

MORPHOLOGICAL CHARACTERISTICS OF THE SUPERIOR 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 for daily clinical work. The aim of this study was to describe the morphological characteristics of the superior cerebellar artery and to emphasize their clinical significance.

In this study we examined radiographs of 109 patients who had CT angiography at the University Clinic for Radiology in Skopje, R. Macedonia. This study included 49 females and 60 males, ranging in age from 27 to 83 years; mean age 57.4 ± 11.8 years.

In 105 patients SCA arose from the basilar artery on both sides as a single vessel. In two patients SCA arose as a duplicate trunk from the basilar artery. We found unilateral duplication on the right SCA in one patient, and bilateral duplication in one patient. In two patients was noticed origin of the SCA from PCA as a single trunk from adult type of the PCA.

Through knowledge of the anatomy and variations of SCA is important for clinicians as well as basic scientists who deal with problems related to intracranial vasculature in daily basis for save performance of diagnostic and interventional procedures.

Key words: superior cerebellar artery, anatomy, variations, basilar artery.

Introduction

Presence of anatomical variations means deviation from the normal pattern without any functional impairment to the individuals. Numerous studies have reported the existence of anatomical variations resulting in a greater care for those who teach anatomy, as well as for radiologists and surgeons [1].

With the advances in micro neurosurgery and radiology, and more effective ability to tackle diseases of the intracranial arteries, accurate knowledge of the intracranial vascular anatomy is becoming increasingly important [2].

Currently the superior cerebellar artery (SCA) attracting the attention of neurosurge-

ons, radiologists and anatomist because of the variations in its origin [1]. So far there is no data exists for the Macedonian population about the anatomy and variations of the SCA, so the authors think that it is worthwhile to make pioneer research for the SCA. The aim of this study was to describe the morphology of the SCA and to emphasize their clinical significance.

Material and Methods

The study population included 109 patients referred to the University Clinic for Radiology in Skopje, R. Macedonia for computed tomography angiography (CTA) during the period January 2013 to February 2014. This study in-

cluded 49 females and 60 males, ranging in age from 27 to 83 years; mean age 57.4 ± 11.8 years. This was an anatomical analysis of CTA images realized for medically justified goal, with the approval of the Macedonian Ethical Committee. The CTA was obtained using a CT scanner, Somatom, from 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. In the process of post-processing we used SYNGO software. The SCA 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 SCA were analyzed, and anatomical variations were recorded on each CT images. The diameters of the SCA and distance between SCA and posterior cerebral artery (PCA) were measured.

Results

The SCA was present in 109 of the analyzed images. In 105 (96.33%) patients SCA arose from the distal portion of the basilar artery on both sides as a single vessel (Fig. 1). Origin from the middle and proximal portion of the basilar artery wasn't noticed in our study.

In 2 (1.83%) patients SCA arose as a duplicated trunk from the basilar artery (Fig. 2). We found unilateral duplication on the right SCA in one patient, and bilateral duplication in one patient.

The first patient was with unilateral duplication of right SCA where the diameter of the first SCA was 1.2 mm, and the diameter of the second SCA was 1.5 mm, the diameter of the left SCA was 2.0 mm. The distance between the two trunks of SCA was 1.1 mm.

The second patient had bilateral duplication of the SCA, on the left side diameter of the first trunk was 0.4 mm, and the diameter of the

second trunk was 0.6 mm. On the right side diameter of the first and second trunk was 0.5 mm. The distance between the two trunks of SCA was 0.7 mm on each side.



Figure 1 – CT angiography of the brain arteries with origin of each SCA as a single vessel from the basilar artery



Figure 2 – CT angiography of the brain arteries with origin of the right SCA as a duplicated vessel and the right arise as a single vessel from the basilar artery

In our study we did not find triplication in the origin of the SCA. In 2 (1.83%) patients was noticed origin of the SCA from PCA as a single trunk from adult type of the PCA.

The diameter of SCA at its origin on the left side was in the range between 0.40–2.40 mm, mean 1.42 mm, and on the right side from 0.44–2.60 mm, mean 1.46 mm.

The distance between SCA and PCA on the left side was 1.52 ± 0.54 mm, and on the right side was 1.62 ± 0.52 mm.

Discussion

The SCA is the most consistent of the infratentorial cerebellar arteries in its presence and area of supply. The SCA is divided into four segments: anterior pontomesencephalic, lateral pontomesencephalic, cerebellomesencephalic, and cortical. Each segment may be composed of one or more trunks, depending on the level of bifurcation of the main trunk. The segments of the SCA passes near and frequently have points of contact with the oculomotor, trochlear, or trigeminal nerves [3].

Even within consistent territory, different variations in the SCA have been described including duplication, triplication and extraordinary origins, whereas the bilateral occurrence of these variations have been encountered less frequently [4].

A number of previous studies in the field of anatomy have focused of the origin of SCA. The SCA was found as a single trunk in 100%, 84%, 82.8%, 67%, by Akgun, Pai, Esmer and Avci respectively [5–8]. The results from our study coincide with research conducted by Akgun et al, in booth studies the highest percentage SCA comes out as single vessel from the basilar artery. Duplication of the SCA was seen in 5.9%, 16%, 17.2%, 25%, 26%, by Uchino, Pai, Esmer, Dagainar and Avci respectively [6–10]. The triplication was seen in 7% by Avci respectively [8].

In most of the cases SCA have origin from the basilar artery, but there are many cases reports in the literature who describes the origin of SCA from PCA [4, 11]. Other studies that have been carried out have determined origin of SCA from PCA in 4% or 2.6% of the cases in the series of Hardy and Uchino [3, 9].

Recent studies have determined the distance between SCA and PCA. The reported distance between SCA and PCA was 0.49–2.17 mm, average 1.15 mm by Avci [8], according to Pai SCA arose very close to the basilar bifurcation from 1 to 3 mm, mean 1.45 mm on the right side and 1.33 mm on the left side [6]. The mean distance of the SCA origin to the PCA origin was in range from 0–3.4 mm, average 1.19 ± 0.8 mm according to Gonzales [12]. The data from the previous published studies are in accordance with our study.

Habibi et al in his study found that the diameter of SCA varied from hypoplastic smaller than 1 mm to 2.40 mm (mean 1.65 mm)

[13]. Pai et al found that the diameter of SCA varied from 0.5 mm to 2.5 mm on both sides, mean 1.4 mm on the right side and 1.6 mm on the left side [6]. According to study conducted by Akgun et al diameter of the SCA was 1.59 ± 0.39 mm on the right side and 1.52 ± 0.31 mm on the left side [5].

In addition, it has been shown that in cases of multiple SCAs the diameter of the first SCA was 0.95–2.25 mm (average 1.56 mm), the diameter of the second SCA 0.35–1.58 mm (average 0.89 mm), and the diameter of the third SCA was 0.42–0.71 mm (average 0.55 mm) [8].

Clinical significance of the SCA

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 morphological characteristics of the SCA must be well known for accuracy of the interpretation of radiological findings and for planning and accomplishing endovascular procedures [4].

Arterial bypass procedure can be used in vertebrobasilar ischemia, skull base tumors, and complex and giant arteriovenous malformations related to posterior circulation. In this procedure knowledge of the anatomic features of the vasculature has an important role in pre-operative planning of the appropriate branches and location for the anastomosis [5].

For revascularization procedures, the rostral or caudal trunks of the SCA can be used. The bifurcating trunks are most easily accessed for revascularization procedures utilizing a combined petrosal, lateral supracerebellar-infratentorial, or subtemporal approach. Generally the largest trunk of the SCA is the rostral trunk, however, the rostral trunk contains more perforating branches than the main trunk, caudal trunk and marginal branch, and the rostral trunk more commonly comes into contact with IV cranial nerve. If the rostral trunk is to be used for revascularization, consideration should be given to the potential risk of injury of IV nerve and the potential for perforator infarcts [8].

Different segments of the SCA have some relationships to the cranial nerve III, IV and V in 70%, 95% and 45% respectively [8, 14]. This relationship between cranial nerves and SCA can be cause of some neurological disorders.

Compression of the oculomotor nerve manifests with symptoms involving eyeball movements and papillary size changes [8, 15]. Trochlear nerve compression with SCA trunk or branches can cause trochlear nerve palsy which manifests with superior oblique myokymia [7, 8, 16]. One of the common causes of trigeminal neuralgia is compression of trigeminal nerve by loops of SCA [17, 18]. The close contact between SCA and cranial nerves is important in all lateral and combined petrosal approaches to the region of the tentorial incisura [14].

Conclusions

This study has demonstrated that thorough knowledge of the anatomy and variants of SCA is essential for clinicians as well as basic scientists who deal with problems related to intracranial vasculature on daily basis in education, diagnosis and treatment of cerebral-vascular diseases.

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Резиме

МОРФОЛОШКИ КАРАКТЕРИСТИКИ НА ГОРНАТА ЦЕРЕБЕЛАРНА АРТЕРИЈА

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Со воведувањето нови техники во дијагностичката и интервентната радиологија и напредокот во микрохирургијата се наметнува потребата од добро познавање на анатомијата на мо-

зочните крвни садови во секојдневната клиничка работа. Целта на оваа студија е да се испитаат морфолошките карактеристики на горната церебеларна артерија и да се прикаже нивното клиничко значење.

За реализирање на оваа студија, 109 пациенти од Универзитетската клиника за радиологија, од оправдани медицински причини, беа прегледани со компјутеризирана томографска ангиографија. Во студијата беа вклучени 49 жени и 60 мажи, на возраст од 27 до 83 години, со просечна возраст од $57,4 \pm 11,8$ години.

Горната церебеларна артерија беше визуелизирана кај сите анализирани слики. Кај 105 пациенти артеријата потекнуваше од дистални-

от дел на базиларната артерија. Кај двајца пациенти артеријата излегуваше како двојно стебло од базиларната артерија. Кај двајца пациенти беше утврдено потекло на горната церебеларна артерија од задната церебрална артерија од адултен тип.

Познавањето на анатомијата и варијациите на горната церебеларна артерија е важно за лекарите од клиничките, но и од базичните науки што се занимаваат со патологија на интракранијалните крвни садови во секојдневната клиничка работа.

Клучни зборови: горна церебеларна артерија, анатомија, варијации, базиларна артерија.