

# Rare Variations of Carotid-Vertebro-Basilar Anastomosis

More Raghunath<sup>1</sup>, Royana Singh<sup>2</sup>, Sangeeta Rai<sup>3</sup>

<sup>1</sup>Assistant Professor Department of Anatomy Banaras Hindu University Varanasi, UP India

<sup>2</sup>Associate Professor Department of Anatomy Banaras Hindu University Varanasi, UP India

<sup>3</sup>Assistant Professor Department of Obstetrics and Gynaecology, Banaras Hindu University Varanasi, UP India

**Abstract:** The circle of Willis is considered an important collateral pathway in maintaining adequate cerebral blood flow in patients with internal carotid artery obstruction. The degree of contribution of the vertebro-basilar and carotid systems having vital role in brain perfusion. Aim of this case study was report vary rare variations in brain circulation from the normal anatomy. Such variation is important to diagnostically as well as therapeutically for neurosurgeons. These variations we got during routine dissections of body for undergraduate students at institute of medical sciences, Banaras Hindu university Varanasi, Uttar Pradesh. variations are i) Bilaterally there is absence of posterior communicating artery. ii) Variations of anterior cerebral artery. These anomalies may alter the occurrence, severity of symptoms, treatment options and recovery from certain cerebrovascular disorders viz., stroke and aneurysms. A thorough knowledge of the vascular variants useful to surgeons in planning their shunt operations, choice of the patients and also keeps away inadvertent vascular traumas during surgeries.

**Keywords:** Circle of Willis, posterior communicating artery, cerebrovascular disorders, internal carotid artery, posterior cerebral artery.

## 1. Introduction

Cerebrovascular diseases such as stroke, aneurysms and arterio- venous malformation are very prevalent in our country. Human brain and its complex vascular network as well as billions of specialized neuronal cells make it the most vital organ in the body. Brain is richly supplied by two internal carotid and two vertebral arteries, connected by a central anastomosis- circulus arteriosus, which lie in the interpeduncular fossa at the base of brain<sup>1</sup>. The internal carotid artery divides into the anterior and middle cerebral arteries. Two anterior cerebral arteries are joined together by an anterior communicating artery. The basilar formed by the union of the two vertebral arteries, branches into two posterior cerebral arteries. Posterior communicating artery a branch of internal carotid completes the arterial polygon by joining with the posterior cerebral artery. A classical arterial circle is bilaterally symmetrical and complete ring of vessels. Vessels generally vary in caliber; often they are hypo plastic, duplicated or even absent. Several studies have shown that these variations play an important role in the development of cerebrovascular diseases. Anatomical variations are probably genetically determined, develop in early embryonic stage and persist in post-natal life<sup>2</sup>. Any change in the normal morphology of the circle may condition the appearance and severity of symptoms of cerebrovascular disorders, such as aneurysms, infarcts and other vascular anomalies.

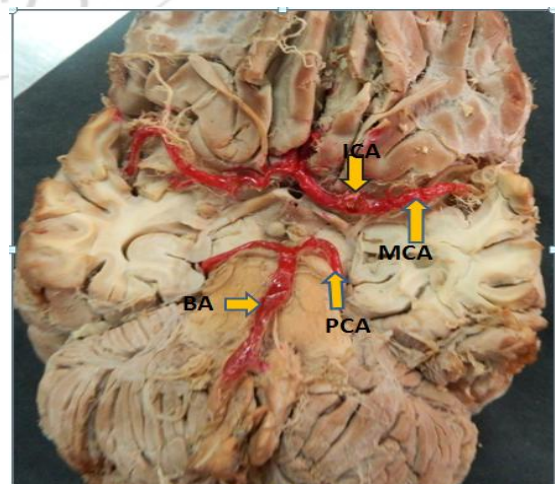
## 2. Case Reports

During routine dissection for undergraduate students in the Department of Anatomy Institute of Medical Sciences ,Banaras Hindu University Varanasi. Uttar Pradesh, India. Variations of circle of Willis were noted in 65 years old male cadaver. Anterior cerebral arteries were extracted from their origin in the internal carotid artery until their division in the frontopolar artery; the middle cerebral arteries were dissected from their first ramification after the generation of

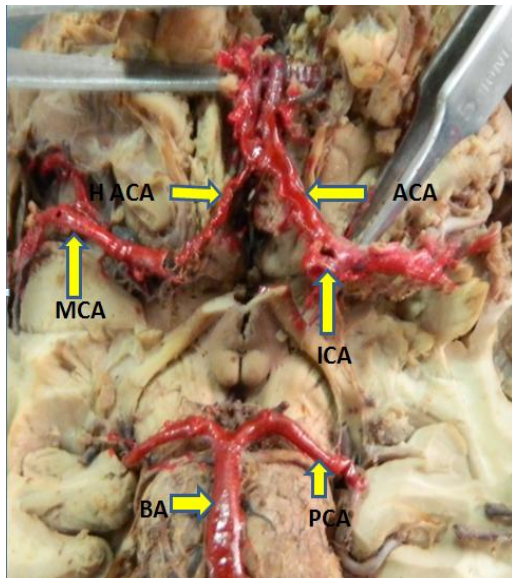
lenticular-striate arteries; the posterior cerebral arteries were dissected from their origin until the ramification in two branches: the parieto-occipital and calcarine arteries.

We noted the variations in the formation of circle of Willis.

- A) Anterior part of the circle Willis (anterior circulation).
- There is hypo plastic (small diameter) right anterior cerebral artery which anatomises directly to the left anterior cerebral artery before the division.
  - There is absence of anterior communicating artery.
  - Left anterior cerebral artery divides into two terminal branches.
- B) Posterior part of circle of Willis (posterior circulation)
- There is bilateral absence of posterior communicating artery.
  - There is no communication between internal carotid artery anteriorly and vertebral arterial system posteriorly.



**Figure 1:** Showing bilateral absence of posterior communicating artery. absence of Circle of Willis. Where ICA- Internal Carotid Artery, MCA- Middle Cerebral Artery, PCA- Posterior Cerebral Artery, A- Basilar Artery.



**Figure 2: Showing peduncular fossa with variation in anterior cerebral arteries. Where ICA- Internal Carotid Artery, MCA- Middle Cerebral Artery, PCA- Posterior Cerebral Artery, BA- Basilar Artery. ACA- Anterior Cerebral Artery, HACA- Hypo plastic Anterior Cerebral Artery.**

### 3. Discussion

Arteries from the circle of Willis are formed from a primitive network surrounding the neural tube in the embryo. First, both carotid arteries are formed; then, they divide into branches which will form the anterior cerebral artery, the posterior communicating artery and both proximal and distal part of posterior cerebral artery (PCA). All the other arteries are additional branches to the primitive ring. As the fetus develops, the posterior communicating artery diminishes, whereas the proximal segment develops and the PCA acquires the classic morphology, originated from the basilar artery (BA)<sup>3</sup>.

Normally internal carotid artery bifurcates at the medial end of the Sylvain fissure in to anterior and middle cerebral arteries. The two anterior cerebral arteries are joined at the anterior end of the longitudinal fissure by the anterior communicating artery. The basilar artery bifurcates at the ponto-mesencephalic junction into two posterior cerebral arteries, which are in turn connected to the ipsilateral internal carotids by the posterior communicating artery. The normal circle is polygonal and symmetrical in configuration<sup>4</sup>.

Although variations of circle of Willis are common occurrence in human brains. previous studies on the variations of circle of Willis The prevalence of the typical circle i.e., the “normal text-book” polygon ranges from 4.6% [9] to 72.2%<sup>5</sup>.

In present case due to absence of bilateral posterior communicating artery, which is branch of cerebral part of internal carotid artery. Due to this there is no formation of as such classical Circle of Willis. There is no anastomosis between internal carotid artery system and vertebral artery system of brain circulation. Also on anterior part of circulation left anterior cerebral artery divides into two

arteries terminally but right anterior cerebral artery anatomizes with left anterior cerebral artery before its division. There is no anterior communicating artery. Such variations in the present case very rarely reported by other researchers on the same topic. Variations in the posterior circulation of the brain are very common<sup>6</sup>, but the Absence of bilateral posterior communicating artery very rarely reported by other research workers.

### 4. Conclusion

The anomalies of the circle of Willis play an important role in the occurrence, manifestation of symptoms, treatment options and recovery process of certain cerebrovascular disorders viz., stroke, and aneurysms. Variations were also found to be associated with migraine and mentally ill patients. The anomalies encountered include hypoplasia of anterior communicating artery, absence of anterior communicating artery, embryonic origin of posterior cerebral and the absent posterior communicating arteries.

Such incomplete circle of Willis with bilateral absence of posterior communicating arteries is the rarest variation of blood circulation of brain. The neurosurgical importance lies during the exposure of the region for different purposes. A thorough knowledge of the vascular variants will increase the success of the procedure.

### References

- [1] Alpers BJ, Berry RG, Paddison RM. Anatomical studies of the circle of Willis in normal brain. *Arch Neurol Psychiatr.* 1959; 81: 409 – 18.
- [2] Hoksbergen AW, Fulesdi B, Legemate AD, Csiba I. Collateral configuration of the circle of Willis: Transcranial color-coded duplex ultrasonography and comparison with postmortem anatomy. *Stroke.* 2003; 31: 1346-51.
- [3] DEVRIESE, B. Sur la signification morphologique des arteres cerebrales. *Archives de Biologie*, 1905, vol. 21, p. 357.
- [4] Crompton MR. The pathology of ruptured middle cerebral aneurysms with special reference to the differences between the sexes. *Lancet.* 1962; 2: 421 - 25.
- [5] Fawcett E, Blachford JV. The circle of Willis: An examination of 700 specimens. *J Anat and Physiol.* 1905; 40: 63 -70.
- [6] Paraskevas GK, Tsitsopoulos PP, Papaziogas B et al (2007) Persistent primitive hypoglossal artery: an incidental autopsy finding and its significance in clinical practice. *Folia Morphol*

### Author Profile



**Dr. More Raghunath Shahaji** is serving as Assistant Professor Department of Anatomy, Institute of Medical Sciences, Banaras Hindu University, Varanasi, UP India.



**Dr. Royana Singh** (MBBS.MD.DNB. Phd) is serving as Associate Professor Department of Anatomy Banaras Hindu University Varanasi, UP, India