ORIGINAL ARTICLE

VARIATIONS OF ANTERIOR CEREBRAL ARTERY (ACA) ON CT ANGIOGRAPHY (CTA)

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ABSTRACT

Background: The variations in anterior cerebral artery (ACA) has high clinical significance for surgeons

Objective: This study aims to assess the variations of ACA with the help of CT angiography (CTA)

Methods: This retrospective study was conducted from Nov 2019 to Feb 2020 at Lahore General Hospital, Lahore. In total, 150 patients went under detailed analysis. The demographic data such as age and gender were noted for each patient. The CTA was performed with the help of 128-slice CT scanner. The reports were assessed by an experienced radiologist. Anatomic variations were noted and presented as frequencies and percentages.

Results: The study included 92 (61.33%) were females and 58 (38.66%) were males with mean age 50.2 ± 3.7 years. Azygos anterior cerebral artery was present in 14 patients (9%), hypoplasia of anterior cerebral artery A1 segment in 43 (35.66%) patients, 11 (7.33%) patients showed bi-hemispheric anterior cerebral artery, right anterior cerebral artery dominance in 2 (1.33%) patients, 8 (4.33 %) were detected with congenital absence of A1 segment. Anterior cerebral artery trifurcation had prevalence of 6(3.2%).

Conclusion: It can be concluded that anterior cerebral artery variations have low prevalence and CT angiography is a gold method for detecting them.

Keywords: anterior cerebral artery, angiography, CT, CTA.

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INTRODUCTION

The anterior cerebral artery (ACA) is recognized as the primary blood supply to frontal lobes in humans. In mammals and amphibians it supplies blood to telencephalon (Dimmick & Faulder 2009)[1]. ACA and related branches are known to comprise of variations that are clinically significant. Consequently, ACA anatomy is vital for surgeons in context of diagnosis of pathological lesions (Jayaraman, Mayo-Smith & Tung 2004)[5].

The anatomical variations of ACA are quite frequent owing to the complicated embryology of intracranial circulation. Duplications, fenestrations, aplasia and hypoplasia of arterial segments and persistent primitive fetal arteries are the most reported variants of ACA. However, the clinical significance of the variants of ACA varies (Okahara, Kiyosue & Mori 2002)[9]. The presence of these variants has widely been associated with aneurysm development and ischemia of both hemispheres. Although most of the variants do not have significant clinical impact, their recognition can be helpful in surgical planning. Moreover, such an approach can help in prevention of complications during endovascular treatment (Bayrak, Senturk & Akay 2011)[4].

Digital subtraction angiography has been recognized as the primary method of detecting intracranial vascular variations. Despite this fact, it has been associated with invasiveness and significant complications (Bayrak, Senturk & Akay 2011)[4]. On the other hand, Computed tomography angiography (CTA) has been acknowledged for non-invasive approach. The only demerit of CTA is the radiation exposure. However, the radiation dose of CTA does not reach the threshold value for cataract formation, hair loss and thyroid malignancy (Uchino, Saito & Okada 2012)[12]. Resultantly, CTA has emerged as a reliable means of evaluating intracranial arterial pathology with high sensitivity (81-90%) and specificity (93%). This is almost equal to the diagnostic accuracy of digital subtraction angiography. (Jayaraman, Mayo-Smith & Tung 2004)[5].

Although extensive works have shown the use of CTA for evaluating ACA, they have remained focused on duplications and fenestrations. Most of the variations associated with ACA have remained ignored in previous research works (Lugt, Buter & Govaere 2004)[8]. Thus the present study opts to fill in this research gap by analyzing prevalence and characteristics of ACA variations on CTA.

METHODS

This retrospective study was conducted from Nov 2019 to Feb 2020 at Lahore General Hospital, Lahore. In total, 200 patients who had undergone CTA were included in the study. These patients had CTA done due to prolonged headache, ischemic cerebrovascular disease suspicion or subarachnoid hemorrhage suspicion. However, 50 patients were excluded from the study owing to the improper image quality. Thus, 150 patients went under detailed analysis. The patients were explained about the purpose of the study and informed consents were collected. The demographic data such as age and gender were noted for each patient.

The CTA was performed with the help of 128-slice CT scanner. With the parameters of 120 KV, 380 mA, and 0.6 mm section thickness, the region from first vertebral body to vertex was observed. The reports were assessed by an experienced radiologist. Anatomic variations were noted for each arterial segment. The variations were presented as frequencies and percentages.

RESULTS

Out of 150 patients, 92 (61.33%) were females and 58 (38.66%) were males. The mean age of patients was found to be 50.2 ± 3.7 years, with the range of 20 to 85 years.

Azygos anterior cerebral artery was present in 14 patients, which makes up a prevalence of 9%, whereas 43 (35.66%) patients were found to have hypoplasia of ACA A1 segment. Only 11 (7.33%) patients showed bi-hemispheric ACA, with right ACA dominance in 2 (1.33%) patients. On the other hand, 8 (4.33%) patients were detected with congenital absence of A1 segment. The patients associated with hypo plastic A1 segment showed associated aneurysm of anterior communicating artery in 24 (15.75%) patients. Anterior cerebral artery trifurcation had prevalence of 3.2%.

DISCUSSION

CTA is considered as a gold standard for detecting normal variants of intracranial circulation. Most of these variations have no clinical value. However, they can make an individual prone towards development of ischemia and aneurysms. On the other hand, their detection by CTA is significant in terms of endovascular and surgical treatment planning.

Many previous research works have emphasized on clinical significance of azygos ACA such as Okahara[9] et al (2002) and Uchino[12] et al (2006). According to Okahara[9] et al (2002), azygos ACA depicts single midline A2 trunk that provides blood to both hemispheres. Uchino et al (2006) found prevalence of 3% for azygos ACA on MR angiography. The present study found prevalence of 9 % for azygos ACA. However, the prevalence of 1.2%, reported by Kovac[7] et al (2014), was quite lower. As A2 trunk is only one, occlusion of it can leads towards ischemia. The bi-hemispheric ACA has same clinical importance. The present study reported prevalence of 7% for this anomaly, which is quite higher than 1%, reported by Kovac[7] et al (2014).

A1 segment hypoplasia is considered to be the most frequent ACA variation. The present study found prevalence for this anomaly to be 15.66%, which is lower than 17.66%, found by Kovac[7] et al (2014). However, in comparison to other ACA variations, this was found to be the most prevalent. Anterior Communicating artery aneurysm was found in 43.75% patients, which is higher than previously reported one (Kovac[7] et al 2014). Despite this fact, the factors of occurrence with right side and male gender dominance were consistent in present study. This anomaly makes individuals prone towards ischemia.

CONCLUSION

The present study renders exclusive assessment of ACA variation with the help of CTA. The findings show that ACA variations have low prevalence. This study can be

helpful in understanding prevalence of ACA variations in general population.

ETHICAL APPROVAL

The study was approved by the Ethical Review Committee of Postgraduate Medical Institute / Ameer-ud-Din Medical College/Lahore General hospital, Lahore via Research No. 00-33-21 Dated: March 02, 2021.

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AUTHOR'S CONTRIBUTIONS

FA: Manuscript Writing, Data Collection
NR: Data analysis
SB, NH: Data collection, Supervision, Proof reading