

Morphometry of Posterior Cerebral Artery

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ABSTRACT

Introduction: Circle of Willis is an arterial circle made from communicating branches originating from carotid and vertebrobasilar arteries. The Posterior Cerebral Arteries (PCAs) are paired vessels, usually arising from the top of the basilar artery and from the lower boundary of circle of Willis. The left and right arteries supply oxygenated blood to the occipital lobe, the inferior part of the temporal lobe, the posterior limb of the internal capsule and the thalamus.

Aim: To observe record and compare variations in the length and diameter of PCA.

Materials and Methods: Sixty human formalin fixed brain specimens were obtained from cadavers donated for the study purpose in the Department of Anatomy, Government Medical College, Baroda and other medical colleges of Gujarat. The process was undertaken according to the

dissection method as per the Cunningham's manual. The variation in length and diameter of PCA was noted using digital Vernier calipers.

Results: The mean length of right and left PCA was 6.64 mm and 6.49 mm respectively. The range of length was 4.1 mm to 7.9 mm on right side and 4.5 mm to 7.5 mm on left side. Mean diameter of right and left PCA was 2.53 mm and 2.49 mm respectively. The range of diameter was 2.1 mm to 3.6 mm on right side and 2.07 mm and 3.2 mm on left side. There was no statistically significant difference in mean of diameter ($p=0.3755$) and length ($p=0.2538$) of right and left side PCA.

Conclusion: Wide range of variations found in length of right and left PCA. No anomaly found in PCA in present study. No statistically significant difference found in mean length and diameter between right and left PCA.

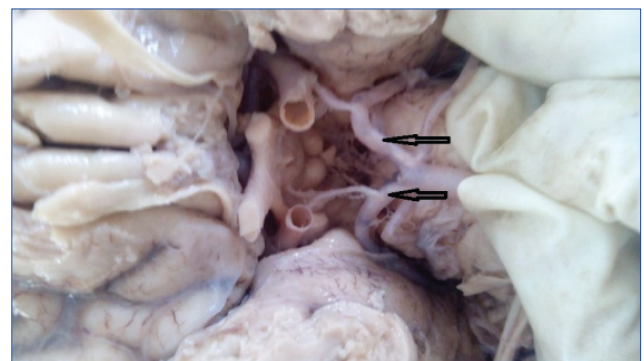
Keywords: Circle of Willis, Circulus arteriosus cerebri, Microsurgical anatomy

INTRODUCTION

The PCA makes up the lower portion of the circulus arteriosus cerebri. Oxygenated blood is supplied to many key regions within the brain through this network of arteries. The arterial circle of brain (circle of Willis) was first described by Thomas Willis in 1664, but many variations have been described in the original definition [1].

PCA is a terminal branch of the basilar artery and it joins the posterior communicating artery to complete the circulus arteriosus cerebri [Table/Fig-1]. After joining with posterior communicating artery from each internal carotid and completing the circle of Willis, each PCA curves round the crus cerebri, passes above the tentorium notch and reaches medium surface of hemisphere beneath splenium of corpus callosum [2] and cortical branches [3].

PCA is distributed to the posterior aspect of the brain and supplies blood to thalamus, midbrain, the posterior part of



[Table/Fig-1]: Right and left posterior cerebral artery.

the cerebral hemispheres, and deeper structures including the choroid plexus of the lateral and third ventricles [4].

The variations or anomalies of PCA may assume considerable significance in neurosurgeries, which require ligation of internal carotid and common carotid artery or in cases of obstruction

of these arteries by embolus [5].

Various studies have been done regarding variations of circle of Willis, but little literature is available about the morphometry of PCA in the Indian population [6]. This knowledge will be helpful for future studies related with PCA as well as for the neurophysicians and neurosurgeons during their clinical approaches.

MATERIALS AND METHODS

This cross-sectional study was conducted in the Department of Anatomy, Government Medical College, Vadodara, and other Medical Colleges of Gujarat, India, between the period of April 2013 to March 2014. Sixty human formalin fixed brain specimens were obtained from cadavers, donated for the study purpose.

The study was approved by scientific review committee and ethical committee (IECHR, Medical College Baroda and SSG Hospital).

Inclusion criteria: Undamaged specimens of the brain with intact circulus arteriosus and PCA.

Exclusion criteria: Damaged circulus arteriosus.

The brain was dissected out of the cadavers, as per the instructions mentioned in Cunningham's Manual of Practical Anatomy [7]. Before further processings, specimen was washed in running tap water for half an hour. The arachnoid and pia mater over the pons, medulla oblongata and the interpeduncular cistern was removed carefully in order to expose and visualize the PCA with the post part of circle of Willis. In situ, formation and termination points were examined and the length of PCA was taken. Part of PCA which contributes to the formation of circle of Willis was measured taking length from basilar bifurcation to the junction with the posterior communicating artery. The dimensions were measured using Digital Vernier calipers (sensitivity: 0.1 mm).

STATISTICAL ANALYSIS

The results obtained were recorded and tabulated. The data was entered in excel sheet and mean and SD was calculated for length and diameter. Student's 't'-test was applied to check the statistical significance of difference in the measurements of right and left PCAs.

RESULT

PCA was normal in all 60 circles. No major anomaly or variation was found in PCA in the study.

The mean length of right PCA was 6.64 ± 0.76 mm. Minimum length was 4.1 mm and maximum length was 7.9 mm. Mean diameter of right PCA was 2.53 ± 0.27 mm. Minimum diameter was 2.1 mm and maximum diameter was 3.6 mm.

The mean length of left PCA was 6.49 ± 0.67 mm. Minimum

length was 4.5 mm and maximum length was 7.5 mm. Mean diameter of left PCA was 2.49 ± 0.22 mm. Minimum diameter was 2.07 mm and maximum diameter was 3.2 mm [Table/Fig-2].

There was not any statistical significant difference in mean length ($p=0.2538$) and mean diameter ($p=0.3755$) of right and left PCA.

Variables	Length		Diameter	
	Right	Left	Right	Left
Mean \pm SD	6.64 ± 0.76	6.49 ± 0.67	2.53 ± 0.27	2.49 ± 0.22
Range	7.9 to 4.1	7.5 to 4.5	2.1 to 3.6	2.07 to 3.2
p-value	$p=0.2538$ (95% CI-0.11049 to 0.4081)		$p=0.3755$ (95% CI-0.0467 to 0.1297)	

[Table/Fig-2]: Measurements of right and left PCA.

DISCUSSION

A wide range of variability, with regard to length and mid length diameter was seen in the PCAs examined in our study. Variations in the length and diameter of PCAs can be attributed to ageing and haemodynamic factors.

A study by Krishnamurthy A et al., showed that the mean length of PCA was 6.75 ± 1.482 mm and mean diameter of the PCA was 1.7 ± 0.7 mm which is similar to our study results [5].

In a study done by Kamath S on 100 samples showed the length of right and left PCA respectively 6.8 ± 2.7 and 6.9 ± 3.1 mm. The range of length of right PCA was from 15.3 to 2.0 mm. The range of length of left PCA was from 19.3 to 2.1 mm. The diameter of right and left PCA was 2.1 ± 0.7 and 2.2 ± 0.6 mm. Maximum diameter of right PCA was 4.9 mm and minimum diameter was 0.6 mm. Maximum diameter of left PCA was 5.0 mm and minimum diameter was 0.5 mm [8].

A study on 340 PCA specimens showed mean length of right PCA 7.8 ± 0.31 mm and left 7.8 ± 0.29 mm. It showed mean right PCA diameter 2.8 ± 0.08 mm and mean left PCA diameter 2.8 ± 0.08 mm [9].

A study on 25 brain specimen showed average length of right and left PCA was 5-10 mm (mean 6.8 mm) and 6-11 mm (mean 7.5 mm) respectively and average diameter in right and left PCA was 2-3.5 mm (mean 2.76 mm) and 1-3.5 mm (mean 2.5 mm) respectively [10].

In a study done by Moore S et al., the mean length of PCA 6.75 mm and diameter 1.7 mm [11]. The range of diameter of PCA was 0.3 mm to 3.8 mm in a study of fifty six formalin fixed brains done by Shah A et al., [6]

There was no anomaly found in PCA in present study but an anomalous origin of the PCA was noted during the study by

Krishnamurthy A et al., with the incidence of 2.2% [5]. A study on 30 cadaveric brain specimens, noted an anomalous origin of the PCA, one of the important variations with the incidence of 6.67% [12].

An occlusion or blockage in PCA may result in thalamic syndrome, Weber's syndrome, contralateral hemiplegia and wide varieties of symptoms like vision loss, failure to see to and fro movements, dizziness, verbal dyslexia and memory loss etc. Thorough knowledge of the morphometry will help clinically and scientifically to deal with lesions involving posterior circulation and it will enhance the knowledge of the vascular variations useful for radiological and surgical diagnosis, procedures and treatment.

As we have included specimens from different Medical Colleges of Gujarat the result is good representative of Gujarat population. Knowledge of variation in the anatomy of circle of Willis and its branches helps clinicians for better delivery of their skills to the needful. In this study we didn't find any anomaly in particular to PCA except in vertebral artery [13]. It may be found with larger sample size or more specimens. Our data was not a true reflection of general population in consideration with anomalies of circle of Willis, because our data were limited to only 60 adult cadaveric brains without any neurological diseases.

CONCLUSION

Our study was conducted to analyze the size and asymmetry of the PCA, using 60 adult cadaveric brains. There was no significant asymmetry found in PCA. The result showed much variation in diameter and length of right and left PCA. The variations in morphometry may be helpful to the neurosurgeons and neuro physicians in diagnosis and treatments.

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