The Circle Of Willis (Circulus Arteriosus) Anatomy

Of all the body parts the brain has a very high oxygen demand. It gets about a fifth of the total body oxygenation. Isn't that amazing? In this article, we shall be having a look at the vascularity of the brain specifically an important anastomosis known as ***The Circle of Willis.***

With just minutes of oxygen deprivation, the brain will develop ischaemic cell death. This is due to its high sensitivity to oxygen deprivation.

Arterial Blood Supply Of The Brain.

The brain is supplied by two main arteries: The left and right vertebral arteries and internal carotid arteries

Let's look at the origin and course of these arteries.

Internal carotid arteries

The aortic arch gives off three great vessels: the brachiocephalic artery, the left common carotid artery and the left subclavian artery.
The brachiocephalic artery then divides into the right common carotid artery and right subclavian artery.

At the level of fourth cervical vertebra C4 the right and left common carotid arteries bifurcate and give rise to the right and left internal carotid arteries respectively.

The internal carotid artery then moves superiorly through the carotid sheath and enters the skull base through the carotid canal within the petrous portion of the temporal bone and ascends anteriorly within the cavernous sinus.

Once the internal carotid artery exits the cavernous sinus it moves intracranially over the anterior clinoid process and terminates in a T junction. Here it gives rise to the anterior cerebral artery medially and the middle cerebral artery laterally.

The middle cerebral artery supplies the lateral portions of the cerebrum but it isn't part of the circle.

Anatomical divisions of the internal carotid artery

Vertebra arteries

As we mentioned above the right and left vertebral arteries to arise from the subclavian arteries, medial to the anterior scalene muscle. These pair of arteries then ascend the posterior aspect of the neck, through an opening known as foramen transversarium of the cervical spine.

These vertebral arteries pierce the dura and enter the posterior fossa at the level of the skull base.

Once it has entered in the cranial vault it gives off to three branches:

1. **The meningeal branch** – which supplies the falx cerebelli.
2. **Anterior and posterior spinal arterie**s supplying the spinal cord and,
3. **The posterior inferior cerebellar artery** which supplies the cerebellum.

They after this division the vertebral arteries join one another to form the basilar artery. The basilar artery
terminates into 2 paired vessels:

- The superior cerebellar artery (SCA) and
- The posterior cerebral artery (PCA).

The superior cerebellar artery supplies the superior portion of the cerebellum. The posterior cerebral arteries and its branches supply the occipital lobe, thalamus and inferomedial portion of the temporal lobe.

The function of the posterior communicating artery is to serve as a bridge between the posterior and anterior circulations by connecting the supraclinoid segment of the internal carotid artery with the posterior communicating artery.

After understanding the flow and course of the vertebral and internal carotid arteries lets now look at the composition, location, and function of the Circle of Willis.

The Circle of Willis.

Like we mentioned in the introduction the Circle of Willis is a ring-like anastomotic arterial structure located at the base of the brain (around the eye level) which supplies blood to the brain and surrounding structures.

It lies in the interpeduncular fossa at the base of the brain and is named after a physician Thomas Willis. It surrounds the optic tracts, pituitary stalk, and basal hypothalamus.

arteries forming the circle of Willis

It begins to form when the right and left internal carotid artery enters the cranial cavity and each one divides into two main branches: the anterior cerebral artery and the middle cerebral artery.

The anterior cerebral arteries are then united and blood can cross-flow by the anterior communicating artery.

The bloodstreams from the internal carotid artery and vertebral artery on both sides come together at a certain point in the posterior communicating artery. At that point the pressure is equal, and they do not mix.

In case there is a blockage in the internal carotid artery or the vertebral artery, the blood will continue to pass forward or backward across that point to compensate for the reduced flow.

This structure (circle of Willis) allows blood to flow across the midline of the brain if there is an occlusion of an artery on one side. The circle, therefore, serves a safety valve function for the brain, by allowing collateral circulation to take place if the flow is reduced to one area of the brain.

It constitutes three main (paired) constituents and two connecting vessels. The main paired constituents are:

Anterior cerebral arteries – terminal branches of the internal carotid arteries.

Internal carotid arteries – located immediately proximal to the origin of the middle cerebral arteries and

Posterior cerebral arteries – terminal branches of the vertebral arteries.

The two ‘connecting vessels’ are:

1. The anterior communicating artery which connects the two anterior cerebral arteries and.
2. The posterior communicating artery is a branch of the internal carotid artery. This artery connects the internal carotid artery to the posterior cerebral artery.

It's important to note that aneurysms are most likely to occur in the vessels contributing to the Circle of Willis.