

STUDY OF VARIATIONS IN ANTERIOR CEREBRAL ARTERY IN HUMAN CADAVERS

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Abstract

Background: Anterior Cerebral Artery (ACA) is one of the terminal branches of Internal Carotid Artery (ICA). It starts at the medial end of the stem of lateral fissure, passes anteromedially above the optic nerve to the great longitudinal fissure. Variations in anterior circulation of the brain is important in Neuro surgical Interventions particularly related to aneurysms and craniotomies. The aim of the study is to find the variations in the Anterior Cerebral Artery in the Human cadavers. **Materials and Methods:** The Ethics clearance was obtained from the Institutional ethics committee. This study was conducted in 60 adult brain hemispheres from 21 male and 9 female cadavers in the Institute of Anatomy, Madras Medical College, Chennai. The brain hemispheres are collected from the embalmed cadavers allotted for the routine academic dissections for the first MBBS and first BDS students. Through conventional dissection method thirty whole brains were removed. The anterior cerebral artery origin was noted and its number was noted. The course of ACA was traced and its relation to optic chiasma, optic nerve and optic tract was noted. The A1 segment length, diameter was measured. The obtained data was entered in the MS Excel Windows 10. Statistical analysis was done with the help of SPSS 23. Categorical data was expressed in terms of Numbers and percentages. The data collected will be entered in the MS Excel and statistical analysis done through SPSS 23. **Result:** In our study no variation observed in the origin of ACA in the present study. In all the sixty hemispheres, the Anterior Cerebral Arteries of both right and left sides were single. Duplication or triplication of the ACA was not observed in the present study. The length of A1 segment in all the sixty hemispheres was measured. The maximum length of A1 segment was 16 mm on both right and left sides. The minimum length of A1 segment observed was 12mm on both sides. The maximum diameter of the A1 segment observed on the right side was 2.58 mm and on left side was 2.60 mm. The minimum diameters for the left and right sides were 0.68 and 0.72mm respectively. **Conclusion:** The study concludes that there is no variations in our study. The comprehensive study of the origin, course, length, diameter, branches and the distance of origin of branches of Anterior Cerebral Artery and Anterior Communicating Artery will be useful to the neurosurgeons for planning endovascular surgeries and anastomosing surgeries.

INTRODUCTION

An important terminal branch of Internal Carotid Artery is Anterior Cerebral Artery. With the anterior communicating artery (ACoA) anterior cerebral artery forms the anterior component of circle of Willis. Anterior cerebral artery supplies blood to the midline portion of the cerebrum on both the sides. They are interconnected by the anterior communicating artery. Orbitofrontal and Medial

hemispheric portions of the brain is supplied by Anterior cerebral artery. It curves around the corpus callosum up to the splenium with cortical and central branches. Anterior cerebral artery is divided into five segments anatomically, i.e A1, to A5. A1 segment is the part which is from the origin to the level of anterior communicating artery. This segment ascends on the Medial surface of the hemisphere and will continue posteriorly on the superior surface of the corpus callosum as A2, A3, A4 and A5 segments.

These segments are demarcated by orbital, frontal-polar, callosal marginal and pericallosal arteries.^[1-3] Large number of morphologic and angiographic anomalies are seen in Circle of Willis. These are not rare anomalies. As these anomalies could cause serious clinical implications we should always keep these anomalies in our mind.^[4-6] Sensory loss in the lower limb, constant weakness, behavioural changes known as Anterior cerebral artery syndrome will occur if there is ischemia in the area supplied by the anterior cerebral artery. The aim of the study is to find the variations in the anterior cerebral artery and its clinical importance.

MATERIALS AND METHODS

This study was conducted in 60 adult brain hemispheres from 21 male and 9 female cadavers in the Institute of Anatomy, Madras Medical College, Chennai. The brain hemispheres are collected from the embalmed cadavers allotted for the routine academic dissections for the first MBBS and first BDS students. Through conventional dissection method thirty whole brains were removed from the cranial cavity and was cut into two equal hemispheres using the brain knife. The anterior cerebral arteries were observed on the medial surface. The anterior cerebral artery origin was noted and its number was noted. The course of ACA was traced and its relation to optic chiasma, optic nerve and optic tract was noted. The number of A1 segment was noted and its length was measured using thread and scale. The A1 segment diameter was measured using

digital vernier caliper after injecting the latex into the Internal carotid artery.

The Ethics clearance was obtained from the Institutional ethics committee. The obtained data was entered in the MS Excel Windows 10. Statistical analysis was done with the help of SPSS 23. Categorical data was expressed in terms of Numbers and percentages.

RESULTS

In the present study, the Anterior Cerebral Artery arose from the Internal Carotid Artery of the same side in all the 60 cerebral hemispheres. There was no variation observed in the origin of ACA in the present study.

In all the sixty hemispheres, the Anterior Cerebral Arteries of both right and left sides were single. Duplication or triplication of the ACA was not observed in the present study.

On the right side, out of 30 cerebral hemispheres, ACA passed above the optic nerve in 23 specimens (76.7%). In 6 specimens, ACAs passed above the optic chiasma (20%). In one specimen the optic nerve passed below the optic chiasma (3.3%). On the left side, out of 30 cerebral hemispheres, ACAs passed above the optic nerve in 23 specimens (76.7%) and ACAs passed above the optic chiasma in 7 specimens (23%).

The length of A1 segment in all the sixty hemispheres was measured. The maximum length of A1 segment was 16 mm on both right and left sides. The minimum length of A1 segment observed was 12mm on both sides.

Table 1: Relation of the ACA to Optic nerve and Optic chiasma.

Cerebral hemispheres	Above OP. N		Above OP.C		Below OP.C	
	Number	%	Number	%	Number	%
Right	23	76.7	6	20	1	3.3
Left	23	76.7	7	23	-	-

Table 2: Length of the A1 segment of ACA (mm)

A1 segment	Number of cerebral hemispheres	Maximum length in mm	Minimum length in mm	Mean length in mm	SD
Right	30	16.00	12.00	13.70	1.02
Left	30	16.00	12.00	14.43	0.97

Table 3: Diameter of the A1 segment of ACA (mm)

A1 segment	Number of cerebral hemispheres	Maximum Diameter in mm	Minimum Diameter in mm	Mean Diameter in mm	SD
Right	30	2.58	0.72	1.72	0.34
Left	30	2.60	0.68	1.76	0.41

Name of the study	Relations of ACA			
	Above the Opt. Nerve	Below the Opt. Nerve	Above the Opt. Chiasma	Below the Opt. Chiasma
SB Pai et al. ^[10] (2005) Bangalore	+	-	+	-
Cessy Job, ^[11] (2016) Kerala	+	-	+	-
Present Study	+(46)	-	+(13)	+(1)

Name of the study	Absent	Single	Double	Triple
Sandhya et al. ^[12] (2013) Maharashtra	1.8	97.3	1.1	
Shwetha Kedia et al. ^[13] (2013) Chandigarh		96.60	3.30	
Cessy job et al. ^[11] (2016) Kerala	0.96	97.1	1.92	

Present Study		100.00		
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Name of the study	RIGHT			LEFT		
	Max (mm)	Min (mm)	Mean (mm)	Max (mm)	Min (mm)	Mean (mm)
Sylvia Kamath et al, ^[14] (1981) Bangalore	25.60	0.34	14.70	21.00	3.10	13.80
Smitha B.Shinde, ^[15] (2016) Aurungabad	15.00	11.00	13.00	13.00	11.00	12.04
Present Study	16.00	12.00	13.70	16.00	12.00	14.43

The diameter of A1 segment in all the sixty hemispheres was measured. The maximum diameter of the A1 segment observed on the right side was 2.58 mm and on left side was 2.60 mm. The minimum diameters for the left and right sides were 0.68 and 0.72mm respectively



Figure 1: Length and Diameter of Anterior Cerebral artery

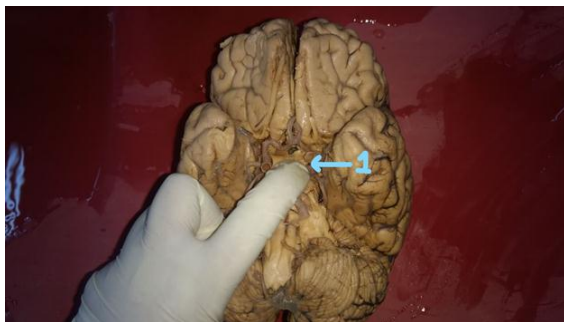


Figure 2: A 1 Segment of Anterior Cerebral artery



Figure 3: Relation of the Anterior Cerebral artery to Optic chiasma

In the [Figure 3] on the right side anterior cerebral artery passes above the optic chiasma whereas on the left side anterior cerebral artery passes below the optic chiasma.

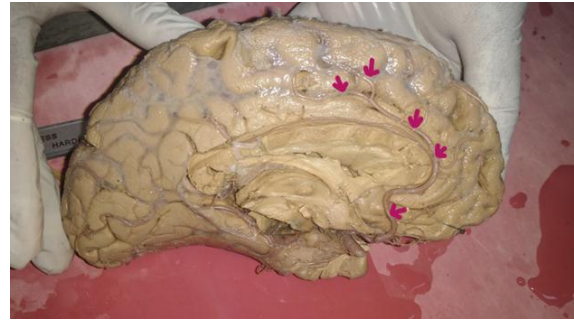


Figure 4: Branches of Anterior Cerebral artery

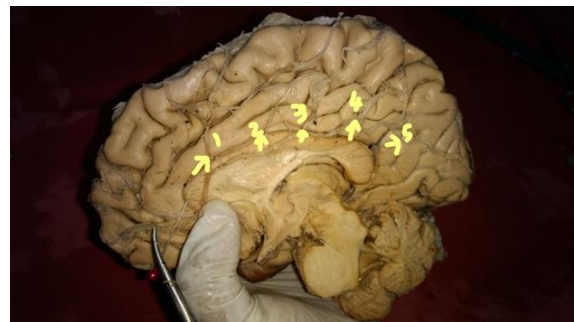


Figure 5: Branches of Anterior Cerebral artery

DISCUSSION

Origin

Among the study participants, the Anterior Cerebral Artery arose from the Internal Carotid Artery of the same side in all the 60 cerebral hemispheres. Similar results was also observed in Saidi hassan et al,^[7] observed ACAs of all hemispheres originated from the ICA of the same side.

Rishi Pokrel et al,^[8] study done in 2013 during his routine dissection observed a case where both the right and left ACAs arose from right ICA which was slightly larger than left ICA. Mahajan et al,^[9] (2018) observed an incidental anomalous variation of left ACA arising from the right ICA.

Relation of ACA to optic nerve and optic chiasma:

In the present study, out of 60 ACAs, 46 ACAs passed above the optic nerve, 13 ACAs passed above the optic chiasma and in one specimen on the right side the ACA passed below the optic chiasma.

The relation of ACA to optic nerve and chiasma scores surgical significance in planning for

temporary vascular clipping in ACoA aneurysmal procedures.

Number of A1 segments of the ACA: In the present study in all the 60 cerebral hemispheres, A1 segments were single. There was no double or triple ACAs observed.

Length of the A1 segment of ACA (mm): The present study measurements were close to the results obtained by Sylvia Kamath in his study. However measurements noted in all the above studies were within the range observed in the present study.

Diameter of A1 SEGMENT (mm): In the present study, on the right side, the maximum diameter of the A1 segment observed was 2.58 mm. The minimum diameter of the A1 segment observed was 0.72mm. The mean diameter of the A1 segment observed was 1.72mm. On the left side, the maximum diameter of the A1 segment was 2.60mm. The minimum diameter of the A1 segment observed was 0.68 mm. The mean diameter observed on the left side was 1.76mm. The measurements of the present study coincides with the results observed by both Sylvia Kamath et al study and Smitha B Shinde et al studies.

The Anatomical variations in the number and diameter of the A1 segment constitute the main indicators for preoperative planning of ACoA aneurysmal clipping procedures. The incidence of intraoperative ACoA aneurysmal rupture during clipping is more common in short A1 segment. Moreover, the surgical access to the inferiorly pointing ruptured ACoA aneurysms is more difficult in short A1 segment. In aneurysm of ACA with unequal diameter of both sides, the base of the aneurysm arises on the side of larger A1 and the dome points towards the side of the hypoplastic A1.

CONCLUSION

The study concludes that the relation of the Anterior Cerebral artery to the Optic nerve gives us an idea about the location of compression in visual defects. In aneurysm of ACA with unequal diameter of both sides, the base of the aneurysm arises on the side of larger A1 and the dome points towards the side of the

hypoplastic A1. The comprehensive study of the origin, course, length, diameter, branches and the distance of origin of branches of anterior cerebral artery and anterior communicating artery will be useful to the neurosurgeons for planning endovascular surgeries and anastomosing surgeries. It is also useful for radiologists to interpret various imaging of Anterior Cerebral Artery.

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