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## Unusual Origin of Left Vertebral Artery from the Arch of Aorta: A Case Report

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### Abstract

The aortic arch is a continuation of the ascending aorta, being located in the superior mediastinum. Three branches, the brachiocephalic trunk, left common carotid artery and left subclavian artery usually branch from the aortic arch. These branches may branch from the beginning of the arch or the upper part of the ascending aorta by varying distances between them. The brachiocephalic trunk later divides into right common carotid artery and right subclavian artery. Variations in the branching pattern of the aortic arch range from differences in the distance between origins of different branches to number of branches [1, 2]. In approximately 48 year old Indian male cadaver during routine dissection, we reported a variant of aortic arch branching pattern where the left vertebral artery arises from the arch of aorta in between the origin of the left common carotid artery and left subclavian artery whereas the right vertebral artery took its normal origin from right subclavian artery.

The anatomic and morphologic variations of the left vertebral artery are significant for diagnostic, surgical procedures and vascular radiology in the head and neck region [3]. It is of clinical importance to know the origin and course of prevertebral segment of the vertebral artery in detail and being aware of the possible variations.

**Keywords:** Arch of aorta, subclavian artery, left vertebral artery, variations.

### 1. Introduction

In anatomy, normality embraces a range of morphologies. It includes those that are more common and others called variations which are less frequent but not considered abnormal [4].

An understanding of the variability of vertebral artery remains most important in angiography and surgical procedures where an incompatible knowledge of anatomy can lead to complications [5]. Aortic arch is a continuation of ascending aorta and is originated at the upper border of second right sternocostal joint lying in the superior mediastinum. Three branches arise from the convex aspect of the arch of aorta, they leave in the following succession from right to left brachiocephalic trunk (BCT), left common carotid artery (LCCA) and left subclavian artery (LSA) [6]. The anomalies of branches arising from the aortic arch are due to variations in the extent of the fusion process and absorption of some of the aortic arches into the aortic sac. Increase and decrease in the number of the branches arising from the aorta in the thoracic region are well known for their variations, the aortic arch being one of them [7]. The vertebral artery supplies the cervical part of spinal cord, spinal ganglion, meninges and dura mater in the posterior cranial fossa. The vertebral artery arises from the supero - posterior aspect of the subclavian artery medial to the scalenus anterior muscle. The artery takes a vertical posterior course and then enters into foramen transversarium of the sixth cervical vertebra. This part of vertebral artery i.e from the origin to its entry into the respective transverse foramina is called pretransverse or prevertebral segment [8]. After passing through the transverse foramen of the atlas it turns posteromedially on its posterior arch, pierces the atlantooccipital membrane and the duramater and then enters the foramen magnum [9, 10]. In our study the left vertebral artery originated directly from the arch of aorta, in between the left common carotid artery and left subclavian artery. Detailed knowledge of the anomalous origin of supra aortic arteries is also important for patients who have to undergo four-vessel angiography in an emergency [11].

### 2. Material and Method

During routine dissection of a 48 year old Indian male cadaver in the Department of Anatomy, CSMSS. Ayurved Mahavidyalaya, Aurangabad, it was observed that the arch of the aorta had

an unusual fourth branch arising from its upper surface. In addition to the three common branches, mentioned above.

### 3. Case Report

During a routine dissection of the thoracic and abdominal cavity, an atypical aortic arch which gave off four branches, BCT, LCCA, LVA, LSA was found in a 48 years old Indian male cadaver in the anatomy dissection hall at CSMSS Ayurved Mahavidyalaya, Aurangabad. After opening the thoracic cavity, the LVA was seen originated from the aortic arch between the origins of the LCCA and the LSA. After its origin, Right vertebral artery originated from the superior aspect of the first part of Right subclavian artery and longus colli behind the common carotid artery. It was related posteriorly to the stellate ganglion and ventral rami of seventh and eight cervical spinal nerves before entering the foramen transversarium of C6 vertebra. Left vertebral artery, originated directly from arch of aorta between the left common carotid artery and left subclavian artery. The LVA, ascended behind the left common carotid artery while stellate ganglion and ventral rami of cervical spinal nerves were related posteriorly and thoracic duct arched anterior to it before it entered the foramen transversarium of C6 vertebra and traversed medially anterior to scalenus anterior. The first part of the artery followed its normal course to enter the foramen transversarium of the sixth cervical vertebra. However, the right vertebral artery arose from the posterosuperior aspect of first part of right subclavian artery, as usual. No other congenital variations were found. The further course, branching and termination pattern of these arteries (brachiocephalic trunk, left common carotid, right and left vertebral and left subclavian arteries) were normal.



**Fig 1:** showing origin of LVA in between LCCA & LSA. (BCT – Brachiocephalic trunk, AA- Arch of Aorta, LCCA – Left Common Carotid Artery, LVA – Left Vertebral Artery, LSA – Left Subclavian Artery)

### 4. Discussion

Anatomic and morphologic variations of the vertebral artery are of immense importance in surgery, angiography and all non-invasive procedures [3]. In our study we found the abnormal origin of left vertebral artery. Literature shows the frequency of origin of the left vertebral artery from aortic arch in the range of about 1% - 3% [12]. The prevertebral segment of vertebral artery is frequently affected with Atherosclerosis [13]. Though the overall incidence of anomalous origin of prevertebral segment of vertebral artery is low, it is extremely

important to be aware of these complications in patients with this anomaly. Even though the branching patterns of the aortic arch are considered to be variants of some deviations from the commonest pattern of development, there were not any noticeable signs of anatomical pathology associated with those variations. These variations have to be taken into consideration by surgeons when they are planning surgical or diagnostic interventions involving the aortic arch and its branches. The presence of anomalous arch vessels has considerable impact on AA reconstruction technique and cerebral protection methods when the separated graft technique is adopted to perform total arch replacement. Some anomalous aortic branches, as the left vertebral artery (LVA), are difficult to diagnose preoperatively as it is often obscured by other larger arch branches, making its preoperative detection considerably more difficult. They are most often discovered intra-operatively, hence it is necessary to take special precaution while the arch branches are dissected and exposed [14].

Surgeons must be aware of possible variations of the major arteries and be able to identify them. Correct identification of these vessels is very important for appropriate invasive techniques in order to achieve desired objectives and to avoid major complications especially during vascular surgery. The LVA arose directly from the aortic arch, and the order was as follows: right brachiocephalic (BCT), left common carotid (LCCA), left vertebral artery (LVA) and left subclavian (LSA). The true value of detecting anomalous origins is of diagnostic importance before vascular surgeries of supra-aortic arteries as variations of the branches of the aortic arch are likely to occur as a result of the altered development of certain branchial arch arteries during the embryonic period of gestation [15]. Abnormal origin of the vertebral artery may favour cerebral disorders due to alterations in cerebral haemodynamics [13]. Anomalous vertebral artery origins do not result in clinical symptoms [5]. Anomalous origin may be a risk factor for the development of saccular aneurysm at the origin of posterior communicating artery, with increased haemodynamic stress or vertebro-basilar insufficiency [16]. Detailed knowledge of the origin, course and relation of vertebral artery is especially important in case of anterior cervical spine surgery [17]. In summary, it is therefore important to be aware of this rare variation in the origin and course of left vertebral artery.

### 5. Conclusion

Anomalies in the origin of the LVA from the aortic arch have been documented worldwide. We hope that our study has provided valuable data to the clinicians and anatomists by enhancing their knowledge regarding the variation of the origin of the left vertebral artery as the course and variability in the origin of the LVA is important in head and neck surgery, angiography and non-invasive procedures of the neck. The wide spectrum of variations in the anatomical arrangement of human aortic arch and its branches offer valuable information to catheterize aortic arch and its branches for safely performing the endovascular surgery. These anatomical and morphologic variations in the arch of aorta and its branches are significant for diagnostic and surgical procedures in the thorax, head and neck regions.

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