ORIGINAL RESEARCH PAPER
Volume - 11 | Issue - 10 | October - 2022 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

INCIDENCE OF HYPOPLASTIC VESSELS IN CIRCLE OF WILLIS –CADAVERIC AND RADIOLOGICAL STUDY

Anatomy

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ABSTRACT

Background: Vessel hypoplasia or absence may render the Circle of Willis non-functional and leave the brain more exposed to a potential blood-supply deprivation and, therefore, more prone to injury. Several studies have explored the correlation between certain types of Circle Willis anatomic variations with a variety of adult brain pathologies. It has been shown that hypoplastic artery in patients with angiographically proved internal carotid artery occlusion is considered a risk factor for ischemic stroke. **Objectives:** Main objective of this study was to determine the incidence of various hypoplastic vessels in circle of Willis. **Materials And Methods:** This study was conducted in 100 Magnetic resonance films in routine radiology scan of asymptomatic patients and 50 cadavers in the department of Anatomy Andhra medical college. **Results:** Vertebral artery hypoplasia was more frequently seen in this study with normal MR imaging findings (26%), in the cadaveric study also we found vertebral artery hypoplasia (9%) was more frequently seen. Apart from vertebral artery we have also noticed hypoplasia in circular part A1 segment of anterior cerebral artery, posterior cerebral artery, and posterior communicating artery. **Conclusion:** All surgical interventions should be preceded by angiography. Awareness of these hypoplastic vessel anatomical variations is important in the neurovascular procedure, as hypoplastic vessels are predisposing factors for stroke

KEYWORDS

vertebral artery hypoplasia, circle of Willis, ischemic stroke. Magnetic resonance imaging.

INTRODUCTION:

The brain is supplied by the paired internal carotid and vertebral arteries through an extensive system of branches.[1] The internal carotid artery, a terminal branch of the common carotid artery, it divides into the middle and anterior cerebral arteries. Different branches arise from the internal carotid artery before its terminal bifurcation; those are hypophysial Arteries, Ophthalmic Artery, Posterior Communicating Artery, Anterior Choroidal Artery, Middle Cerebral Artery, and Anterior Cerebral Artery. The vertebral artery, a branch of the subclavian artery, ascends in the foramina of the transverse processes of the upper six cervical vertebrae. On reaching the base of the skull, the artery winds around the lateral mass of the atlas, pierces the posterior atlanto-occipital membrane, and enters the subarachnoid space at the level of the foramen magnum by piercing the dura and arachnoid. The left and right vertebral arteries join at the caudal border of the pons to form the basilar artery. Branches of the Vertebral Artery are spinal Arteries, Posterior Inferior Cerebellar Artery. Basilar Artery gives off various branches before dividing into the posterior cerebral arteries at the rostral border of the pons. Branches of basilar artery are Anterior Inferior Cerebellar Artery, Labyrinthine Artery, Pontine Arteries, Superior Cerebellar Artery, Posterior Cerebral Artery Anastomoses between branches of the anterior, middle, and posterior cerebral arteries are concealed in the sulci. Impaired collateral blood flow through circle of Willis Hypoplasia is the product of the delayed development might be associated with anomalies in cerebral vessels. It is important to distinguish between acquired narrowing and hypoplasia of the cerebral vessels because each of these has different atherosclerotic burden. Goal of the present study is to find the incidence of hypoplasia in cerebral vessels and throw light on importance of keeping these variants into consideration while performing routine magnetic resonance angiogram because hypoplasia of cerebral vessels are important risk factor for stroke.[1]

MATERIAL AND METHODS:

Study was conducted on 50 cadaveric specimens and 100 radiological films based on magnetic resonance angiography specimens were collected from human cadavers (males and females) donated to Andhra medical college , Visakhapatnam for dissection and research purpose over last 10 years .only cadavers with known identity were selected and all were originated from Andhrapradesh region , aged between 25 to 75 years.

Brains were removed carefully from the cranial cavity and immersed in 10% formalin for fixation. Each brain was placed over glass-wool in separate container to avoid damage. The circle of Willis of each brain was dissected carefully. The arterial circle was studied, photographed and numbered. The pattern of the arterial circle and hypoplastic variations were noted simultaneously.

Radiological study conducted on 100 films, the study includes subjects of adult age groups and of both sexes. The study was conducted in the department of radiology, Andhra medical college, Visakhapatnam, period from 2016 to 2018. All patients went under 3D TOF-MR angiography using 1.5Tmachine.

RESULTS:

Table-1 Distribution Of Sample Size

Specimens Used For Study	Number	Normal Circle	Anomalous Circle
Cadaveric	50	25	25
MRA study	100	54	46

Table-2 Incidence Of Hypoplastic Vessels In Present Study

Name of vessel	Incidence (%)	
	Cadavers (no-50)	MRA(no-100)
Vertebral artery	4	12
Anterior cerebral artery (circular part of A_1 segment)	3	6
Posterior cerebral artery	1	4
Posterior communicating artery	1	4
Total	9%	26%

Fig-1 Normal Circle Of Willis

Fig-2 Hypoplasia Of Right Vertebral Artery

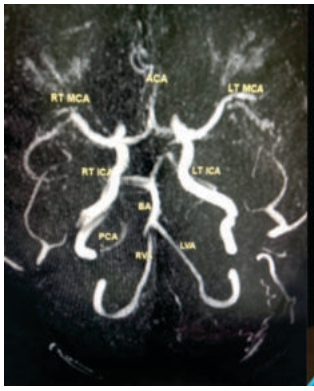

Fig-3 Normal Circle Of Willis In MRA Film

Fig-4 Hypoplasia Of Left Vertebral Artery

Fig-5: Hypoplasia Of A1 segment Of Right ACA

DISCUSSION:

The most common anomaly of the circle of Willis in normal brains was hypoplasia of one or other components of the circle. Arteries of less than 1 mm in external diameter were considered hypoplastic, except for the communicating arteries, where less than 0.5 mm was considered hypoplastic. Such hypoplastic vessels were encountered either alone or in combination with other anomalies. In this study we have followed kamanth's observation in defining hypoplastic arteries.[2]

Most frequent anomaly that encountered in this study was hypoplastic vertebral artery, circular part of the anterior cerebral artery (A-1 segment), circular part of the posterior cerebral artery (P-1 segment) and the posterior communicating artery in both MRA and cadavers. Over all percentage of hypoplastic artery in cadavers was 9 % in the MRA films was 26%. On examination with magnifying lens, majority of the hypoplastic vessels in this series were found to be patent. We compared the present with previous studies.

Table-3 Incidence Of Hypoplasia In Cadavers As Reported In The Literature

Name Of Author	Incidence of hypoplasia in cadavers (percentage)					
	Vertebral artery	ACA	ACA (A1 segment)	PCA	PCoA	Total percentage
s. iqbal[3]	-	4	4	6	10	24
Ramanuju singh et al[4]	-	9	8	2	2.6	20.6
Hina Siddiqi1[5]	-		7		19	26
Alpers et [1]	-		2		22	
Riggs& rup[6]		11.97	17.7	-	53	
Present study	4	-	3	1	1	9

Yen-YuChen[10] et al in his Study suggested that asymptomatic subjects with vertebral artery hypoplasia had a significantly lower net vertebral artery flow volume and a higher frequency of vertebral artery flow insufficiency than the control group.

Table- 4 Incidence Of Hypoplasia In MRA As Reported In The Literature

Name Of Author	Incidence of hypoplasia in MRA(percentage)				
	Vertebral artery	ACA (A1 segment)	PCA	PCoA	total
Jong ho park et al[2]	185	25	-		35.2
Poorwa baburao et al[7]	1	6			7
Mamata singh et al[8]	-	56	-		18.57
Present study	12	6	4	4	26

F Perren[11] et al stated that Vertebral artery hypoplasia was more frequent in posterior circulation than other territories infarction. There were no differences in age and other risk factors between the two groups. The authors concluded that vertebral artery hypoplasia may be a risk factor for stroke in the posterior circulation.

Vertebral artery hypoplasia -related vestibular hypo perfusion may increase vulnerability to more severe viral infection through impeded immunity and restricted neuronal repair capacity. Hypo perfusion with impaired oxidative killing by neutrophils, a primary defence against pathogens, is directly related to tissue oxygenation (12, 13). Co morbid intracranial vertebral artery hypoplasia may also serve as a risk factor for severe vestibular neuronitis.[14]

Most common etiology of posterior circulation strokes (PCS) is Vertebrobasillar atherosclerosis, which account for 20% of all ischemic strokes [Although there is a high prevalence of vertebral artery hypoplasia (VAH) among the normal population, VAH also greatly contributes to an increased risk of PCS.

The A1 segment of the ACA is a principle supplier of anterior collateral blood flow. This segment is also a source of numerous penetrating striatal arteries that supply the anterior hypothalamus, septum pellucidum, and the anterior and inferior portions of the corpus striatum .A1 segment hypoplasia is an uncommon fatal variant of the circle of Willis. A1 agenesis/hypoplasia appears to be a risk factor contributing to ischemic stroke, especially to strokes in arteries penetrating the striatal area.[15]

The most common ischemic event was ipsilateral thalamic lacunar infarctions with or without occipital lobe involvement. Based on their results, PCoA hypoplasia appears to be a contributor to the risk of ischemic stroke, even in the absence of ICA occlusion. This risk is more for strokes involving arteries that penetrate the thalamus.[16]. The hypoplastic posterior communicating artery should be monitored carefully in high risk groups especially in patients with brain tumours, trauma injuries and cerebro vascular complication to avoid abrupt intracranial haemorrhage.

CONCLUSION:

In conclusion we have studied the incidence of hypoplastic vessels in circle of Willis; we have found that vertebral artery hypoplasia was more prominent followed by anterior cerebral artery hypoplasia, posterior cerebral artery hypoplasia and posterior communicating artery hypoplasia. As hypoplastic vessels are more prone for ischemic stroke, knowledge regarding this variation will be useful for future reference.

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