

Role of Magnetic Resonance Angiography in Evaluation of Variants of Posterior Cerebral Circulation

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ABSTRACT

Background: Anomalies of the posterior cerebral circulation comprising vertebrobasilar arterial system are encountered incidentally in magnetic resonance angiography.

Aim: To investigate the role of magnetic resonance angiography in identification of vertebrobasilar arterial anomalies.

Methods: This is a retrospective observational study. The study enrolled 39 cases (18 males and 21 females) with variations in the vertebrobasilar arteries out of 59 cases that performed brain magnetic resonance angiography. Cerebral magnetic resonance angiography examinations were analysed for frequency and distribution of variants of vertebrobasilar arteries and their branches.

Statistics: Independent t-test was used to compare diameters of hypoplastic vertebral arteries to diameters of normal vertebral arteries.

Results: The commonest anomaly of the vertebrobasilar arterial circulation was vertebral artery aplasia/hypoplasia (74%) followed by anomalous foetal origin of posterior cerebral artery (15%). Significant reduction in diameters of hypoplastic vertebral arteries compared to normal vertebral arteries ($t=6.6$, $p<0.0001$) was noted.

Conclusion: magnetic resonance angiography is a reliable rapid imaging method for detection of vertebrobasilar anomalies.

Key words: Anomalies, Posterior cerebral circulation, Vertebrobasilar, Magnetic resonance angiography

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INTRODUCTION

Posterior cerebral circulation comprises vertebrobasilar arterial system [1-3]. Variants of vertebrobasilar arterial system include hypoplasia, aplasia, duplication and anomalous origin [4,5].

Incidence of anomalies of the vertebrobasilar system is not uncommon in brain imaging studies and are usually incidentally discovered in Magnetic Resonance Angiography (MRA) [6,7].

Variants of the vertebrobasilar arterial circulation are commonly asymptomatic or may be associated with clinical significance [6,8]. Cerebral magnetic resonance angiography is a widely used non-invasive imaging method for detection of cerebral arterial anomalies [9-11].

MATERIALS AND METHODS

Aim: To investigate the role of brain magnetic resonance angiography in identification of variants of the vertebrobasilar arterial system.

Methods

This study is a retrospective observational cohort study. 59 human subjects with MRA brain examinations were reviewed from November 2014 till September 2021. Thirty-nine cases out of 59 cases were with variations in the vertebrobasilar arteries in cerebral magnetic resonance angiography and 20 cases were with normal brain MRA. The cases were referred from outpatient clinics to department of radiodiagnosis in Kasr Alainy Hospital, Cairo University. All cases performed Magnetic Resonance Imaging (MRI) of the brain and cerebral MRA on 1.5 Tesla (Intera, Philips Medical System, Best, Netherlands) using head coil.

Data acquisition

MRI brain: Axial T1WI: (TR/TE): 488/15, T2WI: 3732/100, FLAIR: TR/TE/TI: 6000/120/2000, Coronal T2 and sagittal T2. Field of view 24 cm, 256 × 256 matrix, 6 mm slices thickness, 1.5 mm slice gap.

Three-dimension Time of Flight (TOF MRA): TR/TE: 25/6.9, flip 20, 160 slices. Field of view: 160 mm, thickness 1 mm, and matrix: 512 x 512. Maximum Intensity Projection (MIP) axial images were generated. All procedures followed were in accordance with the ethical standards of Code of Ethics of the World Medical Association (Declaration of Helsinki).

Three-Dimension (3D) TOF MRA and maximum intensity projection images were evaluated for anomalies of the vertebrobasilar arteries and their branches.

Diameters of hypoplastic vertebral arteries were evaluated in axial MRA source images. Diameter of vessel less than 0.2 cm was considered hypoplastic [12].

Statistics

Independent t-test was used to compare diameters of hypoplastic vertebral arteries to diameters of the contralateral normal vertebral arteries. A p-value <0.05

was considered significant. Data were expressed as mean $\pm$ Standard Deviation (SD) using the Statistical Package for Social Science version 15.

RESULTS

This study enrolled 39 cases with anomalies of the vertebrobasilar arterial system including 18 males and 21 females with mean age 44.5 ± 15 SD. All examined cases demonstrated normal brain in magnetic resonance imaging study. Most patients were asymptomatic, few cases complained of headache and dizziness.

Vertebral artery aplasia/hypoplasia was the commonest vertebrobasilar anomaly followed by anomalous foetal origin of posterior cerebral artery.

In the current study, basilar artery hypoplasia was found in one case with 0.11 cm in diameter (normal: 0.35 cm)(Table 1).

Table 1: Frequency and distribution of variants of the vertebrobasilar arterial system (n=39) in cerebral MRA.

Artery	Anomaly	Right: Left (Bilateral)	Females: Males	Total number of cases (%)
Vertebral artery	Aplasia/hypoplasia	12:17	13:16	29 (74.35%)
Posterior inferior cerebellar artery	Aplasia	1:0	1:0	1 (2.5%)
Basilar artery	Hypoplasia	1 case	1:0	1 (2.5%)
Posterior cerebral artery	Aplastic pre communicating segment with anomalous foetal origin from posterior communicating artery	3:2 (1 case bilateral)	4:2	6 (15.38%)
Superior cerebellar artery	Common origin with right posterior cerebral artery	2:0	2:0	2 (5%)

Hypoplastic vertebral arteries were more common in males. (Table 2) Significant decrease in diameters of hypoplastic vertebral arteries (mean 0.13 ± 0.03 cm SD)

compared to normal vertebral arteries (mean 0.26 ± 0.05 cm SD) ($t=6.6$, $p<0.0001$) was noted.

Table 2: Distribution of cases of vertebral artery aplasia and hypoplasia (n=29).

Items	Cases with vertebral artery aplasia	Cases with vertebral artery hypoplasia
Total number (%)	18 (46.1%)	11 (28.2%)
Age (mean $\pm$ SD)	44.8 (± 13.7 SD)	37.7 (± 15.5 SD)
Males: Females	10:8	6:5
Right: Left	5:13	7:4

DISCUSSION

In reported studies, the frequency of vertebral artery hypoplasia in autopsy reached to 20% and in MRA studies reached up to 26% [6,13,14]. In the current study, the incidence of vertebral artery anomalies in brain MRA was 74% and unilateral vertebral artery aplasia was 46% from total cases with vertebrobasilar anomalies which was higher than those stated by Mazioti, et al. [15], who reported 23 cases with unilateral vertebral artery aplasia (37%) from total 61 cases with positive magnetic

resonance angiograms for vertebrobasilar arterial circulation anomalies.

In the present study, vertebral artery anomalies were predominantly left sided with high male preponderance which was in accordance with other studies [15,16].

The current results were consistent with a multidetector computed tomography study performed on vertebral artery anomalies conducted by Omotoso et al. [17], who concluded that cases with right sided vertebral artery hypoplasia were more common than left sided ones and

were more frequent in males. Right sided vertebral artery hypoplasia was also more common in a computed tomography and MRA study reported by Kim but with high female prevalence [8].

In the current study, foetal origins of Posterior Cerebral Artery (PCA) was noted in 15% of cases with vertebrobasilar anomalies and were more common in the right side which concurred with results obtained by Bhanu [18], who directed a retrospective study on anomalies of posterior communicating artery and PCA. Unlike few research analyses who reported equal incidence of foetal origin of posterior cerebral artery on either side [19,20].

Likewise, many studies, unilateral foetal origin of PCA was more common than bilateral PCA which was noted in the current study [15,20].

In disagreement with Akgun et al. [21], variants of Posterior Inferior Cerebellar Artery (PICA) and Anterior Inferior Cerebellar Artery (AICA) exceeded cases with anomalous origin of PCA. While in the current study, variants of PCA exceeded anomalies of PICA. This was probably due to different sample population presenting with vertebrobasilar anomalies where the current study demonstrated high female prevalence which discorded with the late study.

Limitations of this study were retrospective nature of the research and paucity of variants of vertebrobasilar branches. However, the current study addressed infrequent anomalies of the posterior cerebral circulation.

CONCLUSION

Cerebral magnetic resonance angiography is a reliable rapid imaging method for detection of anomalies of the vertebrobasilar arteries and their branches.

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