

Original Article

A STUDY OF PARTIAL FETAL POSTERIOR CEREBRAL ARTERY THROUGH MRA- INCIDENCE AND CLINICAL SIGNIFICANCE

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ABSTRACT :

Aim : when the posterior cerebral artery originates from ICA with a small, or hypoplastic , connection with the basilar artery, it is designated as partial fetal PCA (pfPCA) .The partial type of fPCA can be sub typed into three configurations: embryonic, adult and transitional on the basis of diameter of the contributing arteries. The objective of the present study was to assess the prevalence of this variant in this part of population and compare those results with available data in literature.

Material and Method : MR 1.5 T was used for obtaining the MRA. 92 MRA were reviewed (70 male and 22 female) aged between 20 -75 years.

Results: Partial fetal PCA (pfPCA) was observed in 50 subjects (54.3%). In males the incidence of pfPCA was (30.1%), and in females it was (14.9%). Embryonic configuration was found to be 13% on the right side, 4.2% on the left side and bilateral in 4.2%. Adult configuration was 6.5% on the right side, 4.2% on the left side and bilateral in 13%.

Conclusion: This variation occurred predominantly on the right side and showed a male dominance in this part of population.

Key-words: Circle of Willis;Fetal Posterior cerebral artery; Angiography.

INTRODUCTION : Circle of Willis (CoW) is an arterial anastomosis which unites the internal carotid system with the vertebro-basilar system and ensures continuous blood supply to vital nervous tissue in case of occluded cerebral arteries[1, 2]. The Ability of the circle of Willis to redistribute blood flow depends on its component vessels[3]. Morphologically this circle is divisible into an anterior part and a posterior part. The posterior circulation comprises of bilateral P1 (precommunicating) segment of the PCA (Posterior cerebral artery) which arises from the tip of the basilar artery as its terminal branch and bilateral PCoM (posterior communicating artery) which anastomosis the ICA (internal carotid artery) with PCA. In the classical textbook type of CoW, the PCA arises from the basilar artery, but in few

instances the PCA originates from the ICA (Internal carotid artery); such a condition is designated as fetal variant of the PCA (fPCA). In Partial fetal PCA (pfPCA) the posterior cerebral artery originates from ICA with a small, or hypoplastic , connection with the basilar artery .The partial type of fPCA can be sub typed into three configurations: embryonic, adult and transitional[4] on the basis of diameter of the contributing arteries. In embryonic configuration the PCA diameter is less than that of PCoM, in adult configuration the PCA diameter is more than that of PCoM and in transitional configuration PCA diameter is equal to that of PCoM. Basilar artery can supply collateral flow to the anterior circulation through the proximal segment of the posterior cerebral artery with reversal flow through the posterior

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communicating artery[5]. Three-dimensional time of flight magnetic resonance angiography (3D MRA) can provide valuable information regarding the collateral anatomy and function of the circle of Willis[6]. The objective of the present study was to assess the prevalence of this variant in this part of population through MRA and compare those results with available data in literature.

MATERIAL AND METHODS: The population of this study was formed by patients who were referred to diagnostic centre for brain MRA and in whom the apparent cause of referral was not cerebrovascular accidents. Magnetic resonance angiographies of 92 subjects (70 male and 22 female, aged between 20-75 years) were analyzed. 1.5 T MR system with following parameters was used for obtaining the angiographs :40/ 6.5; TR/ TE (time of repetition / time of echo), 200 x 150 mm field of view for the circle area, 225x 512 matrix, 0.67 x 0.39 mm pixel resolution, 1.4 mm section thickness. The 3D time of flight MR angiographic sequence required 4 minutes 30 seconds. All MR angiograms were assessed on a special workstation, by using maximum intensity projections as well as native images. All the component vessels of the posterior part of circle of Willis were assessed by measuring the diameter on the individual transverse 3D time of flight sections.

RESULT: Partial fetal PCA (pfPCA) was observed in 50 subjects (54.3%). Embryonic configuration was found to be 13% on the right side, 4.3% on the left side and bilateral in 4.3%. Adult configuration was 6.5% on the right side, 4.3% on the left side and bilateral in 13%. (Table1). Transitional configuration was not found in any of the cases. In 44(47.7%) subjects only one type of configuration was found in the partial variant of fPCA while in 8(8.6%) subjects two different types of configuration were found on right and left side (Table 2). In males the incidence of pfPCA was (30.4%), and in females it was (15.2%).

CONFIGURATION	UNILATERAL		BILATERAL
	Right side	Left side	Right and left side
Embryonic	12(13.0%)	4(4.3%)	4(4.3%)
Adult	6(6.5%)	4(4.3%)	12(13.0%)
Transitional	-	-	-

Table 1. Prevalence of variants of pfPCA with regard to sidedness

Single configuration		Double configuration		
Type	n	Type	n	%
Embryonic	20	21.7%	8	8.6%
Adult	24	20.6%	-	-
Transitional	-	-	-	-

Table 2. Prevalence of single or double configuration of pfPCA

DISCUSSION: Hollinshead WH[7] has mentioned that the variations of the vertebral artery, the basilar artery or their branches are a rule rather than the exception, and the variations in the sizes of the vessels participating in the arterial circle are very common. The most common anomaly may occur in the form of absence of posterior communicating artery, unilaterally or bilaterally. In embryos, the internal carotid arteries (ICAs) are formed between 28– 30 days, and the basilar artery (BA) is formed between 31–36 days, when the longitudinal neural arteries combine[8-10]. In the 52-day embryo a completely formed circle of Willis appears and all segments are slender and have an identical calibre [11, 12]. In the remaining fetal period, important changes occur in the basic anatomy of the cerebral vasculature. The most obvious is the change from a dominant fetal-type feeding of the posterior cerebral arteries (PCAs) from the ICA via the posterior communicating artery (PCoA) towards a normal adult configuration with feeding of the PCAs from the vertebro basilar system. The PCoAs normally regress in calibre as the vertebro basilar system develops. Any alteration in this process lead to an adult configuration or fetal configuration feeding of the PCA [13]. Also on the anterior aspect of the circle of Willis, the anatomical development will result in several variations [14]. However the disappearance of the vessels that normally exist or the existence of the vessels that normally regress or formation of new vessels can lead to altered hemodynamism and thus the probable reason for the anomalies [15].

Incidence: The partial fetal variant of the PCA (pfPCA) was found to be 54.3% in our study, this contradicts the reported percentage in available literature study 15.1% 16, 12% 17, 22% 18, 27% 19, 32% 20, 15% 21.

A Study of Partial Fetal Posterior Cerebral Artery through MRA-Incidence and Clinical Significance

Laterality: In our study unilateral pfPCA was more frequent (27.9%) than bilateral (17.2%). Previous studies results also show that unilateral variant is more prolific than the bilateral one. In the literature unilateral variant ranges between 11-29%[18-22] but a much higher incidence (67.2%) has been reported by Amir et al [16], the bilateral variant has been reported in the range of 1-9%[17,[20-22] and Amir et al 16 has reported it to be 32.9% .

Sidedness: with regard to sidedness, in our study 19.5% were found to be on the right side and 8.4%on the left and, Amir et al [16] too has reported a right sided dominance (43.9%) as compared to left (23.3%) although the percentages are much higher.

Sexual dimorphism: this variant showed a predilection for males 30.1% as compared to females14.9%.

The Embryonic configuration of pfPCA where the diameter of P1 segment of PCA was less than that of PCoM [Figure1]

Incidence : it was found in 21.4% subjects , this is in line with 20% reported by Roopashri et al[23], Nordon et al[24]found it to be 18% Overbeeke et al[25] in his study found it to be 14%, Yasargil et al [26] reported it as 32.5%, Osborn et al [27] reported this variant in 20-30%, Van Raamt et.al 29% [28], Caplan illustrates 24% of the fetal configuration of PCoA[29], Hussain et al[30] has reported it to be

15%,Mc Cormick et al 31has reported the lowest ever (5.8%).

Laterality: with regard to laterality it was unilateral in 17.2%, this is consistent with other reports 16% 18, 18% 19, 20% 4 but in contradiction to reports of 11% 21, 22. Bilateral embryonic configuration was found in 4.2%. In the literature it is found to be in the range of 1%-9%.1, 4, 17, 18, 20, 22

Sidedness: with regard to sidedness individual variation was predominantly located on the right side (13%).

Sexual dimorphism: this variant had an equal distribution in male and female (10.8%).

The Adult configuration of pfPCA, where the diameter of the P1 segment of the PCA was more than that of PCoM [Figure 2]

Incidence: was seen in 23.7% subjects in our study, it contradicts other reports. This configuration which is designated as the normal configurations in adults, has been reported to be 34% 32, 58% 33,63% 34and Overbeeke et al has reported it to be 84%.which is highest reported 25.

Laterality: This variant was unilateral in 10.7% subjects and bilateral in 13%.

Sidedness: individually it was found to be more on the right side 6.5% as compared to left 4.2%.

Sexual dimorphism: with regard to sexual dimorphism it was found that males were more

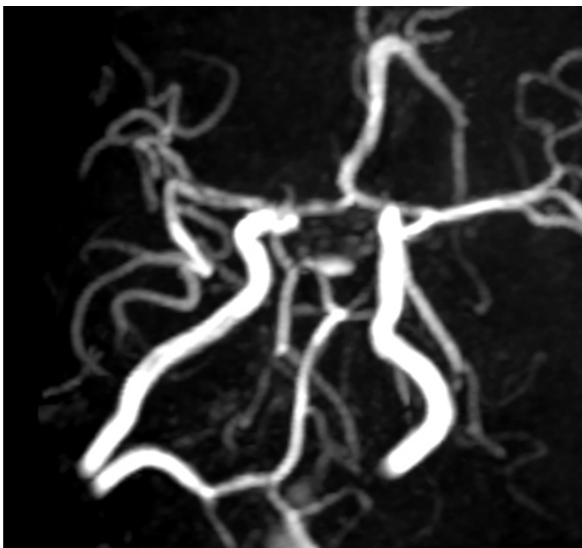


Fig1. Embryonic configuration (PCoM dia > P1 of PCA)

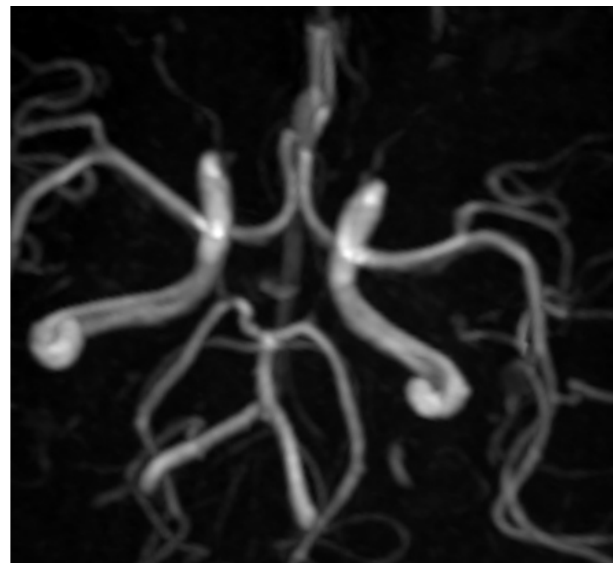


Fig2. Bilateral Adult configuration (PCoM dia < P1 of PCA)

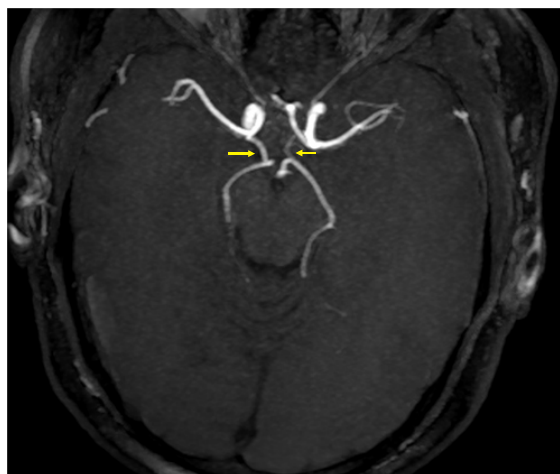


Fig3. Embryonic configuration on the right side (thin arrow) and Adult Configuration on the left side (thick arrow).

prone to this variant (19.5%) as compared to females 4.3%.

pfPCA has less impact on the vascular anatomy of the cerebral circulation, more area is perfused by the anterior circulation as PCA is mostly supplied by ICA, but the leptomenigeal collaterals may develop between anterior and posterior circulation due to the small connection that PCA has with the basilar.

In 8 subjects (8.6%), two different types of configuration were observed in the same individual. Embryonic on one side and adult on the other side [Figure 3]

It is evident from our study that the partial variant fetal PCA (pfPCA) has a high incidence in this part of population. The circle of Willis plays significant role in collateral circulation of the brain, especially in old people who may have reduced brain blood supply due to senile arteriosclerosis 17. Furthermore, such anomalies may lead to aneurysms due to altered hemodynamic in blood flow and induction of strain on the weak points of arterial lumen.

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A Study of Partial Fetal Posterior Cerebral Artery through MRA-Incidence and Clinical Significance

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