

VARIATION IN THE ORIGIN OF POSTERIOR CEREBRAL ARTERY IN THE ADULT POPULATION

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ABSTRACT

Background and aims: The configuration of the posterior bifurcation of the posterior communicating artery is of clinical importance as in fetal type of configuration an embolus arising in the internal carotid artery can cause posterior cerebral ischemia. Three types of configurations are described and they are the adult, fetal and transitional types. The study intends to examine the contribution of vertebro-basilar and the carotid systems in the origin of the posterior cerebral artery. The aim of the study is to find variations found in the posterior part of circle of Willis, in particular the configuration of the posterior bifurcation of the posterior communicating artery.

Materials and Methods: 50 embalmed cadaver brains from Fathima Medical College, Government Siddhartha Medical College and other medical colleges from Andhra Pradesh, India were studied. The external diameter of the posterior communicating artery and the proximal part of posterior cerebral artery were measured using caliper.

Results: The adult configuration is present in 80%, fetal in 13.3% and transitional in 6.7% of brains.

Conclusion: The study reveals that vertebrobasilar system contributes 80% in the origin of posterior cerebral artery whereas the internal carotid artery contribution in the origin of posterior cerebral is 20% i.e. in the fetal and transitional configurations put together.

KEY WORDS: Configuration Of The Posterior Bifurcation, Posterior Communicating Artery, Posterior Cerebral Artery, Vertebra- Basilar And Carotid Systems.

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INTRODUCTION

Since the first detailed description of the circle of Willis by Thomas Willis in the year 1662 many anatomic variations in the circle of Willis were described. One such anatomical variation is the relative sizes of posterior communicating artery (PCoA) and posterior cerebral artery (PCA) on the same side of circle of Willis. The size of the

posterior communicating artery relative to the posterior cerebral artery is one of the main differences between the fetal and adult forms of the circle of Willis [1, 2].

The right and left PCA are the terminal branches of the basilar artery. They become part of the circle of Willis by the joining of the PCoA arising from internal carotid artery (ICA) with the

right and left PCA. The PCA is divided into two parts by the joining of the PCoA i.e. into proximal part P1 or the pre-communicating part and the distal part P2 or the post-communicating part. This junction of PCoA with the PCA is the configuration of the posterior bifurcation of the posterior communicating artery (PCoA). Basically in adults three configurations of the posterior bifurcation of the posterior communicating artery can be distinguished [3].

The three types of basic configuration are the fetal, transitional and the adult types. In the fetal type of configuration, the blood supply of occipital lobe is mainly supplied by the ICA. In the transitional type of configuration, the blood is supplied to the occipital lobe equally by both the ICA and vertebro-basilar system. In the adult type of configuration, the occipital lobe is predominantly supplied by the vertebro-basilar system [3].

In the fetal type of configuration the PCoA is larger in diameter than the ipsilateral P1 and is of clinical importance as a thrombus from the ICA can dislodge and enter into the PCA and cause cerebrovascular accident by blocking the PCA and its branches [4].

There is a dearth of study of configuration of the anatomical posterior bifurcation of the posterior communicating artery, in the adult population and this study is to observe the contribution of ICA and the vertebro-basilar system in the origin of PCA in the embalmed cadaver brains.

MATERIALS AND METHODS

The brain specimens for the study were obtained from 50 embalmed dissecting room cadavers, from Fathima Institute of Medical Sciences, Government Siddhartha Medical College and other medical colleges located in the state of Andhra Pradesh. The study was done after obtaining ethical approval from the institutional ethical board.

A caliper, graduated to measure up to 0.02 mm was used to measure external diameter and length of the vessels forming the circle of Willis [5].

The external diameter of PCoA and P1 (proximal segment of PCA prior to joining of PCoA) and P2

(distal segment of PCA after joining of PCoA) were measured. From the external diameter of the PCoA, the external diameter of P1 on the same side was subtracted. The result obtained could be one of these, either +, -, or 0. The negative result is the fetal configuration. The positive result is the adult configuration and the zero result is the transitional configuration [3].

Line diagrams and photographs were obtained and the origin of the PCA studied.

Microsoft excel was used to make tables and descriptive statistics were used to infer results.

RESULTS

The variations observed in the configuration of adult brains are given in the Table 1. The adult configuration was observed in 80 %, the fetal configuration in 13.3 % and the transitional configuration in 6.7 % of brains. The Fig.1-3 shows the adult and fetal and the transitional configurations.

Fig. 1: Showing bilateral adult configuration.



Fig. 2: Showing right transitional configuration and PCoA absent on left.



Fig. 3: showing left adult and right fetal configuration.

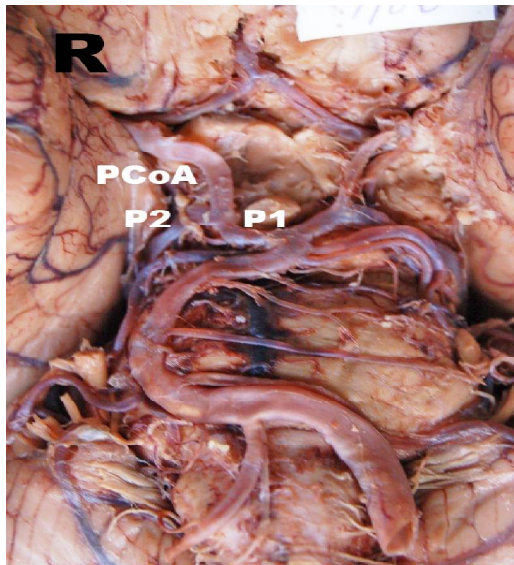


Table 1: Variations in the configurations of adult brains.

Configuration	Adult brains N = 50	
	Number	%
Adult configuration		
Bilateral	26	
Left	3	
Right	7	
Total	36	80%
Fetal configuration		
Bilateral	1	
Left	4	
Right	1	
Total	6	13.30%
Transitional configuration		
Bilateral	0	
Left	0	
Right	3	
Total	3	6.70%

DISCUSSION

The transitional configuration was seen in 6.7% of adult brains. According to the literature the transitional configuration was 7% [6]; 8% [7] and 8.5% [8]. The fetal configuration was observed in 13.3% of brains. According to literature it was 15% [9] and 17% [6, 7, and 10]. The adult configuration was seen in maximum number of brains which was 80% of brains. The adult configuration according to literature was 76% [6, 11]. In the Sri Lankan study by De Silva KRD et al [4], the fetal configuration is the least with 4.4% and the adult configurations was the highest with 93.3%. The Table 2 shows the

comparison of the present study with that of previous studies done in Netherlands, India and Sri Lanka.

Table 2: Comparison of the variations in configuration in adult brains with other studies in the literature.

Configuration	J.J.Overbeeke et al. 1991 [3]	Kamath 1981 [5]	De Silva KRD et al. 2009 [4]	Present study
Country	Netherlands	India	Sri Lanka	India
Total brains	100	100	225	50
Adult	84%	73.50%	93.30%	80%
Fetal	14%	25%	4.40%	13.30%
Transitional	2%	1.50%	2.20%	6.70%

In the studies compared in the Table 2 the adult configuration was the highest and it ranged from 73.5 to 93.3% followed by the fetal configuration which ranged between 4.4 % to 25% and transitional configuration which ranged between 2% to 6.7%. The highest range of difference is present in the fetal configuration.

CONCLUSION

The study has revealed that the contribution of ICA in the formation fetal configuration is 13.3% and in transitional configuration 6.7% making a total of 20%. On the other hand, the contribution of the vertebro- basilar system in the formation of adult configuration is 80%. The variations in the configuration of the posterior bifurcation of the posterior communicating artery are the result of developmental modifications [3]. Apart from the developmental modifications other factors which may include are genetic, environmental, hemodynamic etc. As the fetal configuration can be a route to emboli arising from the ICA and leading posterior cerebral artery ischemia this warrants further investigation.

ABBREVIATIONS

ICA - Internal carotid artery
 PCoA - Posterior communicating artery
 PCA - Posterior cerebral artery

Conflicts of Interests: None

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