

# CNS

## Anatomy

0 slides

0 sheets

▶ number

20 "last sheet"

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## Blood supply of the CNS

We have two main systems supplying the CNS:

1- **Vertebro-basilar system** (30% of the total blood supply)

This system consists of two vertebral arteries that ascend beside the medulla till they reach its upper border where they unite to form the basilar artery. Basilar artery passes in-front of pons in the basilar groove and terminates at its upper border by giving its terminal branches; two *posterior cerebral arteries* that will curve around the superior cerebellar peduncle to run in *calcarine sulcus*.

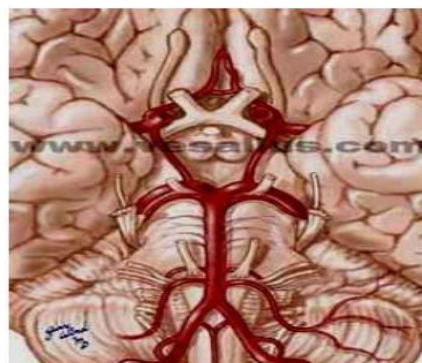
\*calcarine sulcus is seen on the medial surface of the brain

\*This system is mainly responsible for blood supply of the cerebellum, brainstem and spinal cord

\*blood from the right side of the basilar artery doesn't mix with the blood from the left side

2- **Internal carotid artery** (70% of the total blood supply)

There are many branches for internal carotid, but its main two branches are: (1) *anterior cerebral artery*, which will go through the longitudinal fissure and then enters to the *callosal sulcus* above the corpus callosum and (2) *middle cerebral artery* which will go lateral to enter the *posterior ramus of the lateral fissure*.



There are communications between the basilar artery and internal carotid, that together form a closed circle; circle of Willis

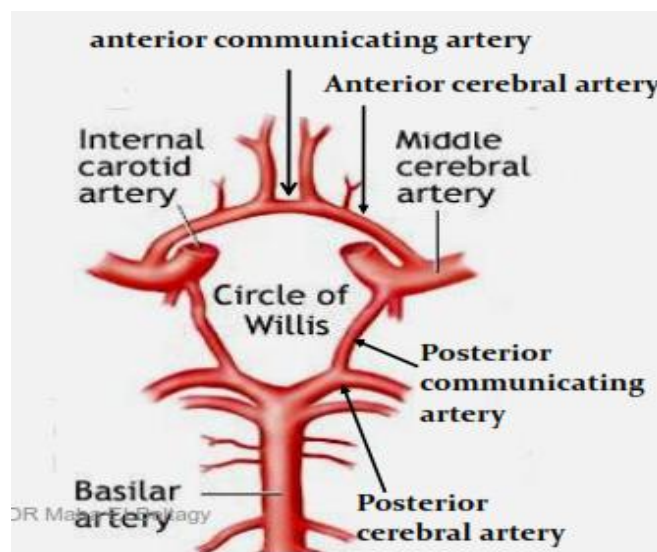
## Circle of Willis (circulus arteriosus)

It's found in the interpeduncular fossa around the base of the brain. It's protected by a well-developed cisterna called **interpeduncular cisterna**.

The basilar artery gives terminal **two posterior cerebral arteries** while the internal carotid gives middle and **anterior cerebral arteries** beside the **posterior communication** artery.

The **anterior communicating artery** joins the two anterior cerebral arteries.

*The previous arteries together form the circle, check the picture below.*



**Physiological importance of the circle:** This circle creates collaterals in the cerebral blood supply; if there are any interruptions or embolus in one of these arteries, other arteries will compensate.

## Angiograms

It's an important role in diagnosing injuries or thrombus in the brain. Here is an example

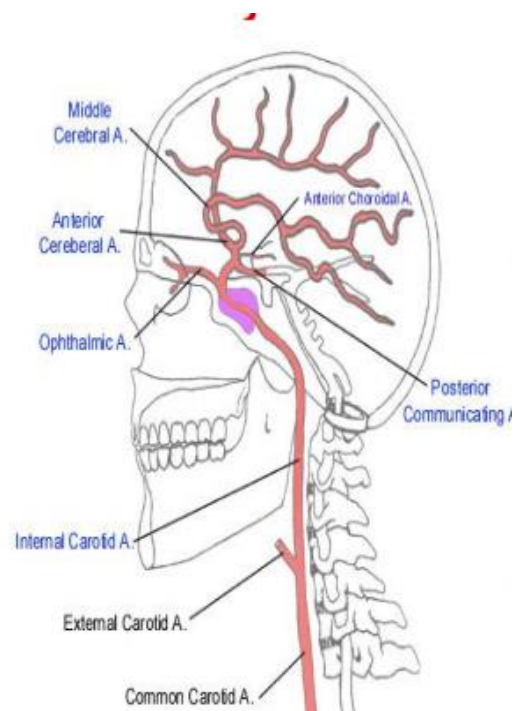


of a normal angiogram.

We'll talk more now about the internal carotid artery, which is a branch from the common carotid. *Remember that the common carotid artery terminates into internal and external common carotid, which is in turn the main blood supply to the head and neck.*

### **The course of internal carotid:**

It arises from the common carotid artery in the neck, entering head at skull base via the carotid foramen to pass through the carotid canal. From there it reaches the petrous part of the temporal bone and leaves through foramen lacerum to enter the cavernous sinus from its posterior end and leaves it anteriorly. Meanwhile in the cavernous sinus, it passes along with the cranial nerves found there (occulomotor , trochlear and abducent "is the most lateral one"). After leaving the cavernous sinus, internal carotid bifurcates into anterior and middle cerebral arteries.



As you can see, we can divide its course into **4 main parts**:

- 1- Cervical part (in neck)**
- 2- Petrous part or bony part (inside the bone and carotid canal)**  
here the branch is artery to pteregoid canal
- 3- Cavernous part (siphon-it looks like S)**
- 4- Cerebral (when it leaves the cavernous)**

*\*other details are not required*

*\*There is no branches of the internal carotid in the neck*

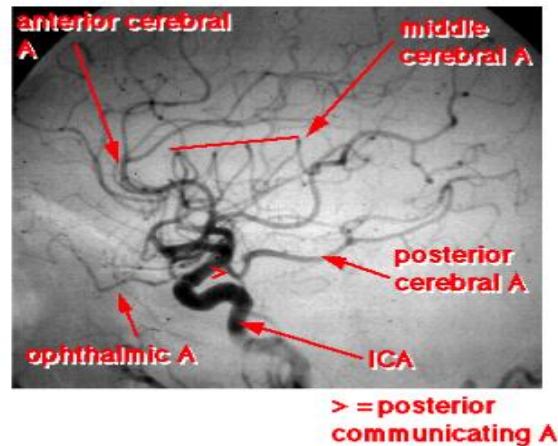
**Branches of internal carotid:**

- 1- **Ophthalmic artery**, it originates after the cavernous sinus, ophthalmic artery itself has branches like:
  - (1) central artery of the retina which supplies the inner layer of the eye (retina)
  - (2) lacrimal artery
  - (3) anterior and posterior ethmoidal arteries that supply ethmoidal air sinuses
- 2- **Artery to the anterior pituitary and stalk**. It supplies the pituitary and infundibulum
- 3- **Posterior communicating artery**, it's a branch from the stem of the internal carotid itself and as mentioned above it communicates with the posterior cerebral artery
- 4- **Anterior choroidal artery**. It provides the blood supply of the choroid plexus in the lateral and third ventricle.

*\*remember that posterior choroidal artery is from posterior cerebral artery*

*\*The 4th ventricle's choroid plexus is supplied by PICA*

**5- Anterior and middle cerebral artery**



There are three cerebral arteries; anterior, middle and posterior.

## **Anterior cerebral artery**

### **Cortical structures supplied by it:**

- Most of the medial surface of the brain.  
*\*Note: the artery runs in the callosal sulcus and ends before the splenium and curve superiorly to run in the marginal sulcus. So it gives branches that supply that area till the parieto-occipital fissure.*
- The frontal pole
- the 1<sup>st</sup> upper inch from the superolateral surface anterior to the parieto-occipital fissure
- Medial half of the orbital surface

### **Callosal parts supplied by it:**

- all parts of corpus callosum except the splenium

### **Septal parts supplied by it: (septum pellucidum)**

- all of it

### **Central structures supplied by it:**

- Anterior part of corpus striatum
- anterior part of internal capsule

*Note: If we are to divide the central structures into two parts; anterior and posterior, The anterior part will be supplied by the anterior cerebral artery while the posterior part will be supplied by middle cerebral artery*

**Question:** if there is an embolus in the anterior cerebral artery, which one of the following parts could be affected:

1-upper limb **2- lower limb (both sensory and motor)** 3-frontal eye field 4-wernick's area 5- broca's area

*In these questions you have to associate each area with its function, so the paracentral lobule can be a correct answer and it also leads to urinary incontinence*

## **Middle cerebral artery**

**Cortical structures supplied by it:**

- Most of the superolateral surface of the brain ***except the upper and lower inches and occipital lobe behind parieto-occipital fissure.***
- Temporal pole
- lateral half of the orbital surface of the brain

**Central structures supplied by it:**

- Most of corpus striatum and internal capsule  
*\*Remember artery of cerebral hemorrhage (charcot's artery) is a branch from middle cerebral artery being the most important branch to the internal capsule "we'll talk about it more at the end"*

## **Posterior cerebral artery**

**Cortical structures supplied by it:**



- Behind the parieto-occipital fissure in both lateral and medial surface.
- Lower one inch of the superolateral surface
- Occipital pole
- all of the tentorial surface except temporal pole

#### **Central and callosal structures supplied by it:**

- Also splenium of corpus callosum, uncus, amygdale and thalamus are supplied by it.

\*\*\*When supplying the thalamus, posterior cerebral artery gives central branches; short and long. The **short central branches** supply the anterior part of the thalamus and the **long ones** supply the thalamus posteriorly.

So the pulvinar and geniculate bodies (which are posteriorly) are supplied by the long central branches of posterior cerebral.

\*\*\*Posterior cerebral artery gives an important branch below the splenium which is the posterior choroidal artery; it supplies the choroid plexus of the lateral and third ventricles.

\*\*\* **The macula is an area in the occipital lobe, responsible for central and precise vision. It takes double blood supply (from the middle and posterior cerebral arteries). So if there is lesion affecting only one of these arteries there will be a lesion WITH MACULAR SPARING. For example, a lesion in Meyers loop will lead to quadrantanopia with macular sparing.**

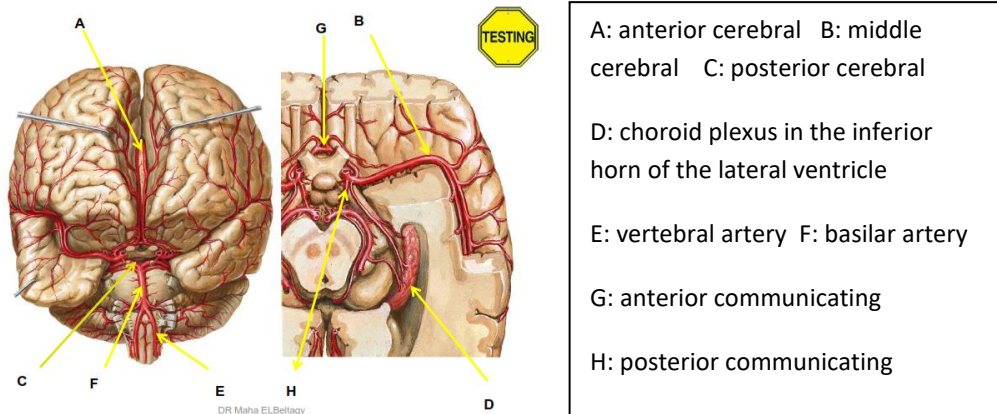
#### **Few notes:**

- *Blood supply run in the subarachnoid space.*
- *Posterior cerebral artery gives branches to the midbrain (the cerebral peduncles)*
- *the anterior choroidal artery is a branch from internal carotid while the posterior choroidal is from posterior cerebral artery.*
- *a lesion in posterior cerebral artery will lead to visual problems such as agnosia, hemianopia or quadrantanopia depends on the area affected WITH MACULAR SPARING.*

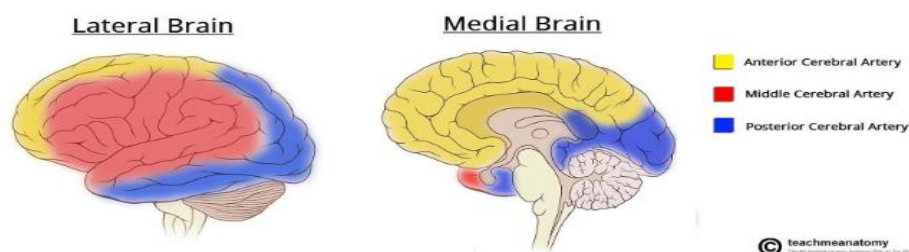


YOU HAVE TO KNOW WHAT WILL HAPPEN IF A SPECIFIC ARTERY IS INJURED. These are only examples:

- Frontal eye field will be affected in an injury to middle cerebral artery.
- Supplementary motor area SMA will be affected in an injury to anterior cerebral artery.



## **Blood Supply to the surfaces of the brain:**



From the previous page we can conclude that there are three cerebral arteries; anterior, middle and posterior. Let's see how these arteries are distributed on the cerebral cortex.

*\*Note that, the info here will be repeated when we talk about each one of the cerebral arteries individually.*

- **Superolateral surface:**

The middle cerebral artery supplies most of this surface, except the upper and lower inches, occipital lobe, and frontal pole

- **The medial surface:**

Most of the medial surface is supplied by the anterior cerebral artery **except** the part behind the parieto-occipital fissure which in turn includes the splenium part of corpus callosum, posterior part of thalamus, tectum of the midbrain and pineal gland (all supplied by posterior cerebral A).

- **The tentorial surface:** (it's the posterior part of the inferior surface)

The entire tentorial surface is supplied by posterior cerebral artery except the temporal pole which is supplied by middle cerebral artery.

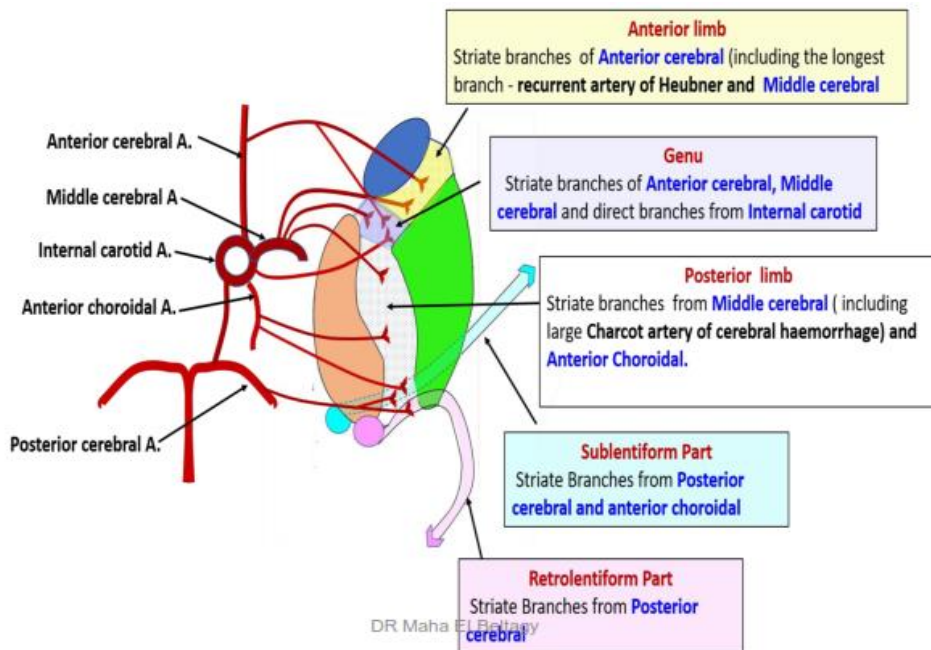
*So, we can say that the temporal pole is supplied by middle cerebral artery, the frontal pole is supplied by anterior cerebral artery and the occipital pole is supplied by the posterior cerebral artery.*

## **Blood supply to the cerebellum**

The arteries that supply the cerebellum are:

- 1- Posterior inferior cerebellar artery (PICA) from the vertebral artery
- 2- Anterior inferior cerebellar artery (AICA) from the basilar artery
- 3- Superior cerebellar artery from the basilar artery

## **Blood supply to the internal capsule(very important)**



*\*This picture summarizes everything, so you can come back here at the end*

As a quick revision, the internal capsule is made up of:

- 1- Anterior limb (between the caudate and lentiform nuclei)
- 2- Genu (between caudate and thalamus medially and the lentiform laterally)
- 3- Posterior limb (between lentiform and thalamus)
- 4- Sublentiform part (auditory radiation)
- 5- Retrolentiform part (optic radiation).

*The internal capsule can be divided "according to the main blood supply" into two parts; anterior part (being supplied by the **anterior cerebral artery**) and the posterior part (supplied by **middle cerebral artery**).*

**The parts of the internal capsule and their blood supply:**

### 1- Anterior limb

- anterior part: branches from anterior cerebral artery  
the longest branch from the anterior cerebral art. is called the **recurrent artery of Huebnar<sup>1</sup>**
- posterior part: supplied directly from the middle cerebral art.

2- **Genu**

middle cerebral artery

3- **Posterior limb**

-anterior half: branch from middle cerebral artery which is the **Charcot artery of the cerebral hemorrhage.**<sup>2</sup>

-posterior half: anterior choroidal artery from the internal carotid

4- **Sublentiform**

anterior choroidal artery from the internal carotid

5- **Retrolentiform**

-anterior choroidal artery from the internal carotid

-but the **main blood supply** to the retrolentiform is the posterior cerebral artery

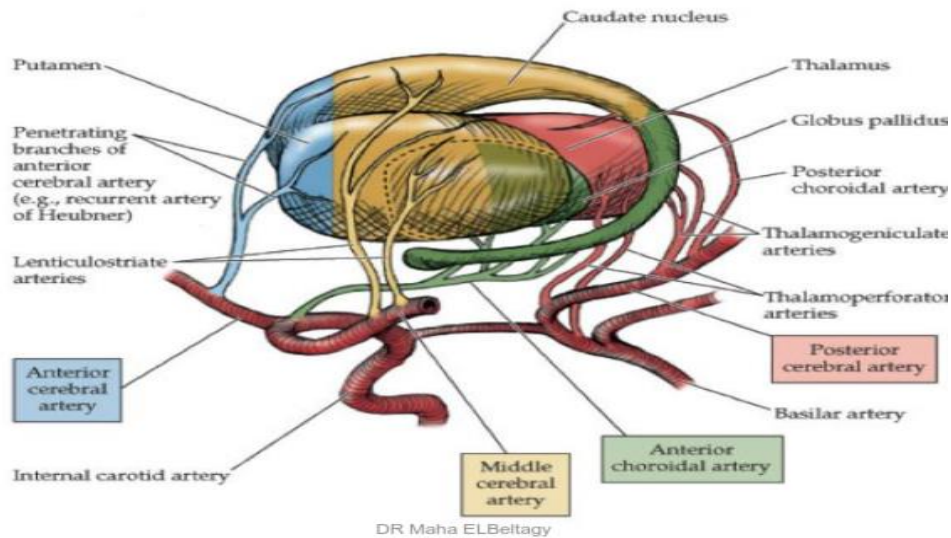
1: this artery is very important; it supplies the anterior limb of the internal capsule and the anterior part of corpus striatum (caudate and lentiform)

2: an injury to Charcot artery (by even minimal increase in its pressure) will lead to the loss of sensory and motor function, contralateral hemiplegia and contralateral hemianesthesia; since the posterior limb contains both ascending and descending "corticospinal fibers"

*Notes:*

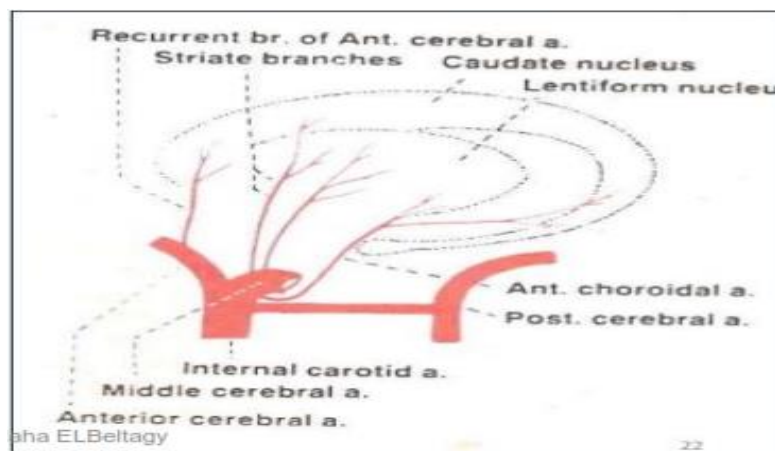
- *the middle cerebral artery is the most important arterial supply to the internal capsule*
- *the anterior choroidal artery from the internal carotid supplies the posterior half of the posterior limb, Sublentiform and retrolentiform*

## **Blood supply to the basal ganglia**

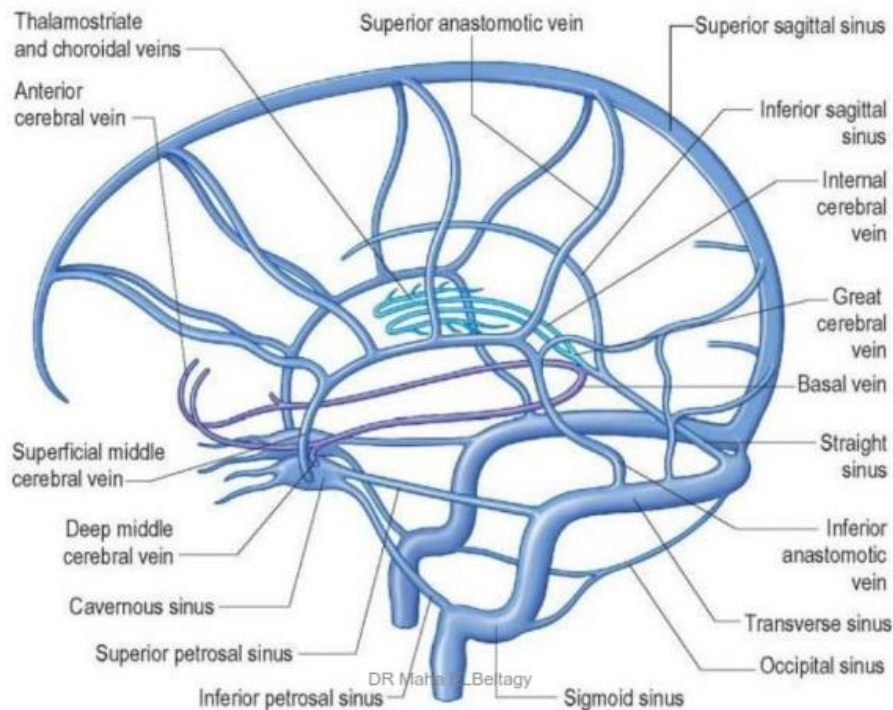


You have to know the followings:

- The recurrent artery of Haubner from the **anterior cerebral artery** supplies the anterior part of corpus striatum and the anterior limb of internal capsule "That makes sense because it's in between the anterior part of corpus striatum so it must be supplied by the same artery!"
- The **middle cerebral artery** supplies the posterior part of corpus striatum
- The thalamus and amygdala is supplied by the **posterior cerebral artery**



## Venous drainage of the brain



It's divided into two types:

- 1- Superficial "near the cortex, bridging veins"  
see the next paragraph.
- 2- Deep "from central structures"

*NOTE: the doctor talked about the deep veins but they are not included in the exam, if you want to know about them you can check video10 (46:46 min)*

☞ The posterior ramus of the lateral fissure is occupied by an artery (middle cerebral art.) and two veins (**superficial** and **deep** middle cerebral veins). These two veins drain the insula and the lateral surface of the brain.

☞ In the picture above you can see the **superior sagittal sinus** which will curve posteriorly to form RT transverse sinuses.

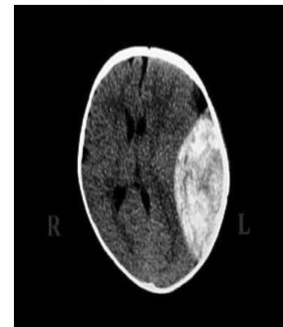
☞ The anastomotic veins (Bridging veins) connect **the superficial middle cerebral veins** with **the superior sagittal sinus**.

## Types of hemorrhage in the brain

### 1- Extradural/epidural hemorrhages

it's caused by an injury to the middle meningeal artery by a direct trauma and appears as a biconcave lens shape in CT.

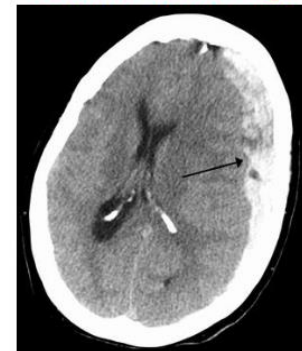
Extradural hemorrhage



### 2- Subdural hemorrhage

it's caused by an injury to bridging veins "there is no need to a direct trauma. And because they are thin, a displacement or a change in pressure will lead to its injury. It has a crescent shape.

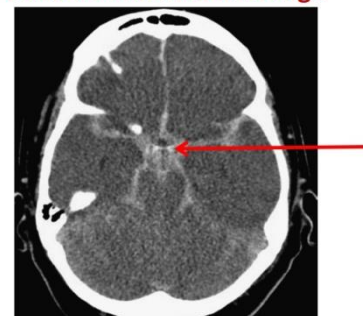
Subdural hemorrhage



### 3- Subarachnoid hemorrhage

It's mainly due rupture of circle of willis or cerebral aneurysm rupture. You can clearly see the hemorrhage around circle of willis in this picture.

Subarachnoid Hemorrhage



- 4- **cerebral hemorrhage** which accounts for 70-80% of deaths,  
**Charcot's artery of cerebral hemorrhage from middle cerebral artery**

*\*If you don't have time to go through the slides, please make sure to check slides 44-46!*

**\*YOU CAN... YOU WILL!\***  
**GOODLUCK**