteries</b>	<p><b>Originates:</b> Subclavian arteries</p> <p><b>Supplies:</b> Spinal Cord and Cerebellum</p> <p><b>Branches:</b> Anterior and posterior spinal arteries. - Posterior inferior cerebellar artery</p>

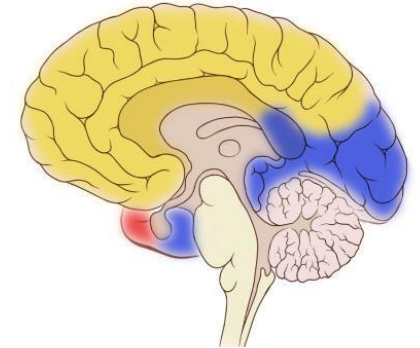
**Note: (important)**  
**Anterior inferior** Is a branch from the basilar artery  
**Posterior inferior** is a branch from the vertebral artery

# Blood Supply

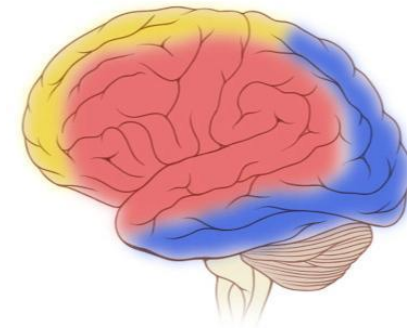
Origin	Internal carotid artery		Basilar artery
Branch	Anterior Cerebral Artery (ACA)	Middle Cerebral Artery (MCA)	Posterior Cerebral Artery (PCA)
Supplies	<ul style="list-style-type: none"> <li>- Orbital and medial surfaces of the frontal and parietal lobes</li> <li>- A narrow part on the superolateral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

## Distribution of cerebral arteries

Medial view



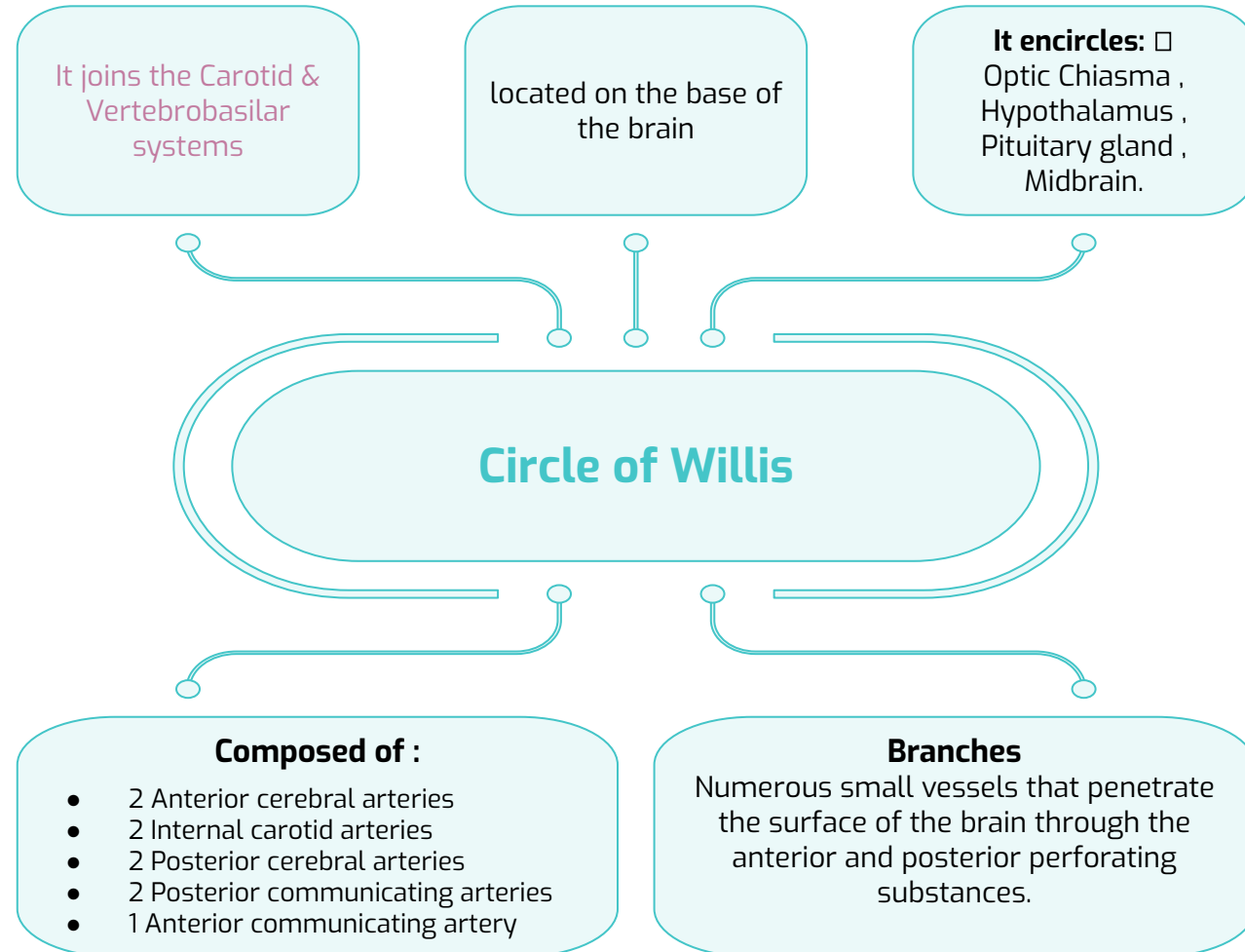
Lateral view



- Posterior cerebral artery
- Middle cerebral artery
- Anterior cerebral artery

# Circulus Arteriosus (of Willis)

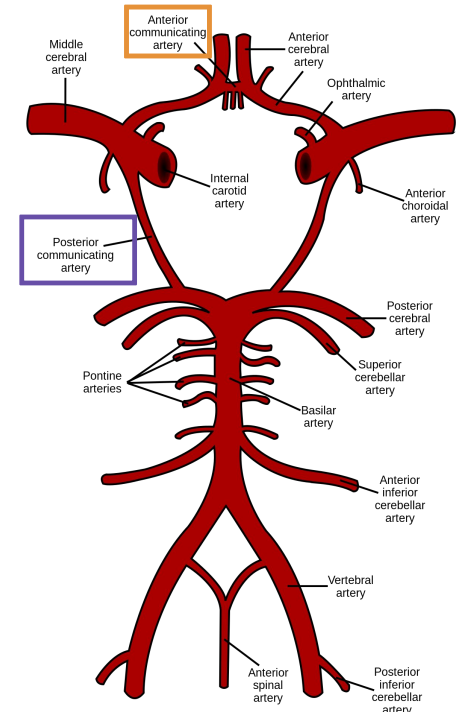
- ❖ The arterial cerebral circulation is divided into anterior and posterior cerebral circulations.
- ❖ The anterior and posterior cerebral circulations are interconnected via bilateral posterior communicating arteries



## Note:

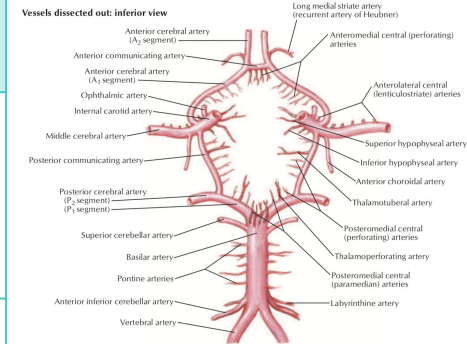
The 2 **posterior communicating arteries** connect the **posterior cerebral arteries** with the **internal carotid arteries**.

(As shown in the yellow box bellow)



# Circulus Arteriosus (of Willis)

	Anterior Perforating arteries (APA)	Posterior Perforating arteries (PPA)
<b>Arise from</b> <small>Male slides only</small>	<ul style="list-style-type: none"> <li>Anterior cerebral artery</li> <li>Anterior communicating artery</li> <li>Middle cerebral artery</li> </ul>	<ul style="list-style-type: none"> <li>Posterior cerebral artery</li> <li>Posterior communicating artery: Located in the base of the brain. It encircles optic chiasma, hypothalamus &amp; midbrain</li> </ul>
<b>Enter brain through</b> <small>Male slides only</small>	<ul style="list-style-type: none"> <li>Anterior perforated substance irregularly quadrilateral area in front of the optic tract and behind the olfactory trigone.</li> </ul>	<ul style="list-style-type: none"> <li>Posterior Perforated substance</li> </ul>
<b>Supply</b>	<ul style="list-style-type: none"> <li>Large part of Basal Ganglia</li> <li>Optic chiasma</li> <li>Internal capsule</li> <li>Hypothalamus</li> </ul>	<ul style="list-style-type: none"> <li>Ventral portion of Midbrain</li> <li>parts of Subthalamus</li> <li>Hypothalamus</li> </ul>



**Note:**

The anterior communicating artery connects the 2 anterior cerebral arteries together.

(as shown in the blue box above)

## Arterial disorders:

### Stroke

Sudden occlusion of the blood supply.

It can be:

1. Hemorrhagic
2. Ischemic

### Aneurysm

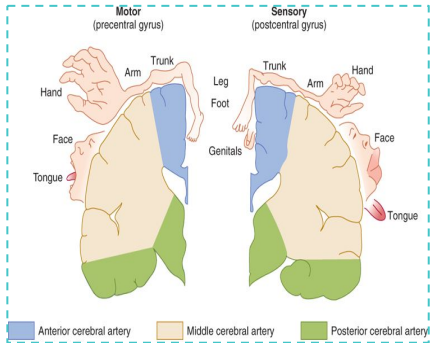
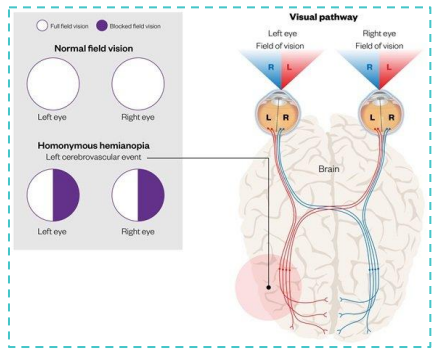
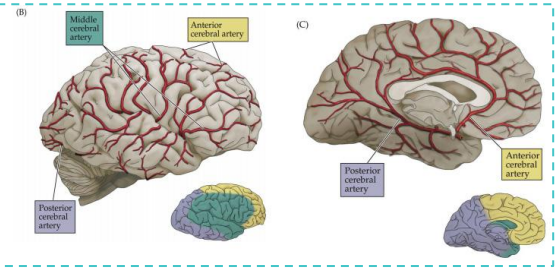
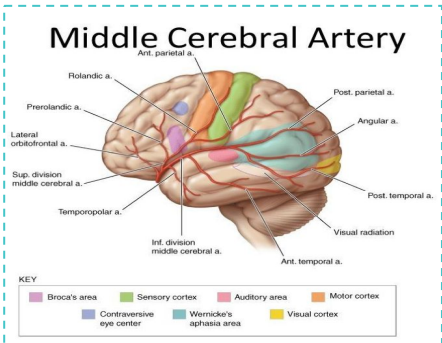
It localized, blood-filled balloon like bulge in the wall of a blood vessel

### 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

# Effect of Occlusion of Cerebral arteries

Anterior cerebral	Middle cerebral	Posterior cerebral
<p>1. <b>Motor &amp; sensory</b> disturbances in the contralateral distal leg.</p> <p>2. Difficulty in the <b>Prefrontal lobe</b> functions:</p> <ul style="list-style-type: none"> <li>• Cognitive thinking,</li> <li>• Judgment</li> <li>• Motor initiation</li> <li>• Self monitoring</li> </ul>	<p>1. Contralateral <b>weakness</b> of: Face, Arm, Hand &amp; leg</p> <p>2. Contralateral <b>sensory loss</b> of: Face, Arm &amp; Hand &amp; leg</p> <p>3. Visual field cut (damage to optic radiation)</p> <p>4. Aphasia (language disturbances )</p> <ul style="list-style-type: none"> <li>• Broca's: production</li> <li>• Wernicke's: comprehension</li> </ul>	<p>1. Visual disturbances</p> <ul style="list-style-type: none"> <li>• Contralateral homonymous hemianopia</li> <li>• In Bilateral lesions: Cortical Blindness, patients unaware they cannot see (Anton's syndrome)</li> </ul> <p>2. Memory impairment If the temporal lobe is affected.</p>





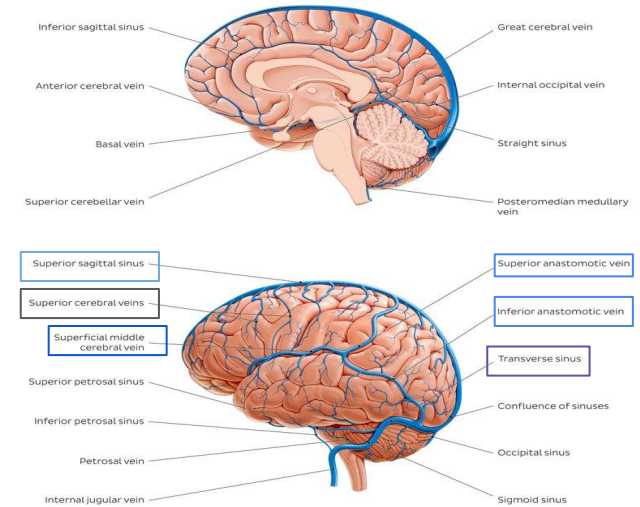
# Cerebral Venous Drainage

## Cortical Veins:

(A) Superficial: found in the Subarachnoid space, Drain the cortical surfaces.

(B) Deep veins: Drain the deeper structures.

□ These veins are thin walled and devoid of valves. □ They ultimately drain into the □ **Dural Venous Sinuses**



## Superficial Cortical Veins

- ❖ Lie on the brain surface, in the subarachnoid space
- ❖ They are divided into:

# 1

### Superior Cerebral Veins (6-12 veins)

- Drain lateral surface of brain **above** the lateral sulcus.
- Terminate mainly into the **Superior Sagittal sinus**, and partly into Superficial middle cerebral vein.

# 2

### 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**.

# 3

### Superficial middle cerebral vein

- Runs **along** the lateral sulcus.
- Terminates into the Cavernous sinus.
- It is connected posteriorly through **Superior & Inferior anastomotic veins** to **Superior Sagittal & Transverse sinuses respectively**

# Deep Cerebral Veins

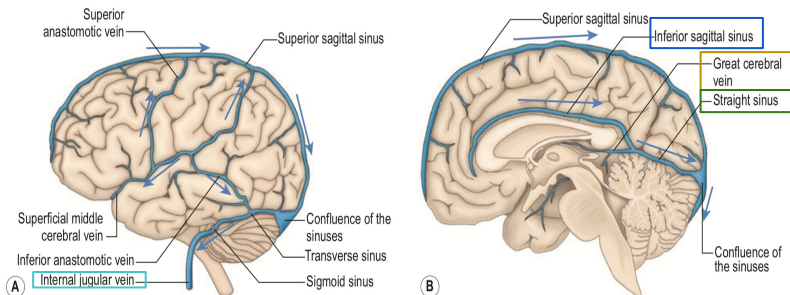
Drain the internal structures  
(basal ganglia, internal capsule, thalamus)

They merge to form two Internal Cerebral Veins. The two veins unite in the midline

to form the **Great Cerebral vein**.

This short vessel joins **Inferior Sagittal sinus**

They form the **Straight Sinus**



# Venous Disorders

Female slides only

**Infarction:** Refers to tissue death (necrosis) that is caused by a localized lack of oxygen due to an obstruction in blood supply.

**Sinus thrombosis:**  Superior sagittal sinus thrombosis can complicate ear infection.

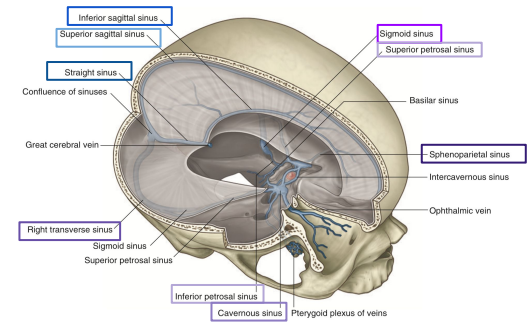
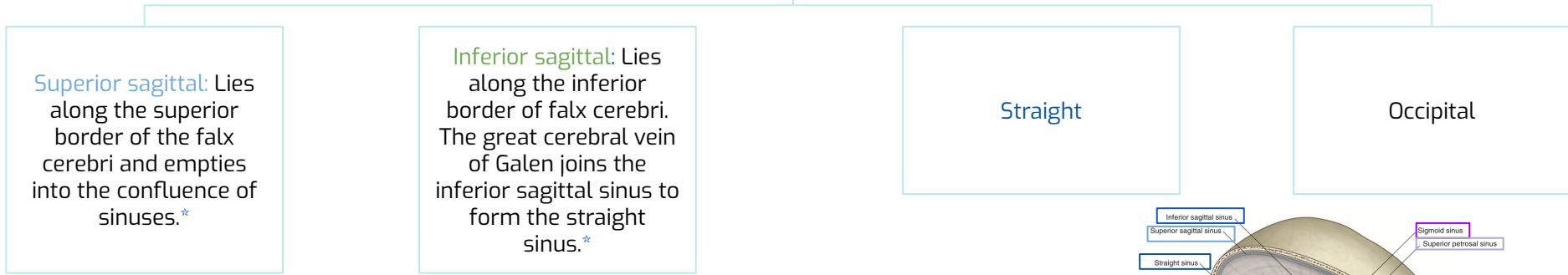
**Cavernous Superior sagittal sinus** (as a complication of infection in the dangerous area of the face).

**Obstruction of venous drainage of the brain** leads to Cerebral edema and raised ICP.

# Dural venous sinuses

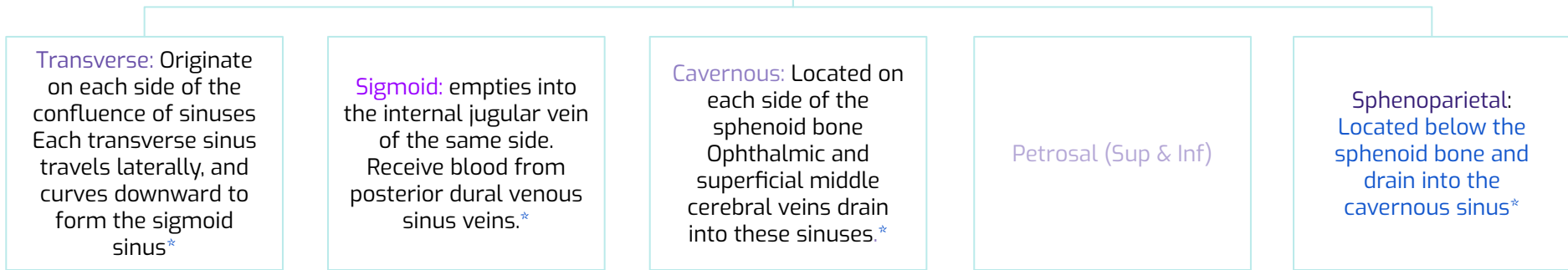
- ❖ The final drainage of venous blood
- ❖ Blood flows from transverse & sigmoid sinuses into **Internal jugular vein**
- ❖ **Confluence of Sinuses:** Where the superior sagittal, straight, transverse, and occipital sinuses join

## Single sinuses



\* explanation in males' slides only

## Paired sinuses



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.

# MCQ

**Q1: Vertebral artery is a branch of which of the following arteries ?**

**A: Subclavian artery**

**B: Internal carotid arteries**

**C: Middle cerebral artery**

**D: Anterior cerebral artery**

**Q2: Broca's Area is supplied by ?**

**A: Anterior Cerebral Artery**

**B: Middle Cerebral Artery**

**C: Posterior Cerebral Artery**

**D: Basilar artery**

**Q3: All of the following are the composition of circle of willis except ?**

**A: Anterior cerebral arteries**

**B: Posterior cerebral arteries**

**C: Anterior communicating artery**

**D: Middle cerebral artery**

**Q4: Which of the following arteries is supplied by Posterior Cerebral Artery ?**

**A: Uncus**

**B: Motor Cortex**

**C: Medial surfaces of the parietal lobes**

**D: Internal capsule**

**Q5: Circulus Arteriosus (of Willis) is located in which of the following ?**

**A: Apex of the brain**

**B: Base of the brain**

**C: Superolateral surface of the brain**

**D: Midbrain**

**Q6: Which of the following arteries is supplied by Posterior Perforating arteries ?**

**A: Basal Ganglia**

**B: Optic chiasma**

**C: Hypothalamus**

**D: Internal capsule**

Answer key:

1 (A) , 2 (B) , 3 (D) , 4 (A) , 5 (B) , 6 (C)

**Q7: All of the following is an effect of occlusion of the middle cerebral artery EXCEPT for:**

**A: Contralateral weakness of face**

**B: Contralateral sensory disturbances in the leg**

**C: Homonymous hemianopia**

**D: Aphasia**

**Q8: Which vein runs along the lateral sulcus?**

**A: Superficial middle cerebral**

**B: Superior cerebral**

**C: Inferior cerebral**

**D: Posterior cerebral**

**Q9: Which structure isn't drained by the deep cerebral veins?**

**A: Basal ganglia**

**B: internal capsule**

**C: cerebral cortex**

**D: thalamus**

**Q10: Blood from which sinus drains into IJV?**

**A: Transverse sinus**

**B: Cavernous sinus**

**C: Sigmoid sinus**

**D: A&C**

**Q11: All of the following are single sinuses except for:**

**A: Superior sagittal**

**B: Superior petrosal**

**C: Inferior sagittal**

**D: Straight**

**Q12: a complication of infection in the face**

**A: Superior sagittal S thrombosis**

**B: Cerebral edema**

**C: Infarction**

**D: Cavernous S thrombosis**

Answer key:  
7(C) , 8(A) , 9(C) , 10(D) , 11(B) , 12(D)

# SAQ

Q1: Mention the composition of the Carotid System?

Q2: Mention 2 of the the Posterior Perforating arteries (PPA) supply ?

Q3: Enumerate the paired and single venous sinuses

Q4: Mention the termination sinuses of the superficial and inferior cerebral veins

## Answers

1 : It is composed of the Internal carotid artery and its branches:

- Anterior cerebral artery & Middle cerebral artery

2 : Ventral portion of Midbrain, Hypothalamus

3 : slide 8

4: Superior sagittal sinus, superficial middle cerebral vein, transverse sinus

## Team leaders

Rayan jabaan  
Abeer Awwad

## A special thanks to Mohamed Alquhidan

### Reviser

Mohamed Alquhidan

### Organizer

Abdulaziz Alrabiah

### Note taker

Mohammed Aldehaim

## Team Members

- Alaa Assulmi
- Albandari Alanazi
- Aljoud Algazlan
- Afnan Almohsen
- Arwa Alqahtani
- Aseel Alshehri
- Asma Alamri
- Bodoor Almubarak
- Deemah Alotaibi
- Fatimah Saad
- Ghada Alabdi
- Ghaida Alassiry
- Joud Alnujaidi
- May Barakah
- Norah Alasheikh
- Nouf Alsubaie
- Raghad Alasiri
- Raghad Soaeed
- Renad Alosaimi
- Sara Alharbi
- Sarah Almuqati
- Sarah Alqahtani
- Shaden Alsaiedan
-  Shahad Almezel
- Shayma Alghanoum
- Sumo Alzeer

- Abdullah Alburikan
- Abdullah Aldosari
- Abdulaziz Alghuligah
- Abdulaziz Alkraida
- Abdulaziz Alomairy
- Abdulaziz Alrabiah
- Abdulaziz Alsuhaim
- Abdulrahman Almugren
- Ahmed Alkhayatt
- Bader Alrayes
- Basel Fakeeha
- Fahad Alajmi
- Faisal Alotaibi
- Fayez Altabbaa
- Feras Alqaidi
- Hadi Alhems
- Hesham Alsqabi
- Mohammed Aldehaim
- Mohamed Alquhidan
- Mohammed Beyari
- Mubarak Alanazi
- Musab Alamri
- Nawaf Alghamdi
- Osama Alharbi
-  Raed Alnutaifi
- Saad Aldohaim
- Saleh Algarni

