

ANTERIOR CEREBRAL ARTERY, ANTERIOR COMMUNICATING ARTERY, POSTERIOR COMMUNICATING ARTERY, POSTERIOR CEREBRAL ARTERY- A RETROSPECTIVE STUDY

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ABSTRACT

In the embryonic period, several developmental anomalies of the cerebral arteries are common. The knowledge of these anatomical variations of the cerebral arteries is important for effective treatment and surgeries. We have studied different patterns and variations of cerebral arteries in 70 cadavers, both foetal and adult, and have depicted our observations and conclusions. "Vascular diseases in general is the commonest cause of death all over India as well as most other countries. But the diseases of blood vessels of the brain which are more frequent causes of death and disability have not attracted as much public attention as the required."¹ Hence a study of vascular supply of brain and its variational anatomy will help in proper and through understanding and interpretations of infarction embolism, thrombosis and other connected problems through modern investigation methods (Non-invasive techniques), MRI, MRA, CT and TCCD, etc. Hence, this work has been taken up, selecting the dead human foetuses and adult human cadavers.

KEYWORDS

Anterior Cerebral Artery, Communicating Artery, Posterior Communicating, Posterior Cerebral Artery.

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INTRODUCTION

The brain is supplied by the branches of internal carotid and vertebral arteries. Each Internal carotid artery gives off two major branches to the brain. These are the Anterior Cerebral Artery (ACA) and Middle Cerebral Arteries (MCA). Posterior Cerebral Artery (PCA) is a branch of basilar artery, which are formed by the union of two vertebral arteries. Posterior Communicating Artery (PCoA) from internal carotid artery joins PCA. The anterior, middle and posterior cerebral arteries give rise to two sets of branches, cortical and central. The cortical branches ramify on the surface of cerebral hemispheres and supply the cortex. The central branches pass deep into the substance of cerebral hemisphere to supply structures within it.

The present work consists of the study of the ACA, ACoA, MCA, PCoA, PCA, in Brain, both adult and foetal cadavers of Indian population.

Name of the Artery	Aspects Studied
ACA	Right and left size difference
ACoA	Presence or absence. Length, direction and duplication
MCA	Fenestration, duplication and quadrifurcation
PCoA	Right and left size difference
PCA	Right and left size difference

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MATERIAL AND METHODS

Fifty dead foetuses while they were still fresh were collected from the labour room of maternity wing of Govt. General Hospital, Guntur. The age of the foetuses are calculated by crown-rump length. The length is ranging from 225mm-310mm and the age is roughly estimated between 20 wks-38 wks; 20 specimens of adult brains with intact vasculature are collected in Department of Anatomy, Guntur, which was kept for medical students for routine dissection.

Soon after the fresh foetuses are brought to the Department of Anatomy from Govt. General Hospital, Guntur, the following procedure is followed to remove the brain. To remove the skull cap, after the dead foetuses are placed in a tray in a supine position, a circular skin incision is given with a scissors, 1cm above the eyebrows in the frontal area, running laterally and posteriorly above the ears and ending at the posterior fontanelle. With the scissors, penetrating deep to the bone in the region of pterion a cut is made in the bones along the line of skin incision as the foetal bones are thin and membranous in character. Soon after the foetal brains are taken out in the process described above, they are kept carefully in 10% formalin solution in plastic tins.

The adult brains are removed following the procedure described in Cunningham's Manual for routine dissection for medical students and preserved in 10% Formalin solution. Dissection is performed after the Brain is fixed in preservative solution and the intracranial vascular pattern is studied carefully. Every artery is observed carefully to know the pattern and whenever it is necessary photographs are taken. After the study is over the specimens are replaced in their respective preservative solution.

RESULTS

Anterior Cerebral Artery

An enormous percentage (71.43%) of specimens (50/70) of this study shows equality of ACA on both the sides. In 12/70 (17.14) specimens, the ACA is larger on left side. Fig 3. on right side the artery is relatively large in 8/70 (11.43%) specimens.

Fig 4. Heubner’s artery in all the specimens of the present study, arises proximal to the fusion on both the sides. Table-1.

Anterior Communicating Artery

The present study shows that the ACoA is ranging in its length from 3mm to 4mm in 64/70 (96%) specimens. In 6/70 (8.5%) specimens, the length is ranging from 1mm to 2mm. Two adult specimens have showed double anterior communicating artery (2/20, 10%). Fig 1. In 3 of the adult specimens the ACoA is obliquely placed. (1/20, 15%). Table- 3. Absence of ACoA is seen in 2 adult specimens. (2/20, 10%). Fig 2. The occurrence of anomalies of the ACoA in the present study in seen only in adult specimens ranging to 25%. No anomalies could be seen in foetal specimens in the present study. Table - 2.

Middle Cerebral Artery

In the present study the MCA is normal in total 100% (70/70) specimens. We have noticed fenestration in 1%, duplication in 1%, accessory MCA in 2%, quadrifurcation in 4% of cases.

Posterior Communicating Artery

PCoA in the present study is equal on both sides 46/70 (65.71%) specimens. The left side PCoA is larger in 14/70 (20%), specimens. Fig 3. In only 6/70 (8.5%), specimens the PCoA is larger on right side. Fig 5. A string like artery in the current study could be observed on the left side of one adult specimen 1/70 (1.43%), Fig 6. The PCoA in this study is absent in 3/70 (4.29%), specimens. Fig 5. Out of these, 3 and 2 are foetal and one is of adult. Out of the above said 3 specimens, 2 specimens have absence of PCoA on left side and one specimen has on right side. Present study has 34.29%, (24/70) specimens of total anomalies. Table-4.

Posterior Cerebral Artery

In the present study is equal on both the sides in a majority of the specimens, i.e., 47/70 (67.14%). On the right side the PCA is larger in 15/70 (21.43%) specimens. Fig 6. on the left side it is larger in 7/70 (10%), specimens. Fig 2. In 2/70 specimens (2.86%) the PCA is arising from ICA. In one of these specimens, the PCA is on the right side (3%) and the other is on the left side. Table-5.

	No. of Specimens	Right Large	Left Large	Equal
Adult	20	1	4	15
Foetal	50	7	8	35

Table 1

The following table and adjacent bar diagram show the presence or absence or otherwise anterior communicating artery.

	No. of Specimens	Presence	Absence	Single	Double
Adult	20	18	2	16	2
Foetuses	50	50	0	50	0

Table 2

	No. of Specimens	Normal / Horizontal	Absence	Abnormal/ Oblique
Adult	20	15	2	3
Foetuses	50	50	0	0

Table 3: Direction of Anterior Communication Artery

The following table and pie diagram show the Presence and Absence of Posterior Communicating Artery.

	No. of Specimens	Presence	Absence
Adult	20	19	1
Foetuses	50	48	2

Table 4

	No. of Specimens	Equal	Unequal	
			Right Large	Left Large
Adult	20	12	3	5
Foetal	50	36	12	2

Table 5: The size of posterior cerebral artery

Comparison of the total percentages of anomalies in posterior communicating arteries with the earlier authors.

	Percentage	Equal / Lesser / Greater
Present study	34.29%	---
Jain P. N. 1990	50%	>
Puchadas orts. A 1976	58%	>

Table 6

	Adult				Foetal			
	Absent		String Like		Absent		String Like	
	Right	Left	Right	Left	Right	Left	Right	Left
Present study	5%	5%	--	5%	2%	--	--	--
Earlier studies	-	-	-	-	-	-	-	-
Jayasri N and Sadasivan G. 1981	2%		9%		--		--	
Vare A.M. & Bansal P.C. 1970	--		11.7%		--		--	
Fawcett E and Blackford J.D. 1905	3.9%		--		--		--	
Ronald A. Bergman et al. 2000	3.09%		--		--		--	
Alpar B.J. and Berry R.G. 1963	0.6%		--		--		--	
Windi 1888	12.5%		--		--		--	
Stopfords 1917	7%		--		--		--	

Table 7: Table showing the percentage of absence and string like in Posterior Communicating artery

The Posterior Cerebral Artery arising from ICA comparative statement

	PCA from ICA	Comparison whether equal / more / less
Present Author	2.86%	
Earlier studies:		
Sundarland S. 1948	32%	>
Alpar B.J & Berry R.G. 1963	15%	>
Vere A.M. & Bensol P.C. 1970	25	>
Macchi C 1996	13	>
Puchades Orts A. et al 1976	11.29%	>
Prasad J. & Lal RLP 1970	8.7%	>
Table 8		



Fig. 2: Absence of anterior communicating artery

	No. of Specimens	Normal		Abnormal	
		No.	%	No.	%
Adult	20	15	75%	5	25%
Foetal	50	48	96%	2	4.6%
Table 9					

The above abnormalities have been tabulated here in the following table.

Abnormal circles of Willis

Total no. of abnormal circles	7
Absence of anterior communicating artery	2
Double anterior communicating artery	2
Absence of posterior communicating artery	3
Table 10	



Fig. 3: Left ACA is larger



Fig. 1: Double anterior communicating



Fig. 4: Right ACA is larger



Fig. 5: Absence of posterior



Fig. 6: String like posterior communicating artery communicating artery

DISCUSSION

Anterior Cerebral Artery

An enormous percentage (71.43%) of specimens (50/70) of this study shows equality of ACA on both the sides. In 12/70 (17.14) specimens, the ACA is larger on left side. On right side the artery is relatively large in 8/70 (11.43%) specimens. The arteries of the left side appear to be larger than those of the right side.² The findings of the present study regarding these variations are similar to the observations of Lee R.M. 1995 who noticed the underdevelopment of one of the two arteries.³ The two anterior cerebral arteries frequently differ in size at their origin and the larger one reinforces the other through

anterior communicating artery.⁴ Heubner's artery in all the specimens of the present study arises proximal to the fusion on both the sides. According to present study neither absence nor duplication nor any other sort of anomaly could have been observed. This phenomenon is dissimilar to the studies of Ronald Bergman who noticed infrequent variations, i.e. duplication of the A-1 segment and a third or medium ACA arising from the ACoA.⁴ Similarly, the present study also varies from the congenital absence of ACA in 1% cases on one side.⁵

The present study shows that the ACoA is ranging in its length from 3mm to 4mm in 64/70 (96%) specimens. In 6/70 (8.5%) specimens, the length is ranging from 1mm to 2mm. The ACoA is usually between 2mm to 3mm in length, but may vary from 0.3mm to 7mm giving a wide range of variation in length.⁴ Two adult specimens have showed double anterior communicating artery (2/20, 10%), in agreement with.^{4,6,7,8,9} In 3 of the adult specimens the ACoA is obliquely placed, in similarity to the findings of Esra Gurdal 2004. (1/20, 15%).⁶ Absence of ACoA is seen in 2 adult specimens; (2/20, 10%) on par with the findings of.^{4,6,7,8,9} The occurrence of anomalies of the ACoA in the present study is seen only in adult specimens ranging to 25% similar to.^{6,10}

Middle Cerebral Artery

The variations of the MCA in the present study is normal in total 100% (70/70) specimens similar to.¹¹ Contrary to the findings of Umansky F et al.1998.¹² who noticed fenestration in 1%, duplication in 1% accessory MCA in 2%, quadrifurcation in 4% cases, we have not noticed any such variations or anomalies in our studies.

Posterior Communicating Artery

The left side PCoA is larger in 14/70 (20%), specimens. Fig no. 2. The arteries of the left side appeared most commonly to be larger than those of the right ones.² the left PCoA had been often fully developed and the right ones underdeveloped.⁴ In accordance with the standard text books, Gray's Anatomy and Last's Anatomy, the two PCoA's, i.e. the left one and the right one are often unequal in size. A string like artery in the current study could be observed on the left side of one adult specimen 1/70 (1.43%), in relevance to.^{13,14,15} The PCoA in this study is absent in 3/70 (4.29%), specimens. Out of these, 3 and 2 are foetal and one is of adult. This observation is having a close relevance to.^{1,4,7,15,16} Out of the above said 3 specimens, 2 specimens have absence of PCoA on left side and one specimen has on right side. The present study has 34.29% (24/70) specimens of total anomalies similar to.^{10,17}

Posterior Cerebral Artery

On the right side the PCA is larger in 15/70 (21.43%) specimens. On the left side it is larger in 7/70 (10%), specimens. The above said right and left parameters are in inverse relationship with PCoA in cohesion with.¹⁴ In 2/70 specimens (2.86%), the PCA is arising from ICA. In one of these specimens, the PCA is on the right side (3%). In this context, the present study is giving a wide range of deviation from the earlier authors.^{1,16,17,18,19} in whose observations the PCA arose from ICA ranging from 8% to 32%.

CONCLUSION

However, the brief understanding is the total abnormalities and variations in the different arteries which have been

discussed so far reveals that these abnormalities and variations are more or less relatively equal in foetal and adult specimens. Hence, this aspect of observation can be identified with that of Baptista A.G.²⁰ 1964, who said "there is no significant difference between a child and adult intracranial arteries of the brain."

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