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Research Article

Retrospective Study of Morphometry and Variations in Anterior Communicating Artery in Human Cadaveric Brains in Eastern Uttar Pradesh Region

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Abstract

Background: Anterior communicating artery connects the two anterior cerebral arteries and is located across the commencement of the longitudinal fissure. Anterior Communicating Artery is an important artery to form the anterior part of the circle of Willis. Present study was conducted to know the morphometry and variations of anterior communicating artery like number, diameter, length, course and direction of placement. The knowledge of the variations of anterior communicating artery is important for radiologists, neurosurgeons and anatomists.

Materials and Methods: Present study was a retrospective study conducted in department of anatomy, Government medical college, Azamgarh, Uttar Pradesh and Subharti Medical College, Meerut, Uttar Pradesh. Duration of the study was more than six years in 100 adult embalmed human cadaveric brains. After removal of the brain from cadavers used in routine educational dissection for MBBS students, the anterior communicating artery was dissected and cleaned and measurements were taken and then digitally photographed.

Results: Among 100 adult brains anterior communicating artery were absent in 02% of the specimens. Course was oblique in 50% and horizontally placed in 50% of the specimens. No duplication and triplication were seen. Average length was 2.82 mm and average diameter was 1.11 mm.

Conclusion: From the present study we conclude that the variations of anterior communicating artery are common. In present study in 02% of the specimens the anterior communicating artery were absent. Oblique and horizontal pattern were also seen in the present study and were found equally. Duplication and triplication were absent. The knowledge of these variations of anterior communicating artery is important for radiologists, neurosurgeons, and anatomists.

Keywords: ACoM Anterior Communicating Artery; ACA Anterior Cerebral Artery

Introduction

Anterior communicating artery connects the two anterior cerebral arteries and are located across the commencement of the longitudinal fissure. Anterior communicating artery is an important artery in the formation of anterior part of the circle of Willis. Aneurysm formation is a common finding found in the anterior communicating artery and these aneurysms can produce variety of symptoms like endocrine dysfunction and sometimes localized frontal headache. Both anatomical structure and physiological functions of brain are complex but essential to sustain life. Starting from planning and initiation, voluntary movements, behaviour, memory, sensory and motor functions, hearing and vision, regulation of all visceral functions are directly or indirectly controlled by brain. The brain receives blood from two sources: internal carotid artery (ICA) and vertebral artery. The internal carotid artery begins in the neck where the common carotid artery bifurcates. The internal carotid artery is one of the terminal branches of the common carotid artery at the level of the upper border of the thyroid

cartilage. It courses through the neck within the carotid sheath and then enters the skull in petrous part of the temporal bone through the carotid canal. The internal carotid artery then runs forward through the cavernous sinus lying in the carotid groove on the side of the body of the sphenoid bone. The internal carotid arteries finally end below the anterior perforated substance by dividing into two major cerebral arteries. The right and left vertebral arteries come together and join each other at the level of pons on the vertebral surface of the brain stem to form a midline single basilar artery which runs in the basilar sulcus of the brain stem. The basilar artery which runs in the basilar sulcus of the brain stem joins the blood supply from the internal carotids in an arterial ring at the base of the brain known as the circle of Willis. The posterior cerebral arteries at this confluence, as two small bridging arteries, the anterior and posterior communicating arteries. Anterior communicating artery joins the two anterior cerebral arteries and takes part in the formation of anterior part of the circle of Willis. Conjoining the two major sources of blood supply through the circle of Willis presumably improves the chances of any region of the brain continuing to receive the blood even if one of the major arteries become occluded as seen in the case of thrombosis of one anterior cerebral artery due to inflow of blood from contralateral anterior cerebral artery through the anterior communicating artery. The anterior cerebral artery is the smaller terminal branch of the internal carotid artery. Surgical nomenclature divides the anterior cerebral artery in following three parts namely A-1 segment, A-2 segment and A-3 segment. The anterior communicating artery is the landmark of A-1 segment of anterior cerebral artery. A-1 segment start from origin of anterior cerebral artery from the internal carotid artery up to the anterior communicating artery. The anterior cerebral artery starts at the medial end of lateral fissure and passes anteromedially above the optic nerve to the great longitudinal fissure where it is connected by anterior communicating artery to another anterior cerebral artery. The anterior communicating artery shows many variations like absent, duplication, triplication etc. anterior communicating artery gives numerous anteromedial central branches that supply the optic chiasma, lamina terminalis, hypothalamus, para olfactory areas, anterior column of the fornix and the cingulate gyrus. The anterior communicating artery aneurysms are most frequently occurring intracranial aneurysms and surgical treatment of these aneurysms are important to save the life of the patient. For neurosurgeons the knowledge of the variations of anterior communicating artery is important. As the variations of anterior communicating artery is common and the artery is deeply placed in the brain so the knowledge of these variations of anterior communicating artery is important for radiologists and anatomists also. The anterior communicating artery is also an important part of circle of Willis to maintain the blood flow to the important areas of the brain.

Aims and Objectives

Present study was conducted to know the variations of anterior communicating artery like number, diameter, length, course and direction of placement. The knowledge of variations of anterior communicating artery is important for radiologists, neurosurgeons, and anatomists. Aneurysms of the anterior communicating artery is common and needs microsurgery as a treatment to save the life of the patient and as the artery is deeply placed in the brain and with lots of variations so the knowledge of these variations are very important not only for the anatomists and radiologists but also for the neurosurgeons.

Materials and Methods

A Retrospective study was conducted with duration of more than six years from January 2017 to April 2023 in 100 adult embalmed human cadaveric brains in the department of anatomy, Government Medical College, Azamgarh, Uttar Pradesh and Subharti Medical College, Meerut, Uttar Pradesh. After removal of the brain from cadavers used in routine educational dissection for undergraduate students, the Anterior Communicating Artery was dissected and cleaned, and measurements were taken with digital Vernier callipers and then digitally photographed. The external diameters were taken at its both the ends and at midpoint and finally its average diameter at the three points was obtained. Any anterior communicating artery with a diameter less than 1 mm has been described as hypoplastic by various authors and this definition was accepted in present study. Variations in the diameter, length, absence, number (duplication, triplication) placement (oblique or horizontally placed) were noted.

Statistical analysis

The calculations of length and diameter were calculated as mean ± standard deviation. Incidences of variations were calculated as percentage. Quantitative parameters were compared by independent t-test. A p-value less than 0.05 was taken to be significant. All statistical analysis was carried out through statistical software SPSS version 25.0.

Results

Among 100 brain, anterior communicating artery were absent in 02% specimens. The course of anterior communicating artery was oblique in 50% and horizontally placed in 50% of the specimens. The length of the anterior cerebral artery was an average of 2.82 mm with a range of 1.5 mm to 5.9mm. the mean diameter of anterior communicating artery was 1.11 mm with the range of .59 mm to 2. 1mm. Hypoplastic anterior communicating artery was found in 5% specimens in which the diameter was less than 1 mm and was said to be hypoplastic.

Variations	Percentage of occurrence
Absent	02
Duplication	0
Triplication	0

Table 1: Variations in number of anterior communicating artery.

Variations	Percentage of occurrence
Oblique	50
Horizontal	50

Table 2: Variations in the course of anterior communicating artery.

Variations	Percentage of occurrence
Hypoplastic	5
Plexiform	0
Fusion	2
Dimple	0

Table 3: Variations in the form of anterior communicating artery.

Discussion

The anterior communicating artery is an important artery of the brain and helps in the formation of circle of Willis in the anterior part and connects the two anterior cerebral arteries and completes the circle of Willis anteriorly. Posteriorly the circle of Willis is completed by posterior communicating artery by connecting the vertebral arterial system with the carotid system on either side. Some workers considered the circle of Willis to be complete even if the normal anterior communicating artery was absent and the anterior cerebral arteries were joined directly with each other. Such a circle of Willis should be considered as anatomically incomplete but physiologically complete.

In the present study the anterior communicating artery was absent in 3% of subjects. Fawcett and Blatchford, von mitterwallner, Blackburn, Vare and Bansal, Jain and Kanchan Kapoor found the same variation of anterior communicating artery but less than that in the present study.Poorwa et al also described the same variation but the frequency of variation was more when compared with the present study.

Author	Brain examined	Absent	Duplication	Triplication	Fusion	Plexiform
Windle [7]	200	-	11 %	-	3 %	0.55
Stopford [8]	150	-	10 %	-	3.33%	1.33%
Fawcett and Blatchford [9]	700	0.14 %	7.28 %	-	-	0.42%
Blackburn [10]	220	0.90 %z	6.36 %	-	-	-
Von Mitterwallner [11]	360	0.27 %	20.55 %	-	1.66%	1.33%
Vare and Bansal [12]	175	1.14 %	2.85 %	2.28 %	-	-
P.N Jain [13]	144	0.69 %	19 %	0.69 %	0.69%	-
Kanchan Kapoor [14]	1000	1.8 %	10 %	1.2 %	-	0.4%
Poorwa Baburao., *et al*. [15]	100	8 %	10 %	1 %	3%	3%
Present Study	100	2 %	0%	0%	2%	0%

Table 4: Comparison of the present study with past studies on anterior communicating artery.

In the present study no doubling of anterior communicating artery (0%) waspresentbut some previous studies like Windle, Fawcett and Blatchford, Blackburn, Stopford, VonMitterwalner, Vere and Bansal, P.N Jain, Kanchan Kapoor and Poorwa., *et al*. observed duplication of the anterior communicating artery.

In the present study no triplication of anterior communicating artery was observedand the incidence of this variation was similar to the findings of the study done byWindle, Fawcett and Blatchford, Stopford, Von Mitterwallner. Some studies observed triplication of anterior communicating artery like Vare and Bansal, P.N Jain, Kanchan Kapoor and Poorwa., *et al.*

In the present study persistence of plexiform pattern of anterior communicating artery were absent but this variation was observed by many previous studies such as Windle, Fawcett and Blatchford, Stopford, Von Mitterwallner, Kanchan Kapoor, and Poorwa.

In the present study the length of anterior communicating artery was an average of 2.82 mm with a range of 1.5 mm to 5.9mm. The length of the ACoM observed by Dhana Lakshmi was between 2 to 3 mm and the length observed by J. Shatri., *et al*. was 2.99 mm on average with a range of 1 mm to 5.6mm.

In the present study the diameter of ACoM was 1.11 mm with a range of .59 mm to 2.1 mm. Dhana Lakshmi observed the diameter range of 0.2 mm to 3.4 mm with an average of 1.5 mm. J. Shatri., *et al*. observed an average diameter of 1.16 mm with range of 0.9 mm to 2.1 mm.

Further research on anterior communicating artery can be done by including the radiological and surgical findings also. Radiological and neurosurgical variations can be added along with the morphometric anatomical study in further study of this important artery. In further study we can compare the anatomical, surgical and radiological variations of the anterior communicating artery to get wide spread results in variations of anterior communicating artery to enhance the knowledge about the variations of anterior communicating artery.

Figure 1: Absent anterior communicating artery.

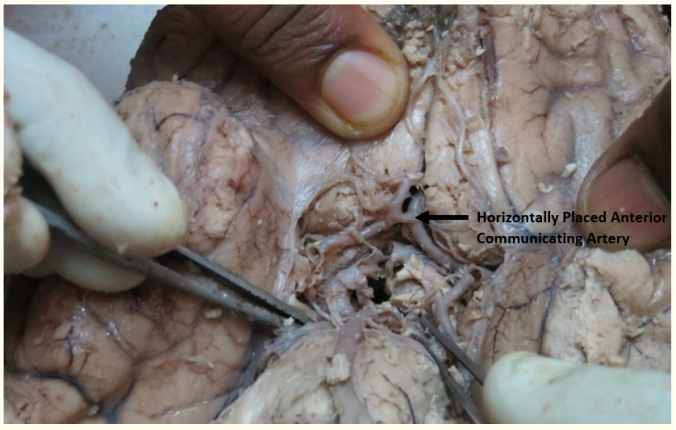

Figure 2: Horizontally placed anterior communicating artery.

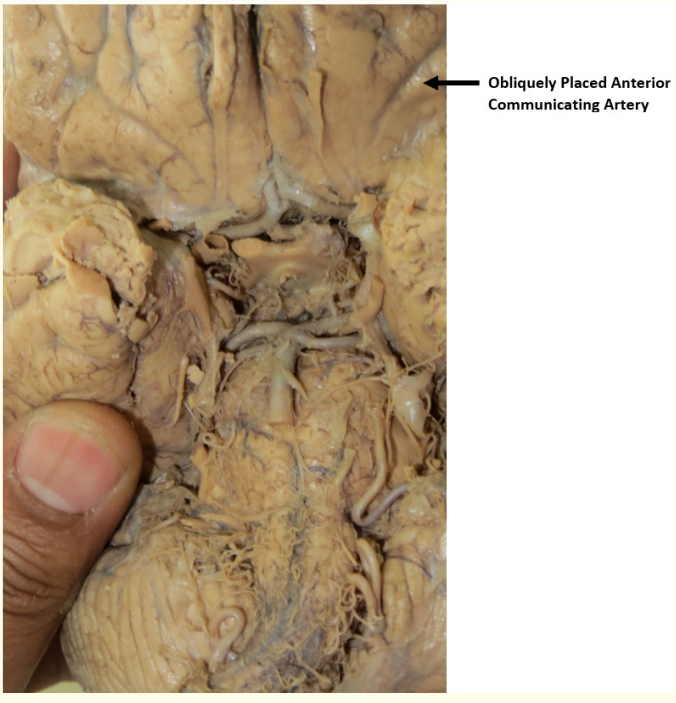

Figure 3: Obliquely placed anterior communicating artery.

Conclusion

From the present study we conclude that variations of Anterior Communicating Artery are common and in the present study we observed absent anterior communicating artery in 2% of the specimens. The length of the anterior communicating artery was on an average 2.82 mm and the diameter of the anterior communicating artery was 1.11 mm with a wide range of variation. Oblique pattern was seen in 50% and horizontally placed anterior communicating

artery in 50%. In present study duplication and triplication were absent. The knowledge of wide range of variations of anterior communicating artery is very important for neurosurgeons, radiologists and anatomists because the variations of the anterior communicating artery is commonly encountered during neurosurgery of the aneurysms of anterior communicating artery. The anterior communicating artery supplies many important structures of the brain with wide variations like absence, duplication, triplication, hypoplastic, oblique placement, horizontal placement, variations in lengths and diameters make this artery as an important artery for the neurosurgeons, radiologists and anatomists. The anterior communicating artery is the part of circle of Willis and helps to maintain the blood flow in the brain if one anterior cerebral artery is blocked due to any pathology. The knowledge of these variations of Anterior Communicating Artery is important in brain surgery and in radiology also.

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