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ANATOMY AND CLINICAL SIGNIFICANCE OF THE POSTERIOR INFERIOR CEREBELLAR ARTERY

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ABSTRACT

With the introduction of new techniques in diagnostic and interventional radiology and progress in micro neurosurgery, accurate knowledge of the brain blood vessels is essential in daily clinical work. The aim of this study was to describe the anatomical characteristics of the posterior inferior cerebellar arteries and to emphasize their clinical significance.

In this study we examined radiographs of 103 patients who had CT angiography at the University Clinic for Radiology in Skopje, R. Macedonia. This study included 45 females and 58 males, age range from 25 to 82 years; mean age 58.4±13.2 years.

The outer diameter of the posterior inferior cerebellar artery at its origin on the left side was in the range between 0.46 - 2.80 mm, mean 1.24 ± 0.42 mm. The outer diameter of the posterior inferior cerebellar artery on the right side was in the range between 0.54 - 2.50 mm, mean 1.18 ± 0.40 mm.

Thorough knowledge of the anatomy and variations of the posterior inferior cerebellar artery is important for clinicians as well as for basic scientists who deal with problems related to intracranial vasculature on daily basis for safe performance of diagnostic and interventional procedures.

Key words: posterior inferior cerebellar artery, anatomy, variations, diameter

INTRODUCTION

The posterior inferior cerebellar artery (PICA) usually arises as the largest branch of the vertebral artery at the anterolateral margin of medulla oblongata, close to the lower cranial nerves, and courses through a series of deep fissures that lie between the tonsil, vermis, and cerebellar hemisphere. The PICA supplies the posterior inferior cerebellar surface, lateral medula and choroid plexus of the fourth ventricle [1]. The PICA has the most complex and variable course of all the cerebellar arteries. Radiologists, neurosurgeons and forensic pathologists must be aware of radiologic features and geographic territories of cerebellar arteries, as even minor variants may have important clinical and forensic consequences [2]. The aim of this study was to describe the anatomical characteristics of the PICA and to emphasize their clinical significance.

MATERIAL AND METHODS

The study population included 103 patients referred to the University Clinic for Radiology in Skopje, R. Macedonia for computed tomography angiography (CTA). This study included 45 females and 58 males, age range from 25 to 82 years; mean age 58.43±13.2 years. We made an anatomical analysis of CTA images realized for medically justified goal, with the approval of the Macedonian Ethics Committee. The CTA was obtained using a CT scanner Somatom Definition AS Siemens Healthcare, Erlangen, Germany. Contrast material was injected through an 18- to 20-gauge IV catheter inserted into an arm vein, a total of 100 ml. at a rate of 3 ml/s with a pressure injector, followed by a flush of 40 ml of saline administered at the same injection rate. After the contrast medium was injected, by use of bolus tracking software, scanning was carried out automatically. The data were transferred to a workstation for post-processing. Reconstruction included the following: maximum intensity projection-MIP; four-dimensional CTA with volume rendering; reformatted multiplanar reformation-MPR. For the post-processing process we used SYNGO software. The PICA was clearly and directly shown in the high quality images, and satisfied the requirements of our study.

The anatomic features of the right and left PICA were analyzed, and anatomical characteristics were analyzed on each CT image.

RESULTS

In this study we determined the origin of the left and right PICA. Absence of PICA was noticed in 8.73% of patients. In 94.67% of patients the left PICA had origin from the vertebral artery and in 5.31% of patients the left PICA had origin from the basilar artery. On the right side in 91.48% of patients PICA had origin from the vertebral artery and in 8.51% of patients it had origin from the basilar artery. No double origin, duplication of PICA, origin from internal carotid artery was noticed in this study.

The minimal value of the outer diameter of the left PICA was 0.46 mm. The maximal recorded value of the outer diameter of the left PICA was 2.80 mm. The average value of the outer diameter of the left PICA was 1.24 mm ± 0.42 mm.

The minimal recorded value of the outer diameter of the right PICA was 0.54 mm. The maximal value of the outer diameter of the right PICA was 2.50 mm. The mean outer diameter of the right PICA was 1.18 mm ± 0.40 mm.

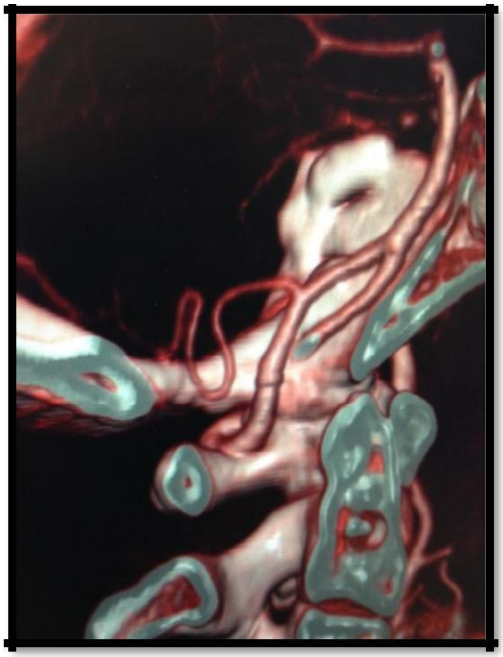

Fig. 1. Origin of the right PICA from the right vertebral artery

DISCUSSION

The PICA has the most complex and variable course of the cerebellar arteries [3]. The PICA arises from the vertebral artery at the anterolateral aspect of the brain stem near the inferior olive and passed posteriorly around the medulla. At the anterolateral margin of the medulla, it passes rostral or caudal to or between the rootlets of the hypoglossal nerve, and at the posterolateral margin of the medulla it passes rostral to or between the fila of the glossopharyngeal, vagus, and accessory nerves. It often has a tortuous course, and its area of supply is the most variable of the cerebellar arteries. Along its course, PICA divides into five segments: anterior bulbar segment, lateral bulbar segment, tonsillar bulblar segment, telovelotonsillar segment, cortical segment [3, 4, 5].

The PICA has a highly variable origin [4]. It usually originates from the vertebral artery, but it may also originate from the basilar artery and internal carotid artery [3, 5]. The PICA can be unilaterally absent in 2 to 26% of the cases and bilaterally absent in 2 - 2.5% of the cases [1, 3]. In our study group PICA was absent in 8.73% of the patients. The data from the previous published studies are in accordance with our study. Usually, if one of the PICA is absent, its territory was supplied either by the anterior inferior cerebellar artery, or by the superior cerebellar artery [2]. According to Lister, Macchi, Kayaci, PICA was defined as cerebellar artery that usually originates from the vertebral artery, and this condition occurs between 80 to 95% of patients [1, 3, 5, 6].

There are reports in the literature which describe origin of PICA from the basilar artery. Our literature search showed that PICA had origin from the basilar artery in 7 to 10% of the cases [3, 5].

Double origin of the PICA is reported rarely and, when it occurs it manifests as two separate vessels arising from the same vertebral artery that then converge and form the PICA proper. Double origin of the PICA can be confused with fenestration or duplication of the PICA. The prevalence of double origin of the PICA in the general population was in range between 0.36% to 1.45%. Double origin of PICA was described by Uchino, Lesley, Pasco et al. [7, 8].

Origin of PICA from the internal carotid artery was described by Ahuja, Nakanishi, Hui et al. [9, 10, 11]. The embryologic explanation postulated is the persistence of a primitive communicating vessel (presegmental artery) between the anterior and posterior circulation [9]. Ogawa et al. presented a case report where PICA had anomalous origin from the posterior meningeal artery [12]. Mercier et al. described cases of origin of PICA and AICA through a common trunk from the vertebral or basilar artery [13].

Recent studies have determined the diameter of PICA. According to Kayaci et al. the mean diameters of the right and left PICAs at their point of origin were calculated as 1.50±0.42 mm and 1.63±0.34 mm [5]. The average outer diameter of the PICA was 1.15 mm on the left side and 1.42 mm on the right in the study conducted by Grasso et al.

Clinical significance of the PICA

The PICA may be exposed in surgical approaches to the 4th ventricle, cerebellar hemisphere, brain stem, jugular foramen, cerebellopontine angle, petrous apex, clivus and trigeminal nerve. The increasing use of surgical magnification for operations in these areas has created the need for a better understanding of the microsurgical anatomy of the PICA [3].

During the past few decades, there were rapid and continuous advances in the field of diagnostic subtraction angiography, CT and MR angiography techniques, and these methods have become more commonly used in analysis of the brain blood vessels pathology. The anatomy and variations of the PICA must be well known for accuracy of the interpretation of radiological findings and for planning and accomplishing endovascular procedures [3, 5, 6].

As double origin of PICA has rarely been reported, the significance of the finding is uncertain. But according to Lesley, Trivelato et al. double origin of PICA has an increased association with intracranial aneurysm and may represent a risk factor for subsequent development of intracranial aneurysm [8, 14].

Nassr et al. reported a case of aberrant PICA injured during C1 lateral mass screw placement, resulting in a cerebellar stroke of PICA distribution territory [15].

The PICA has the most complex relationship to the cranial nerves [3]. Microvascular compression of lower cranial nerves is believed to cause syndromes such as glossopharyngeal neuralgia (glossopharyngeal nerve compression), spasmodic torticollis (accessory nerve compression) and hemifacial spasm (facial nerve compression) [3, 4, 5, 16]. Batten reported an unusual case of facial pain and swelling caused by compression of the facial and vestibulocochlear cranial nerves due to the tortuous course of a branch of the PICA [17]. The symptoms were relieved after micro vascular decompression [3, 4, 5, 16, 17].

CONCLUSIONS

Thorough knowledge of the anatomy and variations of PICA is important for clinicians as well as for basic scientists who deal with problems related to intracranial vasculature on daily basis for safe performance of diagnostic and interventional procedures.

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