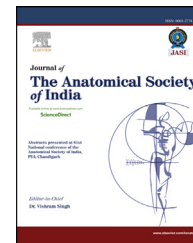


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Original Article

Magnetic resonance angiographic investigation of azygous *alias* monkey type anterior cerebral artery – Incidence and clinical significance



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ABSTRACT

Introduction: Azygous anterior cerebral artery (ACA) is one of the extremely rare variant occurring in the A2 segment of ACA, where the bilateral A1 segments unite together to form a single midline trunk. This trunk supplies both ACA territories. It has been also referred to as the unpaired pericallosal stem artery, unpaired anterior cerebral artery, common anterior cerebral trunk and azygos pericallosal artery.

Method: 1.5 T (GE OPTIMA MR 360) was used for obtaining the angiographs, 114 MRA were reviewed, 90 male and 24 female, aged between 20 and 75 years.

Result: The Azygous type anterior cerebral artery was present in (3.5%), in (1.75%) a long trunk depicting the classical Azygous anterior cerebral artery was present, while in (1.75%) a short median stem was present.

Discussion: This type of presentation is a risk factor for development of aneurysm in distal part of ACA due to alteration of hemodynamics, sometimes this variation may be associated with vascular or nonvascular neurological anomalies like arteriovenous malformations, defects of septum pellucidum, Holoprosencephaly, meningomyelocele.

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1. Introduction

Anterior cerebral artery (ACA) is one of the two terminal branches of internal carotid artery that supplies medial surface of each cerebral hemisphere, superior to the corpus callosum

and extends posteriorly up to the parieto-occipital sulcus.¹ Topographically and surgically it is divided into A1–A5 segments. The part between its origins from the internal carotid artery up to anterior communicating artery (ACoA) is called the A1 segment or proximal ACA or pre-communicating segment, whereas the segment after the ACoA has been called the distal

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ACA or the post communicating or the pericallosal artery (PerA).² The latter has been divided into 4 parts: the A2 segment, extends from the ACoA to the rostrum of the corpus callosum (CC), the A3 segment extends from previous point to the genu of the CC, the A4 segment extends from the previous point to the line where the CC intersects laterally with the coronal suture; and the A5 segment extends from previous point to the splenium of the CC.³ One of the extremely rare variant occurring in the A2 segment is the Azygous ACA, where the bilateral A1 segments unite together to form a single midline trunk. This trunk supplies both ACA territories. In the available literature it has been also referred to as the unpaired pericallosal stem artery, unpaired anterior cerebral artery, common anterior cerebral trunk and azygos pericallosal artery. Such a vascular malformation may be associated with other vascular or nonvascular neurological anomalies. This type of presentation is a risk factor for development of distal anterior cerebral artery aneurysm due to hemodynamic vulnerability.⁴ Due to the important clinical implications this study was undertaken to find its incidence in this part of population and also make a comparative study with the similar studies done in the other parts of the world so as to ascertain if there is any geographical and racial predisposition.

2. Material and method

At the beginning of this study, approval from the research ethics committee was obtained. The population of this study was formed by patients who underwent MRA for investigations like metastasis, epilepsy, acute or chronic headache and where the apparent cause was not cerebrovascular disease. 114 MRA were reviewed. Of the 114 subjects 90 were male and 24 female, aged between 20 and 75 years. 1.5 T (GE OPTIMA MR 360) was used for obtaining the angiographs using three dimensional time of flight technique. Maximum intensity projection (MIP) images and native source images were reviewed.

3. Result

In 4 cases Azygous variant of anterior cerebral artery was observed. In 2 cases it was classical Azygous type (Fig. 1) forming a long midline trunk, and the diameter of this midline trunk was 2.2 mm, which was more than the A2 segments (1.8 mm on the right side and 1.5 mm on the left side). This common trunk traversed around the genu of corpus callosum, and at the level of its upper border tetra furcated (Fig. 2). In 2 cases the azygous trunk was short and it further divided into two arteries (Fig. 3), here also the diameter of the single trunk formed was more than the individual A1 segments.

4. Discussion

The prefrontal cortex is less developed in fish, reptiles and amphibians and there is absence of anterior communicating artery, the two anterior cerebral arteries run parallel to each other. The Azygous ACA is common in lower primates but rare

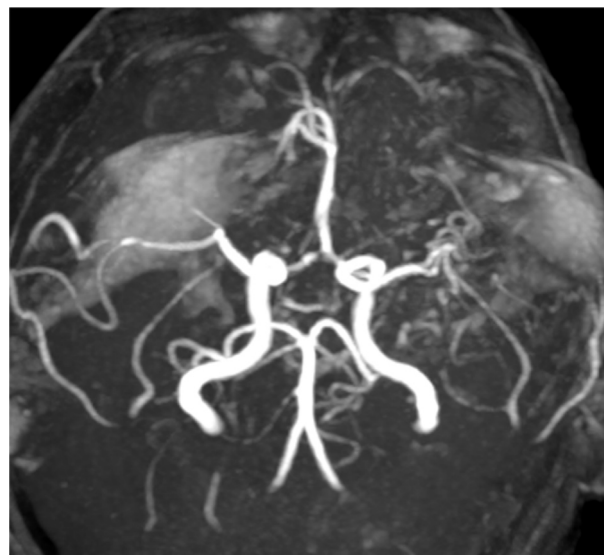


Fig. 1 – PA projection of CoW angiogram showing Azygous ACA.

in humans (0–10%). In chimpanzees the ACA's unite to form a median trunk which courses towards the rostrum of CC, depicting an Azygous ACA.⁵ Belenkaya et al had referred to this anomaly as a *monkey's type of ACA*.⁶ Wilder in 1885 for the first time introduced the term *arteria termatica* for the single median artery formed by the confluence of bilateral A1 segments.⁷ Baptista⁸ described three types of anomaly occurring in the distal part of the anterior cerebral artery: Type 1 – an unpaired anterior cerebral artery, in which a single anterior cerebral artery feeds both cerebral hemispheres. Type 2 – a bihemispheric anterior cerebral artery where both right and left anterior cerebral arteries are present, but one is rudimentary and most of the major branches to both hemispheres arise from the dominant one. Type 3 – a triple anterior cerebral artery with the accessory anterior cerebral artery arising from the anterior communicating artery. Our cases were judged to belong to Type 1. The azygous type anterior cerebral artery was present in 4 cases (3.5%), this is in agreement with the study by previous authors.^{2,6,9} Osborn et al¹⁰ has reported

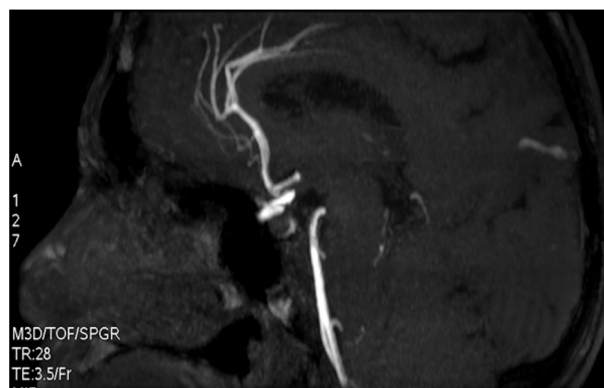


Fig. 2 – Sagittal MIP showing Azygos anterior cerebral artery.

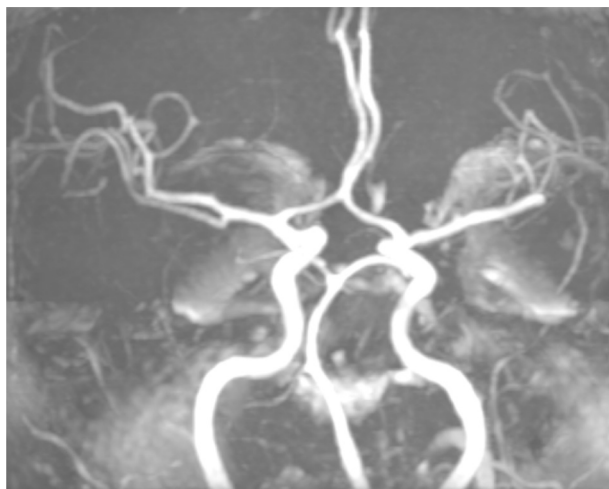


Fig. 3 – Anterior MIP demonstrating a short single Azygous trunk.

the highest ever (10%). Comparative percentage has been tabulated in Table 1. The median trunk or stem formed may be long or small,¹⁷ amongst the 4 cases, in two cases (1.75%) a long trunk depicting the classical azygous anterior cerebral artery was present, Sandhya et al¹⁵ has reported a higher incidence of 2.7%, Szdzuy et al¹⁸ had reported three such observations in association with holoprosencephaly and distal ACA aneurysm. In remaining two cases (1.75%) a short median stem was present, this is in accordance with the percentage reported by Sandhya et al (1.8%).¹⁵ The diameter of the single midline trunk formed in all the cases was more than the individual A1 segments, justifying the observation made by Vasovic et al.¹⁹ The unusual fusion of the paired A2 segments originates either from the medial branch of the olfactory artery at the initial 16 mm stage of embryogenesis or the persistence of the median artery in the corpus callosum at the 20–24 mm stage.^{16,20} It can also be generated by a lack of development or regression of the embryological ACA.^{13,16,21} This vascular malformation may be associated with a large number of cerebral anomalies such as: agenesis of corpus callosum, prosencephalic cysts, hydranencephaly, and lobular holoprosencephaly, septo-optic dysplasia (blindness,

optic nerve atrophy, and absence of septum pellucidum). Holoprosencephaly, meningomyelocele, lipoma and arteriovenous malformation.^{5,22–25} Since there is an alteration in the hemodynamic, it acts as a risk factor for aneurysm formation.²⁶ Saccular azygos ACA aneurysms are relatively common – 13–71%.^{7,20,25–28} Furthermore clinical relevance of this anomaly is that if there is an occlusion of anterior cerebral artery secondary to thromboembolic disease or any neuro surgical error, the resultant ischemia affects both the hemispheres.²⁹

5. Conclusion

Variations of anterior cerebral circulation may be asymptomatic and may not produce complications, although some of them increase the risk of aneurysm formation, acute intracranial hemorrhages, and alteration of arterial hemodynamic of the frontal lobe. An awareness of the potential of these malformations will allow more informed decisions regarding the management of patients presenting with an AACA in the acute context or as an incidental finding. Our study suggests that this type of variant of anterior circulation of Circle of Willis is independent of any kind of geographical or racial distribution.

Conflicts of interest

All authors have none to declare.

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Table 1 – Comparative study of incidence of Azygous ACA in different studies.

S.no	Author	Percentage (%)
1	Baptista et al ⁸	0–5
2	Schick et al ¹¹	1.1
3	Hashizume et al ¹²	1.1
4	Belenkaya et al ⁶	0.2–3.7
5	Osborn et al ¹⁰	10
6	Huber et al ¹³	0.21
7	Dietrich et al ¹⁴	0.1–5
8	Kakau et al ⁹	0.1–5
9	Sandhya et al ¹⁵	4.5
10	Rhoton et al ²	4.0
11	Stefani et al ¹⁶	2.63
12	Present study	3.5

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