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Case Report

UNUSUAL ARTERIAL ANASTOMOSES ON THE ANTERIOR SIDE OF THE MEDULLA OBLONGATA: A CASE REPORT

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Abstract. *The cerebral arterial circle is a constant carotid-basilar anastomosis on the brain base. However, some transitory primitive intercarotid or carotid-vertebral or carotid-basilar or lateral basilo-vertebral anastomoses can persist and change the common angioarchitecture of the brain. One of these transitory persistent anastomoses was found in a 72-year-old male, autopsied at the Institute for Forensic Medicine of Niš, after a fatal cranial fracture. We discovered persistent lateral basilovertebral anastomosis that originated from the right side of the basilar artery, immediately below the beginning of the right anterior inferior cerebellar artery, which was connected with the left anterior spinal artery (ASA). In addition, there were two transversal anastomoses between both vertebral arteries. Although the discovered arterial anastomoses on the ventral side of the medulla oblongata persisted in the human adult, pathologic changes of this artery and other cerebral arteries were not found. The rarity of these vascular variants in the vertebrobasilar system deserves a description in this article and future scientific attention.*

Key words: *Human brain, lateral basilo-vertebral anastomosis, anterior spinal artery, intervertebral anastomoses*

Introduction

The vertebral artery (VA) is formed in the embryo between the 32nd and 40th day of gestation. Vascular anastomoses developing between the proatlantal intersegmental and successive six cervical intersegmental arteries lead to the formation of a primitive VA on each side from the subclavian artery [1]. Primitive arterial anastomoses appear transiently, while the basilar artery (BA) is formed by a pair of longitudinal neural arteries (LNAs) [2–5].

Morphologically, VA course in the neck has three topographical segments—prevertebral, cervical and atlantic parts, whereas its fourth topographical segment—intracranial or V4 part starts after VA piercing the dura and arachnoid mater at the level of the foramen magnum entering the posterior cranial fossa. V4 segment of the VA usually extends to the junction with the opposite one at the level of bulbopontine sulcus into the unpaired BA [6].

The VA distributes the greatest number of the branches in V4 part that are officially marked as anterior and posterior spinal arteries, inferior posterior cerebellar artery, lateral and medial medullary, meningeal and cerebellar tonsillar branches and choroidal branch to fourth ventricle [7]. These arteries supply corresponding structures of grey and white substances of the spinal cord, myelencephalon or medulla oblongata and cerebellum, as well as the meninges of the posterior cranial fossa, and participate in choroid plexus of the central cavity of the rhombencephalon [6].

The anterior spinal artery (ASA), as one of previous branches, merges bilaterally as a delicate short VA branch that joins with the opposite branch into single ASA that descends along the anterior median fissure of the spinal cord. Along its course, it is reinforced by other spinal branches of ascending and deep cervical, intercostal, subcostal, lumbar, iliolumbar and lateral sacral arteries, which enter the vertebral canal via corresponding intervertebral foramina [6, 8]. ASA has a considerable functional significance because of its penetrating branches that feed the anterior two thirds of the spinal cord [9].

In this article we want to describe an incidental finding of a persistent lateral basilo-vertebral anastomosis (LBVA) and its involvement in the formation of ASA, as well as a presence of two transversal channels between the two VAs on the anterior side of the medulla oblongata in a human adult cadaver.

Material and Methods

The investigation of the carotid and vertebrobasilar (VBS) systems of 377 cadaveric specimens, routinely autopsied at the Institute for Forensic Medicine of Niš, was performed during co-author's (MT) undergraduate and postgraduate studies. The latest study was approved by the Research Ethics Committee Faculty of Medicine

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Niš (No. 01-206-1). The focus of our investigation was morphological status of cerebral arteries on the brain base. The arteries were dissected in the subarachnoid space and documented in the notebook and by photos. With the help of the ruler immediately positioned to the cerebral arteries, outer diameters (ODs) of arteries were calculated on digital images by the ImageJ program (http://rsb.info.nih.gov/ij/index.html).

A unique case of vascular variations of the VBS was discovered in 72-year-old male, routinely autopsied at the Institute for Forensic Medicine of Niš, after a fatal cranial fracture.

Marking of the constant arteries in this case was in accordance with the official Terminologia Anatomica [7], whereas the marking of the primitive vessels was in accordance with the corresponding descriptions the papers published earlier [3, 10].

Case Report

We inspected the images and schemes of a dissected human brain base, with vascular components of the carotid and vertebrobasilar systems, in a 72-year old male. Except for the islands of the atheromatous plaques and the fetal origin of both posterior cerebral arteries, other morphological and/or pathological changes of the arteries of the carotid system on the brain base were not found. We found small atheromatous plaques, but also some vascular variants of the arteries of the VBS. The left VA was dominant (OD=4.19 mm), whereas the right VA was hypoplastic (OD=2.81 mm); their convergent junction was at the level of bulbopontine sulcus. The trunk of BA runs along the basilar sulcus and bifurcates in the interpeduncular fossa.

Among other variations of VBS, there were also segmental duplication of the left superior cerebellar artery (SCA), early bifurcation of the right SCA and the presence of the LBVA, which gives off from the right side of the BA, immediately below ipsilateral anterior inferior cerebellar artery (AICA). This LBVA coursed parallel with AICA along a part of its course and then it descended in front of the right V4 and joined with the left ASA, below the level of the pyramid of the medulla oblongata. Single ASA descended to the anterior median fissure of the spinal cord. Another intervertebral anastomosis, relatively long, positioned bellow the junction of the left ASA and LBVA in the single ASA, was also found. Rostral intervertebral anastomosis was relatively short (5.51 mm) and large (OD=0.45 mm), whereas caudal intervertebral anastomosis was longer (24.76 mm) and thinner (0.38 mm) (Figs. 1–2).

Discussion

The presence of LBVA and two intervertebral transversal anastomoses in this case can be explained by embryological data [11]. Namely, anomalous blood vessels may be due to the persistence of vessels which are normally obliterated by fusion and absorption of the parts which are usually distinct.

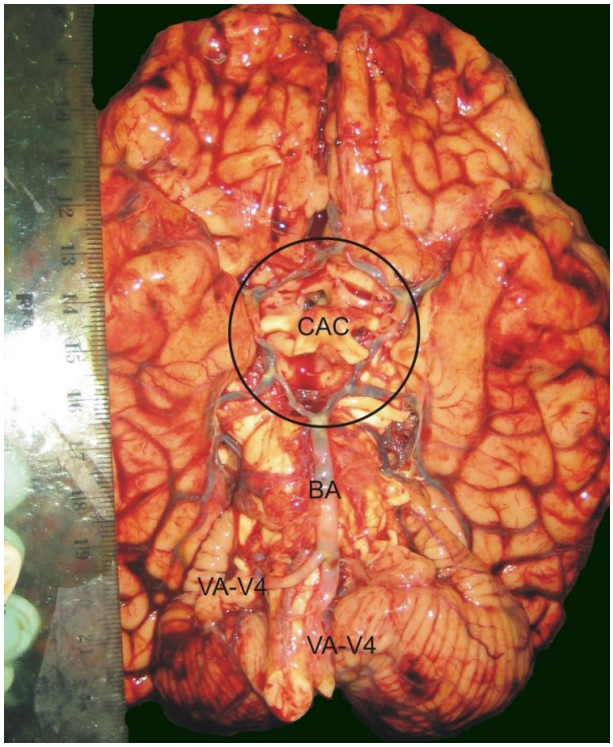
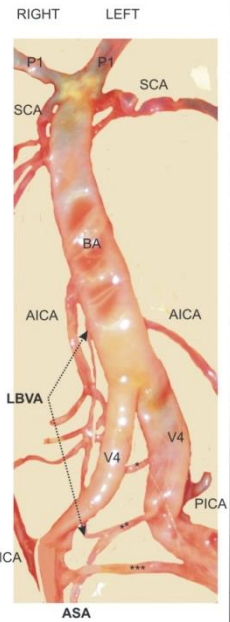


Fig. 1. Arteries in the human brain base of presented case. Vascular components of the cerebral arterial circle are encircled.
VA–V4, vertebral artery-intracranial part (on both sides); BA, basilar artery.



Arteries of the vertebrobasilar system	Outer diameter		Length	
	Left	Right	Left	Right
Posterior cerebral artery–pre-communicating part (P1)	1.79	1.29		
Superior cerebellar artery (SCA)	0.96	0.96		
Basilar artery (BA)	4.61		31.19	
Anterior inferior cerebellar artery (AICA)	0.49	0.81		
Lateral basilo-vertebral anastomosis (LBVA)		0.38		
Vertebral artery-intracranial part (V4)	4.19	2.81		
Rostral intervertebral anastomosis (*)	0.38		5.51	
Left anterior spinal artery** (ASA)	0.62			
Caudal intervertebral anastomosis (***)	0.45		24.76	
Anterior spinal artery (ASA)	0.62			

Fig. 2. Combination of the picture of the separated arteries of the vertebrobasilar system and the Table with calculated quantitative values of vessels' outer diameters and lengths.
Abbreviations in the picture are explained in the Table.

The posterior cerebral circulation initially consists of two parallel longitudinal neural arteries (LNAs), which later fuse forming the BA over the midline of developing pons. Lateral to each LNA is the primitive LBVA of Padget, which gives off many vessels which form a plexiform network with the LNA [2]. Prior to the complete development of the VA, the posterior circulation is supplied by transitory carotid-vertebral and carotid-basilar channels—caudal division of the internal carotid artery, the trigeminal, otic, hypoglossal and proatlantal intersegmental arteries [1–5]. If the embryo has an inappropriate development of the VA or inappropriate fusion between the VA and BA, blood circulation of the posterior brain is supplied mainly by the primitive LBVA, through which the VA and BA communicate with each other.

Among primitive carotid-vertebral anastomoses, the proatlantal intersegmental artery (PIA) has a branching pattern that closely resembles the typical distribution of spinal radicular arteries [12]. It gives off a dorsospinal vessel that further divides into ventral and dorsal branches. The ventral branch supplies the developing BA and eventually becomes incorporated into the definitive VA. In addition, the ventral branch gives off ascending and descending branches that later fuse with their opposite counterparts to give ASA. The spinal branch of PIA and its ventral radicular component remain prominent in the adult and can form the V4 segment.

We presented that right LBVA and left ASA participated in the formation of single ASA, whereas Tuccar et al. [13] described unilaterally origin of the left ASA from the hypoplastic left VA. Similar LBVA on the right side was also found in the human fetus [3].

One century ago, Stopford [14] cited that the right ASA was found to be absent in 9 %, the left ASA in 3%, and that the ASA arose by one stem from the angle formed by the junction of the two VAs in 3% of cases. This author also noted that the origin of the right and left branches remained separate in 6%, but there were one or more transverse channels between them, or they were fused forming one median vessel; these two alternatives occurred in equal proportion (47%). In a study by Zhao et al. [15] the incidence of the ASA scanned by multi-detector computed tomography was 52%.

Presented transversal intervertebral anastomoses could be compared with a case (n. 28) described by Stopford [14]. An intervertebral transversal anastomosis and ASA which originated from it, were presented in one fetal case [3], and one adult case [10]. Yonas et al. [10] noted that a group of small vessels, which later joined to form the ASA, arose from the aberrant crossing channel between the two V4 parts, whereas other authors [3, 5] were of opinion that it could be partially persistent PIA.

We measured OD of the right ASA and single ASA and it was 0.62 mm, although the caliber can range from 0.34 to 1.02 mm [16].

The clinical importance of the persistent LBVA and intervertebral anastomoses is yet unclear, although Yonas et al. [10] revealed ruptured large aneurysm located on the junction of the right VA and the aberrant crossing vessel from which ASA gives off. However, a thorough knowledge of vertebrobasilar variations may improve the outcome of head and neck operations, as well as the interpretation of angiography findings [17].

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