

ORIGINAL PAPER

Morphometry of posterior cerebral artery: embryological and clinical significance

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Abstract

Posterior cerebral artery, terminal branch of basilar artery joins the posterior communicating artery to help complete the circulus arteriosus cerebri in human beings. A study of 89 formalin-fixed brain specimen of either sex and of Indian origin has showed that the mean length and diameter of the posterior cerebral artery was 6.75 ± 1.482 mm and 1.7 ± 0.7 mm respectively. Anomalous origin of the posterior cerebral artery was the only variation found during the present study. The incidence of occurrence of the particular variant was 2.2%. The variation did not have any sex or side predilection.

Keywords: posterior cerebral artery, morphometry, arterial variations, circulus arteriosus cerebri.

Introduction

Posterior cerebral artery is a terminal branch of the basilar artery formed at the upper pontine border where it joins the posterior communicating artery to help complete the circulus arteriosus cerebri in human beings [1].

Various authors have studied about the length, diameter and anomalies in the origin of this artery and found that the parameters in different geographical limits were different.

Studies on the length of the posterior cerebral artery by various authors have shown it to vary between 6.8–7.5 mm. Diameter of the vessel was seen to be between 2.1–2.75 mm on right side and 1–2.5 mm on the left side.

Authors who have studied the anomalous origin of the said artery have reported it to occur in 5–13.7% on right side, < 5–13% on the left side and 2–5.7% on both sides.

The anomalies of posterior cerebral artery may assume considerable significance in surgeries of the head and neck, which require ligation of internal carotid and common carotid artery or in cases of obstruction of these arteries by embolus.

Material and methods

Eighty-nine formalin fixed brain specimen of either sex and of Indian origin with intact circle of Willis were studied.

The dissections were carried out on the arterial circle after the removal of the brain and the mean length, diameter and origin (variations constituting) of the posterior cerebral arteries were studied in detail.

Results

The mean length and diameter of the posterior cerebral artery was 6.75 ± 1.482 mm and 1.7 ± 0.7 mm. Anomalous origin of the posterior cerebral artery was the only anomaly found during the present study. The incidence of occurrence of the particular variant was 2.2%. The present variation did not have any sex or side predilection (Figures 1 and 2).

Discussions

Various authors have studied the morphometry of the posterior cerebral artery in different populations and the results have been seen to vary in different races. A study on the length of the posterior cerebral artery by various authors has shown it to vary between 6.8–7.5 mm.

Kamath S [2] in her studies on 100 embalmed cadavers had found that the length of the posterior cerebral artery was 6.8 ± 2.7 mm and 6.9 ± 3.1 mm on the right and left sides respectively; while Pai BS *et al.* [3] mentioned that the mean length of the posterior cerebral artery was 6.8 mm on the right and 7.5 mm on the left side. Our study on the length coincides with that of the other authors with the mean at 6.75 ± 1.482 mm.

A study on the diameter of the vessel by previous workers was seen to be between 2.1–2.75 mm on right side and 1–2.5 mm on the left side.

Kamath S [2] in her studies on 100 embalmed cadavers has mentioned the diameter to be 2.1 ± 0.7 mm and 2.2 ± 0.6 mm on right and left side respectively, while Pai BS *et al.* [3] has mentioned the diameter of the vessel to be 2–3.5 mm (mean = 2.76 mm) on the right and 1–3.5 mm (mean = 2.5 mm) on the left side.

Even our studies have shown the diameter to lie in the same range i.e., 1.7 ± 0.7 mm.

The embryonic derivation of the posterior cerebral artery from the internal carotid artery is widely studied by workers. It is known to vary between 11–24% cases [2, 4, 5]. Individually the variation was seen to be present in 5–13.7% on the right, < 5–13% on the left and 2–6% on both the sides [6–8].

The largest study of the *circulus arteriosus cerebri* by Alpers BJ *et al.* [9] on 837 brains have found that the anomaly was present unilaterally in 31% and bilaterally in 25% cases. Battacharji SK *et al.* [10] have found the incidence of the particular anomaly to be more in brains with infarction (27%) against those in control series (17%).

Such a vessel when present was connected by a small branch to the basilar artery. It is the preservation of the large (primitive) connection of the internal carotid with the caudal portions of the encephalon that accounts, presumably, for the embryonic derivation of the posterior cerebral artery from the internal carotid [9].

The presence of anomalous origin of posterior cerebral may assume considerable significance if one is to ligate internal carotid, common carotid or in cases of obstruction of these arteries by embolus. In such cases, the blood supply of large area of brain might be interrupted [8].

When the posterior cerebral artery arises from the internal carotid, thrombosis or embolism affecting the carotid territory may cause infarction of the occipital pole and, conversely, such an anatomical arrangement will prevent occipital pole infarction in basilar thrombosis. Even if the circle serves a stabilizing function the possibility still exists that inadequacy of this mechanism may determine the occurrence of brain infarction in the presence of carotid and vertebral artery occlusion. Functional failure of the circle could arise from anatomical anomalies or obstructive vascular disease in a component vessel of it [10].

☞ Conclusions

Posterior cerebral artery is a highly variable structure. Neurosurgeons and neurophysicians who work on this area must look for the possible variations that occur in this vascular channel.

References

- [1] GABELLA G., Subclavian system of arteries. Cardiovascular system. In: GRAY H., *Gray's Anatomy*, 38th edition, Churchill Livingstone, London, 2000, 1529–1536.
- [2] KAMATH S., *Observations on the length and diameter of vessels forming the circle of Willis*, *J Anat*, 1981, 133(3):419–423.
- [3] PAI B. S., VARMA R. G., KULKARNI R. N., NIRMALA S., MANJUNATH L. C., RAKSHITH S., *Microsurgical anatomy of the posterior circulation*, *Neurol India*, 2007, 55(1):31–41.
- [4] JAIN P. N., KUMAR V., THOMAS R. J., LONGIA G. S., *Anomalies of human cerebral arterial circle (of Willis)*, *J Anat Soc India*, 1990, 39(2):137–146.
- [5] JAYASREE N., SADASIVAN G., *Variations of circle of Willis in man*, *J Anat Soc India*, 1981, 30(2):72–77.
- [6] STOPFORD J. S. B., *Arteries of the pons and medulla oblongata*, *J Anat Physiol*, 1915, 50:131–164.
- [7] SUNDERLAND S., *Neuro-vascular relation and anomalies at the base of brain*, *J Neurol Neurosurg Psychiatr*, 1948, 11:243.
- [8] VARE A. M., BANSAL P. C., *Arterial pattern at the base of the human brain*, *J Anat Soc India*, 1970, 19(3):71–79.
- [9] ALPERS B. J., BERRY R. G., PADDISON R. M., *Anatomical studies of the circle of Willis in normal brain*, *AMA Arch Neurol Psychiatry*, 1959, 81(4):409–418.
- [10] BATTACHARJI S. K., HUTCHINSON E. C., MCCALL A. J., *The circle of Willis. The incidence of developmental abnormalities in normal and infarcted brains*, *Brain*, 1967, 40:747–758.

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Figure 1 – Base of the adult human brain showing circulus arteriosus cerebri (A – Anterior cerebral artery; I – Cut ends of Internal carotid artery; PCA – Posterior cerebral artery as a direct continuation of Internal carotid artery; Block arrows – Thin channel connecting the Basilar artery (B) with the PCA)

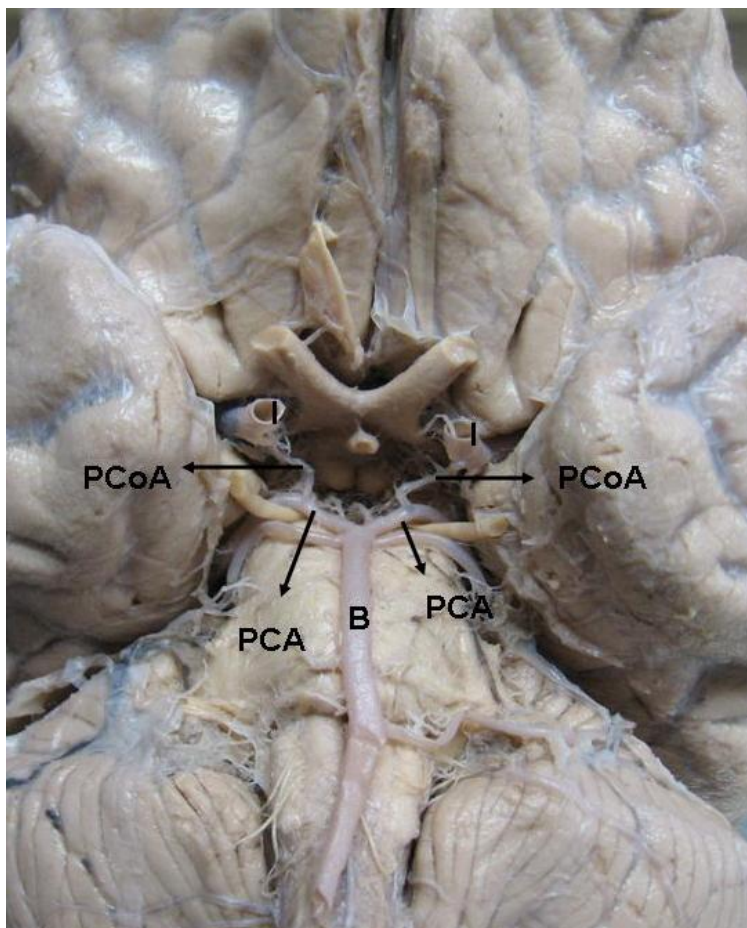
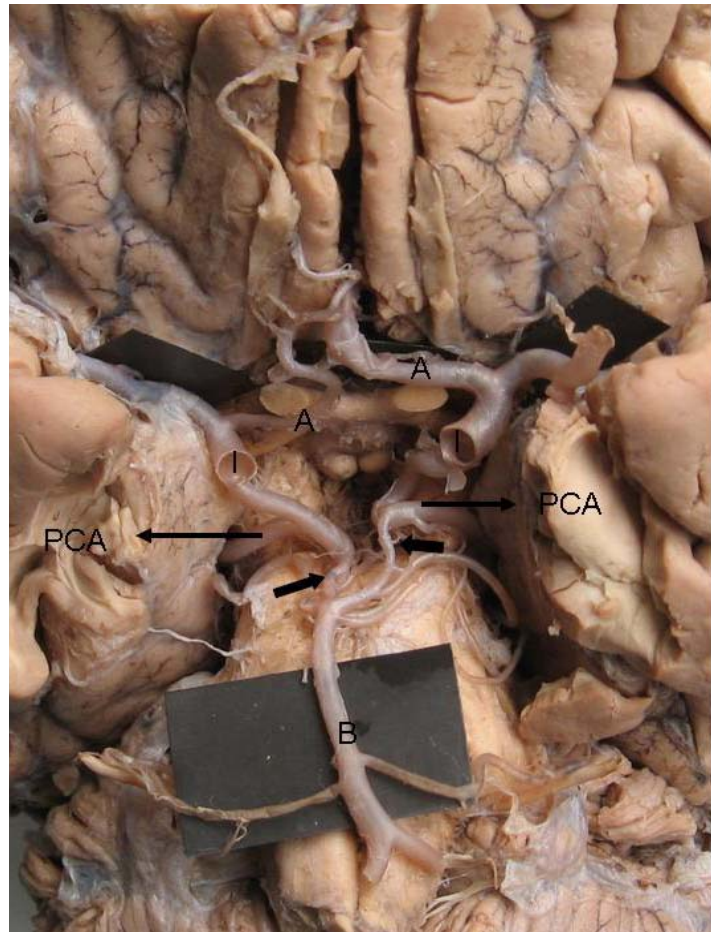


Figure 2 – Base of the adult human brain showing the normal circulus arteriosus cerebri (I – Internal carotid artery; PCoA – Posterior communicating artery; PCA – Posterior cerebral artery; B – Basilar artery)

