

## Circle of Willis (Circulus Arteriosus Cerebri)

[See online here](#)

The circle of Willis, also called *circulus arteriosus cerebri*, is one of the anastomotic systems of arteries in the body which supplies blood to the brain. It is located at the base of the brain. Willis is the name of the author of *Cerebri Anatome*, a book that described this ring of blood vessels present at the base of the brain. The circle of Willis is present around the stalk of the **pituitary gland**. It connects the blood supply of the forebrain and the hindbrain.



**Circle of Willis**  
Saccular (Berry) Aneurysms

- 40% at junction of anterior cerebral and anterior communicating arteries
- 34% at bifurcation of middle cerebral artery
- 20% at bifurcation of internal carotid and posterior communicating arteries
- 4% at basilar artery bifurcation

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### Video Course: Cerebral Cortex

This course reviews the structure of the cerebral cortex. Professor Craig Canby explains the different lobes and arterial supply, as well as the Circle of Willis and Saccular Aneurysms.

## Structure of the Circle of Willis

The **internal carotid arteries (ICA)** of both sides enter the cranial cavity via the carotid canals and become the **anterior cerebral artery (ACA)** and **middle cerebral artery (MCA)**. An **anterior communicating (ACOM) artery** communicates the two anterior cerebral arteries, one from each side of the body. This is the **anterior circulation** of the circle of Willis.

The vertebral arteries from each side when entering the cranial cavity via the foramen magnum join to form the **basilar artery**, which gives out the left and right **posterior cerebral arteries (PCA)**, which form the posterior circulation. A communicating artery called the **posterior communicating (PCOM) artery** connects the two posterior cerebral arteries.

The PCAs complete the circle of Willis by joining the internal carotid system anteriorly via the posterior communicating (PCOM) arteries.

## Vessels Comprising the Circle of Willis

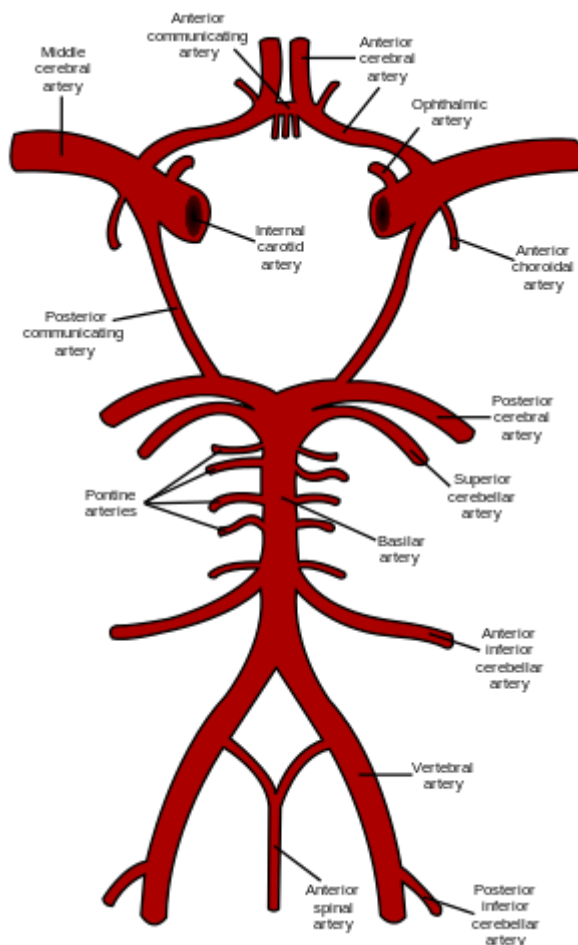


Image: "Schematic representation of the circle of Willis, arteries of the brain and brain stem." by Rhcastilhos - Gray519.png, License: [Public Domain](#)

Anterior circulation:

1. Left and right internal carotid arteries (ICA)
2. Horizontal segments of the left and right anterior cerebral arteries (ACA)
3. Single anterior communicating (ACOM) artery

Posterior circulation:

1. Left and right posterior communicating (PCOM) arteries
2. Horizontal segments of the left and right posterior cerebral arteries (PCA)
3. Single basilar artery

## Anterior cerebral artery

The anterior cerebral artery is divided into various segments. The first segment starts from the internal carotid artery (ICA) bifurcation up until the junction of the artery with the anterior communicating artery in the **longitudinal fissure**.

Branches of the first segment include:

1. The **medial lenticulostriate artery**: This artery supplies the anterior hypothalamus, anterior commissure, fornix, striatum, optic chiasm, and optic nerves.
2. Perforator branches of the anterior communicating artery supply the [hypothalamus](#) and optic chiasm.

The second segment of the ACA extends from the anterior communicating (ACOM) artery to the bifurcation of the ACOM artery forming the **pericallosal and callosomarginal arteries**, near the genu of the **corpus callosum**.

Branches of the second segment include the **perforators to the frontal lobe**, as well as the **recurrent artery of Heubner**. The recurrent artery of Heubner is a large **lenticulostriate vessel** which supplies the **caudate nucleus, internal capsule, and putamen**. The orbitofrontal and frontopolar arteries are also branches of the second segment.

The third segment, also called the **pericallosal artery** includes all the branches of the ACA that originate after the origin of the pericallosal and callosomarginal arteries distally. The third segment ends into **parietal arteries** which supply the **corpus callosum** and **precuneus**.

## Middle cerebral artery

The middle cerebral artery is divided into four segments.

The first segment starts from the internal carotid artery up until its bifurcation (or trifurcation) into branches.

The middle cerebral artery can bifurcate or trifurcate; it varies from person to person. Branches of the first segment are:

1. **Lenticulostriate arteries**: these arteries supply the anterior commissure, internal capsule, caudate nucleus, putamen and globus pallidus.
2. **Anterior temporal artery**: this artery supplies the anterior temporal lobe.

### Second segment

This segment starts from the bifurcation of the middle cerebral artery to the **circular sulcus of the insula**. It extends up until the margin of the insula within the **Sylvian fissure**.

### Third segment

The third segment starts from the **circular sulcus of the insula** and terminates at the surface of the **Sylvian fissure**. It is made up of **cortical branches**. It moves over the surface of the **frontal and temporal opercula** and ends near the external surface of the **Sylvian fissure**.

Both second and third segments give off cortical branches supplying the **cerebral**

**cortex.**

### **Fourth segment**

This segment of the middle cerebral artery gives off cortical branches which supply the **frontal, parietal, temporal and occipital lobes**. These include:



**Image:** "1 - Arterial circle of Willis, 2 - Arteria carotis interna, 3 - A. basilaris, 4 - A. vertebralis, 5 - Pons, 6 - Cerebellum"  
by John A Beal, PhD Dep't. of Cellular Biology & Anatomy  
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1. Orbitofrontal branch
2. Prefrontal branch
3. Pre-central branch
4. Central branch
5. Anterior and posterior parietal branch
6. Angular branch
7. Temporo-occipital branch
8. Temporal branch
9. Temporopolar branches

## **Posterior cerebral artery**

This artery is also divided into four segments.

**The first segment**, which starts from the **basilar artery bifurcation** till the junction of the posterior communicating (PCOM) artery, gives off perforators to the midbrain, pons, and medulla. These are called the **posterior thalamo-perforators**.

**Anterior thalamo-perforators** are the vessels that originate from the PCOM artery. The direct perforators supply the thalamus, brainstem and the internal capsule. Circumflex arteries from the first segment supply the thalamus and midbrain. The meningeal branch supplies the inferior surface of the **tentorium cerebelli**.

**The second segment** starts from the posterior communicating PCOM artery and terminates at the posterior aspect of the midbrain. It gives off direct perforating branches to the thalamus, internal capsule and optic tract. Branches of the second segment are:

1. The **posteromedial choroidal artery**: this artery supplies the midbrain, pineal gland, thalamus, and medial geniculate body.
2. The **postero-lateral choroidal artery** supplies the choroid plexus, thalamus, geniculate bodies, fornix, cerebral peduncle, pineal body, corpus callosum, tegmentum, and temporal occipital cortex.
3. One hippocampal artery may also be present.

The **third segment**, which starts from the posterior aspect of the midbrain till the **calcarine fissure**, divides into two terminal branches; the **calcarine artery** and the aforementioned **parieto-occipital artery**.

**The fourth segment** includes the branches of distal branches of the artery to the anterior aspect of the calcarine fissure. It often includes any one of the two main terminal branches of the PCA. The other terminal branch originates from the second or third segment.

## Basilar artery

This is the major artery formed by the junction of the left and right vertebral arteries at the base of the [brain](#). It moves anteriorly near the **brainstem** and gives off various branches to the base of the brain and cerebellar branches. These include the **superior cerebellar artery (SCA)** and the **anterior inferior cerebellar artery (AICA)**.

The superior cerebellar artery starts at the basilar artery just prior to its bifurcation. It also comes into close contact with the [trigeminal nerve](#). This artery gives off branches to the tectum, the vermis and the medial aspect of the cerebellar hemisphere.

The anterior inferior cerebellar artery moves toward the **cerebellopontine angle**.

The **posterior inferior cerebellar artery (PICA)**, the largest branch supplying the cerebellum, supplies the medulla, cerebellar tonsils, vermis, and inferolateral cerebellar hemisphere. **Pontine branches** supply the brainstem.

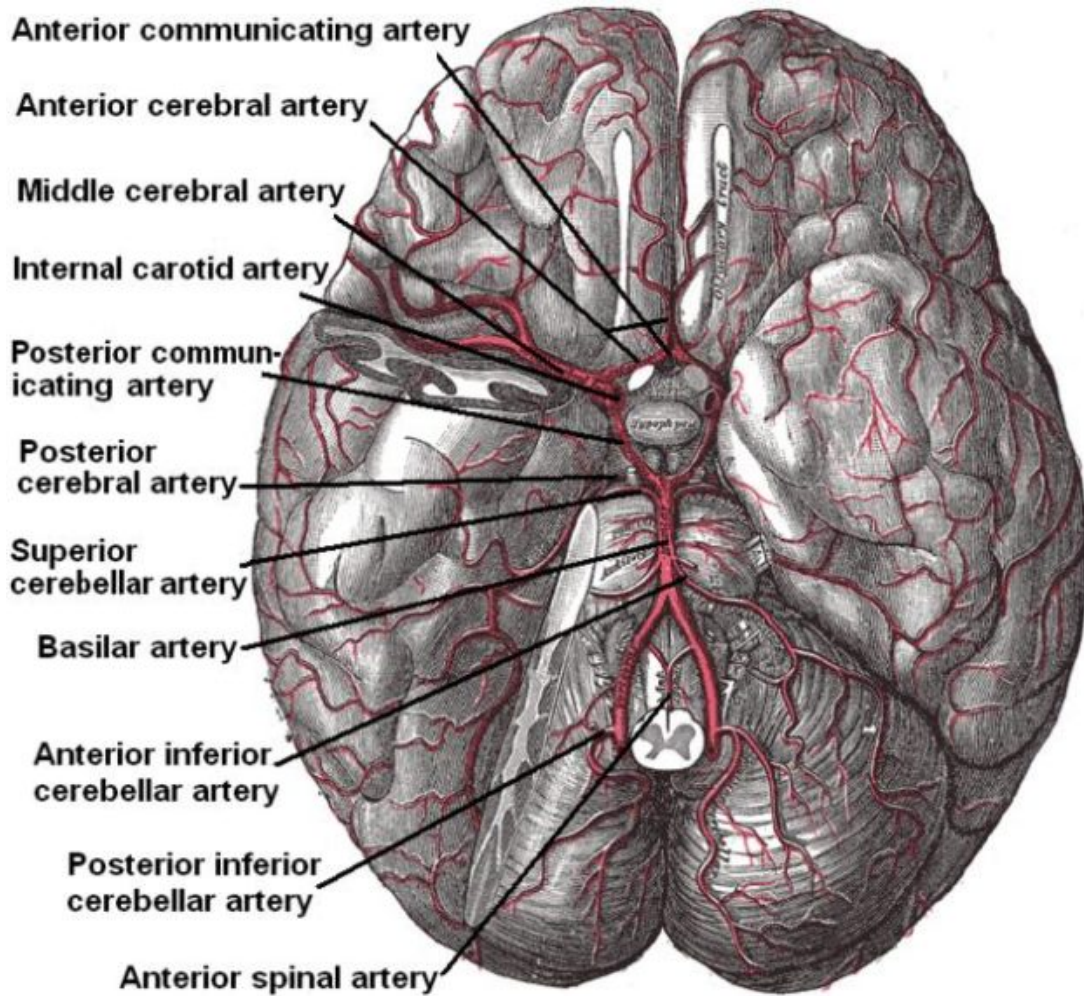


Image: "The brain and arteries at base of the brain. Circle of Willis is formed near center. The temporal pole of the cerebrum and a portion of the cerebellar hemisphere have been removed on the right side. Inferior aspect (viewed from below)." by Wikid77 - Derivative of Image: Gray516.png, narrowing labels to magnify image 16%; removed smudges near labels. License: [Public Domain](#)

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## References

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[Blood Flow Through the Brain, pt. 3 \(Circle of Willis\)](#) via [neuroems.com](#)

[Definition of Circle of Willis](#) via [medicinenet.com](#)

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