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Original Research Paper

Anatomy

STUDY OF DIAMETER AND VARIATIONS OF POSTERIOR CEREBRAL ARTERY BY MR ANGIOGRAPHY.

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ABSTRACT The basilar artery terminates by dividing into two posterior cerebral anteries at a veriable level but most frequently in the interpeduncular cistern, behind the dorsum sallae. Each posterior cerebral arteries supplies respective occipital lobe of the cerebrum. The present study is designed to know the diameter and variations of posterior cerebral artery included MR Angiographies of 132 patient.

The diameter of posterior cerebral artery measure 2 mm away from its origin and observe variation of artery. The mean diameter of posterior cerebral artery of all age group are Right - 1.5 mm, and Left - 1.5 mm (2) below age group 60 year- Right – 1.6 mm and Left – 1.6 mm (3) age above 60 year – Right – 1.7 mm and Left- 1.7 mm. Variations in posterior cerebral arteries are Hypoplastic 1.89% and Absence 4.03%. The need for the diamensional data for diameter of artery and variations by neurosurgeons and radiologist as well as researchers but no comprehensive measurements have been published especially, in the Indian data.

KEYWORDS : Diameter, Variation, Posterior Cerebral Artery.

Introduction

The basilar artery terminates by dividing into two posterior cerebral arteries at a variable level but most frequently in the interpeduncular cistern, behind the dorsum sallae.

The surgical nomenclature identifies three segments : p1 - form the basilar bifurcation to the junction with the posterior communicating artery, p2 - from the junction with the posterior communicating artery to the portion in the perimesencephalic cistern, and p3 - the portion running in the calcarine fissure.

The posterior cerebral artery is larger than the superior cerebellar artery, from, which it is separated near its origin by the occulomotor nerve and lateral to the midbrain, by the trochlear nerve. It then winds round the cerebral peduncle and reches the tentorial cerebral surface, where it supplies the temporal and occipital lobs. Like the anterior and middle cerebral arteries, the posterior cerebral artery has cortical and central branches [6].

The haemodynamics of the circle is influenced by variation in the calibre of communicating arteries and in the segments of the anterior and posterior cerebral arteries which lies between their origins and their junction with the corresponding communicating arteries. The greatest variation in calibre between individuals occur in the posterior communicating artery commonly, the diameter of the precommunicating part of the posterior cerebral artery is larger than that of the posterior communicating artery in which case of the blood supply to the occipital lobes is mainly from the vertebrobasilar system. Sometimes, however, the diameter of the precommunicating part of the posterior cerebral artery is smaller than that of the posterior communicating artery in which case the blood supply to the occipital lobes is mainly from the internal carotids via the posterior communicating arteries. Agenesis or hypoplasting of the initial segment of the anterior cerebral artery are more frequent than anomalies in the anterior communicating artery and contribute to defective circulation in about a third of individuals [6].

Though many workers have reported abnormalities in the diameter of the vessels forming the circle of willis, the normal dimensions of these vessel have been not reported. The vessels have been described as, narrow, thread like, string like, but actual diameter has nearly been measured. Its increasing utilization in angiography and development of cevebrovascular surgary, there is obvious need for validating this concept of the architecture of the circle of willis.

The present study included MR Angiographies of 132 patients, the diameters of vessels were mesured where they formed part of the circle of willis and observed variation only in the right and left posterior cerebral arteries. The need for dimensional data for diameter of vessels is expressed by neurosurgeons and radiologist as well as researchers but no compressive measurement have been published especially in the indian data.

Materials and methods

The study included MR Angiographies of 132 patients (88 males and 44 females) for male age range from 18 to 80 years (mean 49 years) while for the femaie age range from16 to78 years (mean 49 years) patients having cerebral ischaemia caused by atherosclerosis, embolism and infarction were excluded in this study and also patient with history of accidental head injuries and tumors were excluded. In this study patient having complaints other than those mentioned above were included in the study.

The magnetic resonance imaging (MRI) machine is 1.5 Tesla super conducting magnet (Magnetom, Siemens Eriagen, Federal Republic of Germany) that uses liquid helium. Brain images were obtained with a circularly polarized head coil. MRI room is air - conditioned, attached to machine room is console room, which has computerized monitor on which images are directly seen.

The patient is made to lie down in supine position on the table and a specific circularly polarized head coil is adjusted for the head region. The table can moved vertically and horizontally, with the help of these movements, patients head is allowed first inside the machine i.e. head first in supine position in all patients MRI was performed in axial plane. The method of MRI technique used three diamensional - time - of - flight MRA sequence or time - of- flight turbo MRA, circle of willis sequence

There MR angiograms were evaluated on a dedicated work station by using maximum intensity projection posterior cerebral artery assessed by measuring the diameter and section of vessels that were visualized as continuous segments for at least 1 mm in diameter were considered normal, those smaller than 1 mm in diameter were considered hypoplastic. Those segment, which were not visualized, were considered as absent.

The diameters of the vessels were measured where they formed part of the circle of willis. The right and left posterior cerebral arteries are

measured 2mm away from its origin and observed variation of vessels

Observation

Table 1 - Observed number of posterior cerebral artery in both males and females of all age groups

SR NO	OBSERVATION	NUMBER
1	Number of observed artery	132
2	Number of observed artery in males	88
3	Number of observed artery in females	44
4	Number of observed artery in below 60 years (both males and females)	101
5	Number of observed artery above 60 years (both males and females)	31
6	Number of observed artery above 60 years (both males and females) A) Right posterior cerebral artery B) Left posterior cerebral artery	129

Table 2 - Mean diameter of posterior cerebral artery (all age group)0 yrs.)

Sr. No.	Name of Artery	Males		Females		Males + Females	
		No.	Mean (mm)	No.	Mean (mm)	No.	Mean (mm)
1.	Right posterior cerebral artery	80	1.6	42	1.5	122	1.5
2.	Left posterior cerebral artery	85	1.6	44	1.5	129	1.5

Table 3 - Mean diameter of posterior cerebral artery (agebelow 60 yrs.)

Sr. No.	Name of Artery	Males		Females		Males + Females	
		No.	Mean (mm)	No.	Mean (mm)	No.	Mean (mm)
1.	Right posterior cerebral artery	65	1.7	29	1.6	94	1.6
2.	Left posterior cerebral artery	69	1.7	30	1.6	99	1.6

Table 4 - Mean diameter of posterior cerebral artery (age above 60 yrs.)

Sr. No.	Name of Artery	Males	Females	Males +	Females		
		No.	Mean (mm)	No.	Mean (mm)	No.	Mean (mm)
1.	Right posterior cerebral artery	15	1.8	17	1.7	28	1.7
2.	Left posterior cerebral artery	16	1.8	14	1.6	30	1.7

DISCUSSION

Sir Thomas Willis [16] first indicated the collateral potential of the circle in his Cerebri Anatome in 1664. The development of such collateral routes depends on individual morphological and hemodynamic factors. Though many workers have reported abnormalities in the diameter of vessels forming the circle of willis, the normal dimensions of these vessels have not been reported. The vessels have been described as, narrow, thread like, string like. But actual diameters have rarely been measured. With increasing utilization of angiography and development of cerebrovascular surgery, there is obvious need for validating this concept of the architecture of the circle of willis.

However three dimensional time-off-flight MR as angiography MJ Krabbe -Hartkamp et al (1998) revealed that many of the communicating vessels had diameters of 0.8 mm. Twenty five percent of posterior communicating artery and fetal type of posterior cerebral artery vessels were classified as absent, hypoplastic with three dimensional time-of-flight MR angiography when 0.8 mm threshold was used. In autopsy study performed earlier by Hillen B (1987)[7] on 100 normal adult brains diameter of posterior communicating artery and fetal posterior cerebral artery, if 0.6 mm or less, these vessels were defined as hypoplastic, in normal distribution of diameter the three dimensional time-of-flight measurement of 0.8 corresponds to 0.6mm at anatomic dissection. This slight overestimation at MR angiography of diameters of about 0.8mm is related to the partial volume artifact and limited resolution.

Blatter DD et al (1991)5: studied intracranial MR angiograms of 23 nonselective individuals aged between 27 - 68 years. All MR angiographic studies were performed with use of an unmodified 1.5 Tesla MR imager with use of standard patient position and with guadrature head coil. MR angiography was performed by using the MOTSA technique. The presence or absence of the vessel lumen diameter was measured on both direct contrast enhanced and MR angiograms.

Though in the present study visibility of a vessel's diameter, posterior cerebral artery and tabulated separately for males and females, for comparison purpose with other workers diameter the mean of male and female subjects have been considered together because these workers do not specify the sex. The values of dimensions by Kamath S (1981), Bisaria KK (1984), Saeki N et al (1977) and David Perlmuttar et al (1976) with dissection studies and dimensions by Hartkamp MJ et al (2000), Karbbe- Hartkamp MJ et al (1998) and Blatter DD et al (1991) with help of MRA studies are considered.

Diameter : Posterior cerebral Artery (Diameter in mm)

Posterior Cerebral Artery	Kamath S 9 (1998)	Krabbe hart kamp MJ 10 et al(1998)	Saeki N 15 et al (1977)	Blatter DD5 et al (1991)	Present study
Right	2.1	1.9	-	-	1.5
Left	2.2	1.9	-	-	1.5
Both	-	-	2.6	1.6	1.5

The diameter of the right posterior cerebral artery mentioned by Kamath S (1981) with dissection method is 2.1 mm, Krabbe-Harkamp MJ et al (1998)with the help of MRA is 1.9 mm and in the present study it is 1.5 mm. The diameter by the dissection method is greater by 0.6 mm and MRA study is greater by 0.4 mm than the present study.

The diameter of the left posterior cerebral artery mentioned by Kamath S (1981) with dissection method is 2.2 mm, Krabbe – Hartkamp MJ et al (1998) with the help of MRA is 1.9 mm and in the present study it is 1.5 mm. The diameter by the dissection method is greater by 0.6 mm and MRA study is greater by 0.4 mm than the present study.

- The diameter of both posterior cerebral arteries mentioned by Saeki N et al
- (1977) with the help of autopsy is 2.6 mm, Blatter DD et al (1991)with MRA
- method is 1.60 mm, and in the present study it is 1.5 mm. The diameter by
- the dissections method is greater by 1.1 mm and MRA study is greater by
- 0.1 mm than the present study.

Variations : Percentage of variations in Posterior Cerebral Arteries:

Posterior Cerebral Artery	Puchades-orts32 A et al (1975)	Alper BJ 1 al et (1972)	Reddy R33 (1972)	Rigg HE Rupp C34 (1962)	Bisaria KK 5 (1984)	Alper BJ 2 (1663)	Hodes PJ 19 (1953)	Present Study
Hypoplastic	11.3	-	-	-	-	-	-	1.89
Absence	2.4	-	-	-	-	-	-	3.03
Total	13.7	14.9	20.4	4.98	31.71	17	16	4.92

Hypoplasia of posterior cerebral arteries by Puchades – orts A et al (1975) with dissection method is 11.3% and in the present study it is 1.89%. The percentage of hypoplasia of posterior cerebral arteries by dissection method is greater than that of the present study.

Absence of posterior cerebral arteries by Puchades-orts A et al (1975) with dissection method is 2.4%, Reddy RD et al (1972) with dissection method is 20.4% and in the present study it is 3.03%. The percentage of absence of posterior cerebral arteries found by dissection method is greater than that of the present study Both hypoplasia and absence of posterior cerebral arteries by Puchades – orts A et al (1975) with dissection method is 13.7%, Alper BJ et al (1959) with the help of autopsy is 14.9%, Reddy RD et al (1972) with dissection method is 20.4%, Riggs HE and Rupp C (1962) with dissection method is 4.98%, Bisaria KK (1984) with dissection study is 31.7% , Alper BJ et al (1963) with dissection method is 17% HodesBJ et al (1953) with help of carotid angiogram is 16%, and in the present study it is 4.92%. The percentage of both hypoplasia and absence of posterior cerebral arteries found by dissection method, by carotid angiography is greater than that of the present study.

Alpers BJ et al (1959),Fetterman et al (1941), Riggs HE and Rupp C (1962), Alpers BJ et al 1963, Reddy RD et al (1972) have reported hypoplasia of vessels as the commonest anomaly in the circle of willis. They also reported abnormal diameters most commonly in the posterior communicating arteries, followed by the posterior cerebral artery

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