

INCIDENCE OF LEFT VERTEBRAL ARTERY ORIGIN DIRECTLY FROM THE AORTIC ARCH

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Abstract

The vertebral artery (*a. vertebralis*, VA) is classically described as the first branch of the ipsilateral subclavian artery (*a. subclavia*). This study aimed to show the aberrant pattern of *a. vertebralis sinistra*. The study included 1000 CTA images taken from 1000 patients. The only recorded variation in the origin of *a. vertebralis* was a separate origin of *a. vertebralis sinistra* (LVA) in 28 of the patients (2.8%). It was present as a four-vessel aortic arch pattern with *a. vertebralis sinistra* arising between *a. carotis communis sinistra* (LCCA) and *a. subclavia sinistra* (LSA). Establishing the diagnosis of these variations is very important before cerebral angiography or endovascular surgeries in the head and neck region are performed.

Keywords: vertebral artery, origin, variations

Introduction

The vertebral artery (*a. vertebralis*, VA) is classically described as the first branch of the ipsilateral subclavian artery (*a. subclavia*). Several studies have reported anomalous origin, with *a. vertebralis* arising from the aortic arch^[1-9], from the thyrocervical trunk^[1,8,10], from the brachiocephalic trunk^[11], from the common carotid artery^[1,8,12], and from the external carotid artery^[1,6,8]. *A. vertebralis* may have a duplicate origin, generally from the aortic arch and *a. subclavia*^[13-15]. Establishing the diagnosis of these variations is very important before cerebral angiography or endovascular surgeries in the head and neck region are performed^[14].

The aim of this study was to present the frequency of variations in VA origin.

Material and methods

The study included 1000 CTA images taken from 1000 patients of both sexes, older than 18 years, as a part of the scientific project of the Institute of Anatomy, Faculty of Medicine in Skopje, and University Clinic for Surgical Diseases “St. Naum Ohridski” in Skopje. Patients were referred to the clinic with referral diagnoses requiring CTA chest radiography, which visualizes the aortic arch (arterial diseases and aneurysm of the aorta, traumatic vascular chest injury, pulmonary embolism). Before the examination, patients had been informed that their recordings would be used for the purposes of a research, and they signed a written consent. CTA was obtained using a MDCT scanner BrightSpeed GE 16 slices. In order to make a successful visualization of the blood vessels, patients were appropriately prepared for the examination. During the procedure, patients were lying on a

CT table in supine position and were advised to stay calm. The scan started at the level of the thoracic inlet to include the proximal parts of the carotid and subclavian arteries and ended below the diaphragm. In addition to pathological changes, the collected images were also analyzed in terms of variations in the origin of VA.

Results

The only recorded variation in the origin of *a. vertebralis* was a separate origin of *a. vertebralis sinistra* (LVA) in 28 of the patients (2.8%). It was present as a four-vessel aortic arch pattern with *a. vertebralis sinistra* arising between *a. carotis communis sinistra* (LCCA) and *a. subclavia sinistra* (LSA) (Figure 1).



Fig 1. *A. vertebralis sinistra* arising between LCCA and LSA

Discussion

In anatomy, surgery, angiography as well as in all non-invasive procedures, it is very important to know the exact course of the artery and the possible variations^[1]. *A. vertebralis* is the first branch of *a. subclavia*, and arises from the upper and back part of the first portion of the vessel. Anatomical variations of *a. vertebralis* concerning their site of origin, course and branching pattern are not common and present particular clinical interest. In order to understand the majority of *a. vertebralis* variations, a deep knowledge of embryological development of the aortic arch and its branching pattern is required.

Embryologically, *a. vertebralis* is formed by the development of longitudinal anastomoses that link the cervical intersegmental arteries. During embryological development, as the heart and aorta move caudally, cervical intersegmental arteries appear from the aortic arches^[16]. The intersegmental arteries eventually regress except for the seventh, which becomes the proximal subclavian artery and which includes the point of origin of *a. vertebralis* in adults^[13,15].

The results obtained in this study showed that the only variation in *a. vertebralis* origin was the arising of *a. vertebralis sinistra* between *a. carotis communis sinistra* and *a.*

subclavia sinistra, found in 2.8% of the patients which was in agreement with the results reported in the literature. According to Matula, the variations of the origin of *a. vertebralis* can be divided by two criteria: first, the vessel of origin of *a. vertebralis* and second, the origin from the subclavian artery with respect to circumferential division. Origin from a vessel other than the subclavian was found in 8 (3.48%) cases. According to Gray's Anatomy^[15], *a. vertebralis sinistra* may arise between *a. carotis communis sinistra* and *a. subclavia sinistra* or rarely (0.2%) distal to *a. subclavia sinistra*. An analysis made by Saadoon Kadir showed that 70% of the population had the usual pattern of the aortic arch. About 6% of the analyzed cases had a separated arising of *a. vertebralis sinistra*^[17]. *A. vertebralis sinistra* not infrequently arises from the aortic arch, with a reported prevalence of 2.4–5.8%^[13-15,18]. When it originates from the arch, it usually enters the transverse foramen of the fourth or fifth cervical vertebra rather than the sixth one^[14]. On the other hand, an aortic origin of *a. vertebralis dextra* is a rare anatomic variant. In such instances, the artery generally arises distal to the supra-aortic trunks. In a literature review from 1999, Lemke et al.^[14] found only nine cases in which *a. vertebralis dextra* originated from the arch. In those cases, *a. vertebralis dextra* arose between *a. carotis communis sinistra* and *a. subclavia sinistra* (one case), between *a. subclavia dextra* and *a. carotis communis dextra* in the absence of a formed innominate artery (*truncus brachiocephalicus*) (one case), or distal to *a. subclavia sinistra* (seven cases). A bilateral aortic arch origin of *a. vertebralis* represents an exceptional anatomic variant^[13]. Sait Albayram et al. presented a case of bilateral origins of *a. vertebralis* from the aortic arch in which both arteries arose proximal to the left subclavian artery^[13]. In the other reported cases with anomalous origin of *a. vertebralis sinistra*, the artery arose between the origins of *a. carotis communis sinistra* and *a. subclavia sinistra*^[18,19,20]. The aberrant right *a. vertebralis* arose from the descending aorta distal to the origin of *a. subclavia sinistra*^[13,14,21].

Anomalous origins of the vertebral arteries represent a potential pitfall at diagnostic cerebrovascular imaging. One or both arteries may be wrongly assumed to be occluded or diseased, either by eluding catheterization during angiography or by lying outside the region of interest during noninvasive studies such as CT angiography, MR angiography, or Doppler sonography. Finally, knowledge of potential *a. vertebralis* origin variants appears to be mandatory for planning aortic arch surgery or endovascular interventions. The true value of detecting anomalous origins is the diagnostic gain prior to the surgery of supraaortic arteries. For cases in which *a. vertebralis* originates from the carotid artery or its branches, the ligation of the common carotid artery may cause a compromise of the posterior fossa blood supply^[22].

In most cases described in the literature, anomalous *a. vertebralis* origin was not presented with clinical symptoms^[23,7,22]. In rare cases, patients complained of dizziness and vertigo, which was thought to have no connections to the anomalous origin of the artery^[7,22].

At the Institute of Anatomy, Faculty of Medicine in Skopje, a few studies of primary cardiac malformations in congenital heart diseases associated with anomalies of embryonic aortic arches and coronary circulation were done. The results of these previous examinations (Korneti, Kargovska) made on heart specimens fixed in 10% formaldehyde, showed that congenital heart diseases most often (70.9%) were accompanied with anomalies of the aortic arch (interrupted, hypoplastic, vascular ring with right aortic arch and coarctation)^[24]. The analysis of the branching pattern of the aortic arch showed that the most common variation was reduction of the number of branches to two (3.6%) with *a. carotis communis sinistra* arising from *truncus brachiocephalicus* (Zhivadinovik, 2000)^[24,18]. The second most common variation was increasing the number of branches to four due to separated arising of *a. vertebralis sinistra* between *a. carotis communis sinistra* and *a. subclavia sinistra* (2.7%) (Kargovska, Korneti 1985) (Zhivadinovik, 2000)^[24,18].

Conclusion

This results obtained in this study showed that *a. vertebralis sinistra* was present as a four-vessel pattern between *a. carotis communis sinistra* and *a. subclavia sinistra* in 28 of the patients (2.8%). Although this variant is generally asymptomatic, it is crucial to be aware of it during endovascular surgeries or in cases of catheterization and noninvasive studies such as CT angiography.

Conflict of interest statement. None declared.

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