



ANATOMICAL VARIATIONS OF ANTERIOR COMMUNICATING ARTERY AND ITS IMPLICATION : A MRA STUDY.

Dr Antima Gupta	Assistant professor & head of department of anatomy. LLRM Medical college , Meerut , UP
Dr Anuj Malik	Assistant professor ,department of anatomy.LLRM Medical college , Meerut , UP.
Dr Ketu Chauhan*	Assistant professor, department of anatomy. LLRM Medical college , Meerut , UP.*Corresponding Author
Dr Arvind yadav	Assistant professor, department of anatomy. Government Medical college , Shivpuri, MP

ABSTRACT

Cerebral circulation receives 15-20% of the cardiac output and is closely regulated to maintain perfusion in response to metabolic and physiological demands. The main cerebral distribution center for blood flow is the Circle of Willis. Anterior communicating artery anastomoses the bilateral A1 segment of anterior cerebral artery, hence becomes significant channel for blood diversion in case of hypoplastic or aplastic contralateral A1 segment as well as in pathological conditions . Complete absence of anterior communicating artery was seen in 116 cases (29.0%) . Anterior communicating artery and its variants form the basis for successful endovascular or surgical treatment of aneurysms located at this site.

KEYWORDS : circle of willis, ACoM, aneurysm, collateral blod flow.

INTRODUCTION :

The brain is one of the vital organs in the body and stable perfusion is essential to maintain its function. Cerebral circulation receives 15-20% of the cardiac output and is closely regulated to maintain perfusion in response to metabolic and physiological demands. The main cerebral distribution center for blood flow is the Circle of Willis.^(1,2) Under normal conditions, blood flow in the communicating arteries is negligible. However, if a subject has an atypical Circle of Willis, e.g., missing one of the main arteries or communicating arteries or under pathological conditions such as complete or partial occlusion of one of the cerebral or carotid vessels, the flow can be redirected to perfuse deprived areas^(3,4) . The borderzones are then perfused through the network of communicating arterioles. The anterior communicating artery is a small vessel that connects the A1 segments of the anterior cerebral arteries of both the sides in the midline across the commencement of the longitudinal fissure The most common topological variations include missing communicating vessels, fused vessels, string-like vessels, and presence of extra vessels.⁽⁵⁾ In case of complete unilateral vascular occlusion or thrombosis, expansion of anastomotic channels and collateral circulation in circle of Willis is life saving⁽⁶⁾ .Aneurysms are balloon-like swellings which occur on as a result of defects in the arterial wall. They are most commonly found on the vessels of the circle of Willis particularly at or near the junctions of vessels.

MATERIAL AND METHOD:

MR angiogram of circle of Willis in 400 patients were retrospectively evaluated who were considered as healthy subjects with regard to the anatomy of the circle of Willis. MR examination was performed with 1.5 T MR machine (GE OPTIMA). The MR angiography examination was performed with standard head coil. The MR angiography protocol consisted of non-contrast 3DTOF transaxial acquisition which was used for examination of all patients with the following parameters (Table 3.1): TR/TE/FA (30–40/6–10 ms/20–25). Rectangular field of view (FOV) 150 · 200 mm, matrix size 192 · 256 with slice thickness of 0.8–1 mm and 96 partitions with the total imaged volume (effective slab thickness) 72 mm.

RESULTS: 2 types of variations were found. Single ACOM- was present in 184 cases (46.0%) (fig 1) Complete absence of

anterior communicating artery was seen in 116 cases (29.0%) (fig 2)

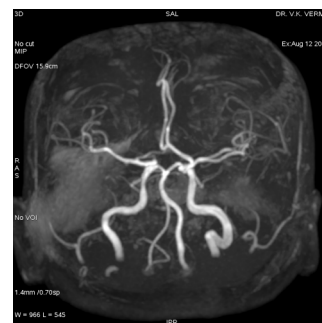


Fig 1. Single ACoM is present



Fig 2: ACoM is absent

DISCUSSION :

Anterior communicating artery anastomoses the bilateral A1 segment of anterior cerebral artery, hence becomes significant channel for blood diversion in case of hypoplastic or aplastic contralateral A1 segment as well as in pathological conditions. It is also one of the frequent site of formation of an aneurysm. Single ACOM- was present in 184 cases (46.0%) , which is close to similar other studies done in the past,. Li et al⁽⁷⁾ has reported a much higher percentage (Table 1). Complete absence of anterior communicating artery was seen in 116 cases (29.0%) which is high in comparison to other similar studies (Table 2).Hina et al⁽⁸⁾ has reported the lowest ever (1.96%). The collateral ability of

circle of Willis was assessed by Hoksbergen et al. ⁽²²⁾ by using Transcranial colour-coded duplex ultrasonography with common carotid artery compression tests in atherosclerotic patients with no cerebrovascular symptoms and concluded that the anterior collateral pathway (ACOA) of the circle was always functional while the posterior collateral pathway (PCOA) is nonfunctional in almost half of the hemispheres. Rogers ⁽²³⁾ observed that the circle of Willis is not an equalizer and distributor of blood from different sources, there being no mingling of blood from different sources in the circle under normal circumstances. It functions as an anastomosis and offers a potential shunt under abnormal conditions such as might occur during an occlusion or spasm. Lazzaro et al ⁽²⁴⁾ , analysed 132 patients with ACOA and PCOA aneurysms and concluded that circle of Willis anomalies were commonly found associated with rupture of aneurysms and concluded that the presence of circle anomaly is an important criterion for selecting patients for preventive aneurysm treatment. Kapoor et al ⁽¹⁸⁾ examined 1000 cadaveric brains and concluded that all aneurysms are located in the anterior half of the circle, at the junction of anterior cerebral and anterior communicating arteries.

Table 1: Incidence of single ACOM in different studies

S NO	AUTHOR	PERCENTAGE
1	Li et al ⁽⁷⁾	76.25%
2	Maaly et al ⁽⁸⁾	47.2%
3	Hina et al ⁽⁹⁾	42%
4	Piotrowska et al ⁽¹⁰⁾	47.2%
5	Qiu et al ⁽¹¹⁾	55.07%
6	Present study	46.0%

Table 2: Incidence of ACoM absence in different studies

S NO	AUTHOR	PERCENTAGE
1	Fawcett & Blachford ⁽¹²⁾	0.14%
2	Blackburn IWN ⁽¹³⁾	0.9%
3	Von Mitterwallner F ⁽¹⁴⁾	0.27%
4	Vare & Bansal ⁽¹⁵⁾	1.14%
5	Jain et al ⁽¹⁶⁾	0.69%
6	Macchi et al ⁽¹⁷⁾	3%
7	Kapoor et al ⁽¹⁸⁾	1.8%
8	Abubakr et al ⁽¹⁹⁾	2.1%
9	Li et al ⁽⁷⁾	9.38%
10	Maaly et al ⁽⁸⁾	16.6%
11	Piotrowska et al ⁽²⁰⁾	22.8%
12	Hina et al ⁽⁹⁾	1.96%
13	Kardile et al ⁽²¹⁾	8%
14	Saikia et al ⁽²²⁾	5%
15	Qiu et al ⁽¹¹⁾	16.69%
16	Present study	29.0%

CONCLUSION :

A high incidence of anomalous circle of Willis has been reported in patients of saccular aneurysms of the intra cranial arteries. ^(25,26) Anterior communicating artery and its variants form the basis for successful endovascular or surgical treatment of aneurysms located at this site. The main collateral blood flow in the circle is through communicating arteries and in symptomatic internal carotid artery occlusion, the blood flow through collateral pathways may be important in determining the severity of hemodynamic impairment. ⁽²⁷⁾

REFERENCES:

- Cebra J.R, Castro M.A , O. Soto, R. Lohner And N. Alperin, Blood-Flow In The Circle Of Willis From Magnetic Resonance Data, J. Eng. Math., 47 (2003), Pp. 369-386.
- Hall Je. Guyton And Hall Textbook Of Medical Physiology: Enhanced E-Book. Elsevier Health Sciences: Philadelphia, Pa, 2010.
- Devault K, Pierre A. Gremaud, Vera Novakš, Mette S. Olufsen Guillaume Verni Eresk, And Peng Zhao\$Multiscale Blood Flow In The Circle Of Willis: Modeling And Calibration - Model Simul. 2008 Jan 27; 7(2): 888-909.
- Ferrandez A ,.David T And Brown M, Numerical Models Of Auto-Regulation And Blood Flow In The Cerebral Circulation, Comp. Meth. Biomech. Biomed. Eng., 5 (2000), Pp. 7-19.

- Alpers Bj, Berry Rg. Circle Of Willis In Cerebral Vascular Disorders. Arch Neurol 1963; 8: 398-402
- Schomer D F, Marks M P, Steinberg G K, Et Al. The Anatomy Of The Posterior Communicating Artery As A Risk Factor For Ischemic Cerebral Infarction. The New Eng. J. Med. 1994; 330(22): 1565-70.
- Li Q, Li J, Lv F, Li K, Luo T, Xie P (2011) A Multidetector Ct Angiography Study Of Variations In The Circle Of Willis In A Chinese Population. J Clin Neurosci, 18: 379-383.
- Maaly Ma , Ismail A A, "Three Dimensional Magnetic Resonance Angiography Of The Circle Of Willis: Anatomical Variations In General Egyptian Population," *The Egyptian Journal Of Radiology And Nuclear Medicine*, Vol. 42, No. 3-4, Pp. 405-412, 2011.
- Hina S, Mohammad T, Khalid P.L. In Cerebral Arterial Circle Of Willis In Adult Pakistani Population. Journal Of The Variations College Of Physicians And Surgeons Pakistan 2013, Vol. 23 (9): 615-619.
- Piotrowska W K , Kopećm, Kochana M, Krzy ewski R M, Tomaszewski K A, Brzegowyp, Walocha J. Configurations Of The Circle Of Willis: A Computed Tomography Angiography Based Study On A Polish Population. Folia Morphol. 2013 Vol. 72, No. 4, Pp. 293-299.
- Qiu C X C, Zhang Y, Jiang S, Zhang W. Mra Study On Variation Of The Circle Of Willis In Healthy Chinese Male Adults. Biomed Research International Volume 2015 (2015), Article Id 976340, 8 Pages.
- Cassels D: Italian Anatomist Titler Of The Tube. Medical Post 34: 31, 1998.
- Blackburn J.W. The Anomalies Of The Encephalic Arteries Among The Insane: A Study Of The Arteries At The Base Of The Encephalon In 220 Consecutive Cases Of Mental Disease. Journal Of Composite Neurology And Psychiatry 1907; 17: 493-517.
- Mitrerwallner, F. Von. Variationen Statistische Untersuchungen An Den Baselen Hirngefassen. Acta Anatomica 1955 24, 51-87.
- Vare A M And Bansal P C. Arterial Pattern At The Base Of The Human Brain. Journal Of Anatomical Society Of India 1970; 19 (3):71-79.
- Jain P N, Kumar V, Thomas R J, Longia G S. Anomalies Of Human Cerebral Arterial Circle (Of Willis). Journal Of Anatomical Society Of India 1990 Dec; 39(2): 137.
- Macchi C, Catini C, Federico C. Magnetic Resonance Angiographic Evaluation Of Circulus Arteriosus Cerebri (Circle Of Willis): A Morphologic Study In 100 Human Healthy Subjects. Ital. J. Anat. Embryol 1996; 101(2): 115-23.
- Kapoor K, Singh B, Dewan Li. Variations In The Configuration Of The Circle Of Willis. Anatomical Science International, 2008; 83: 96-106.
- Alawad Ahm, Hussein Ma, Hassan Ma. Morphology And Normal Variations Of The Cerebral Arterial Circle Of Willis In Khartoum Diagnostic Centre. Khartoum Medical Journal, 2009; 2 (2): 215-219.
- Kardile P B, Ughade J M, Pandit S V , Manohar Namdeo Ughade M N. Anatomical Variations Of Anterior Communicating Artery. J Clin Diagn Res. 2013 Dec; 7(12): 2661-2664.
- Saikia B , Handique A , Phukan P, Lynser D , Sarma A. Circle Of Willis: Variant Forms And Their Embryology Using Gross Dissection And Magnetic Resonance Angiography. Int J Anat Res 2014, 2(2):344-53.
- Hoksbergen Aw, Fulesdi B, Legemate Ad, Csiba I. Collateral Configuration Of The Circle Of Willis: Transcranial Color-Coded Duplex Ultrasonography And Comparison With Postmortem Anatomy. Stroke. 2003; 31: 1346-51.
- Rogers. The Function Of The Circulus Arteriosus. Brain 1947; 70: 171.
- Lazzaro Ma, Ouyang B, Chen M. The Role Of Circle Of Willis Anomalies In Cerebral Aneurysm Rupture. J Neuro Intervent Surg. 2011; Doi: 10. 1136/Inis. 2010.004358.
- Alpers B J, Berry R G And Paddison R M. Anatomical Studies Of The Circle Of Willis In Normal Brain. Archives Of Neurology 1959; 81: 409-18.
- Riggs H E And Rupp C. Variation In The Form Of Circle Of Willis: The Relation Of The Variations To The Collateral Circulation, An Anatomical Analysis. Archives Of Neurology 1963; 8: 24-30.
- Yamauchi H, Kudoh T, Sugimoto K, Takahashi M, Kishibe Y, Okazawa H. Pattern Of Collaterals, Type Of Infarcts, And Hemodynamic Impairment In Carotid Artery Occlusion. J Neuro Neurosurg Psychiatry. 2004; 75(12): 1697 - 1701.