

## A STUDY ON THE VARIANT ORIGINS OF VERTEBRAL ARTERY

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### ABSTRACT

**Background:** Vertebral artery is the first branch of subclavian artery. It is an important source of blood supply to the brain. Accurate knowledge of normal and variant arterial anatomy of vertebral artery is important for clinical procedures and vascular radiology as its injury may occur at the time of cervical fracture or dislocation. The present study was done to study variant origins of vertebral artery.

**Aims & Objective:** To study the variant origins of vertebral artery.

**Materials and Methods:** The present study was done on thirty human cadavers to know the variant origin of vertebral arteries by Dissection method.

**Results:** In the present study, variant origin of Left Vertebral Artery (LVA) was found in one male (3.33%) cadaver out of 30 cadavers. There was aortic origin of Left Vertebral Artery (LVA) instead of left subclavian artery.

**Conclusion:** An understanding of anomalous origin of vertebral artery is very much important while performing diagnostic and interventional angiography & clinical improvements before vascular surgeries of supraaortic arteries.

**Key Words:** Vertebral Artery; Subclavian Artery; Arch of Aorta; Cervical Vertebra; Variant Origins

### Introduction

The vertebral arteries arise from the superoposterior aspect of the first part of subclavian artery. The vessel takes a vertical posterior course to enter into the foramen transversarium of sixth cervical vertebra. The vertebral artery on both sides passes through the foramina transversaria of the first six cervical vertebrae, penetrate the posterior atlanto-occipital membrane and enter the cranial cavity through the foramen magnum. They unite at the caudal border of the Pons to form an unpaired basilar artery, which supplies the brain. It is divided into 4 segments- The Prevertebral (V1) segment, Vertebral (V2) segment, atlantooccipital (V3) segment, Intracranial (V4) segment. The segment of the artery from its origin at subclavian artery to its respective transverse foramen is called the pretransverse or prevertebral segment.<sup>[1]</sup>

A variation in the origin and distribution of the vertebral artery can cause alterations in cerebral hemodynamic that may predispose to aneurysmal formation with a greater risk of cerebrovascular accidents.<sup>[2,3]</sup>

The knowledge of variations in vertebral artery is of great clinical interest to the neurosurgeon and radiologist for diagnostic investigation and surgical procedures of the neck. The present study showed anomalous origin of left vertebral artery which is clinically important.

### Materials and Methods

The present study was done on 30 human cadavers at dissection hall, Anatomy department, CU Shah medical college, Surendranagar during the period of 2010-2013. Permission of Ethical committee was taken. Thirty human cadavers were dissected to study variations in the origin of vertebral artery. Dissection of superior mediastinum was done in cadavers. A transverse incision through mediastinum sterni, just below the level of the first rib was done. It was extended posteriorly through the first intercostal space. The ribs from 2-9 were cut at costochondral junction. The sternum was turned on to the upper part of the abdominal wall. The fat tissue and the pericardium covering the ascending aorta and the great vessels were removed.<sup>[4]</sup> The right and left brachiocephalic trunk veins were gently cut and deep dissection of neck region was done to find out further course of vertebral artery. Left vertebral artery, originated directly from arch of aorta between the left common carotid artery and left subclavian artery in one cadaver.

### Results

In present study, thirty human cadavers were dissected to study variations in the origin of vertebral artery. Variant origin of left vertebral artery was found in one male (3.33%) cadaver out of 30 cadavers. In which the left vertebral artery arise as a third branch of aortic arch

between left common carotid (LCC) and left subclavian artery (LSA) and then artery, 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 sixth cervical vertebra (figure 1). Further course of vertebral artery was found normal.



**Figure-1: Variant origin of left vertebral artery** (AA: Arch of Aorta; LVA: Left Vertebral Artery; LCCA: Left Common Carotid Artery; LSA: Left Subclavian Artery; BCT: Brachiocephalic Trunk)

## Discussion

The variation in origin of vertebral artery is asymptomatic. Nonetheless, diagnosis of these abnormalities in cases of vascular diseases such as arteriovenous malformations or aneurysms, before cerebral angiography, is important to avoid wrongly interpreting non-opacification of vertebral arteries as a blockage or stenosis that may prove dangerous during the endovascular surgeries in the head and neck region. Anatomic and morphological variations of the vertebral artery are of immense importance in Surgery, angiography and all non-invasive procedures.<sup>[1]</sup>

In the typical pattern three branches arise from the arch of aorta and they are: brachiocephalic trunk, left common carotid artery and left subclavian artery. However, in approximately 6% of the population the left vertebral artery arises from the arch of aorta, usually between left common carotid and left subclavian artery.<sup>[5]</sup> The right vertebral artery can arise from the first part of the right subclavian artery (1% cases), directly from the arch of aorta (3%), from right common carotid artery or from brachiocephalic trunk.<sup>[6]</sup> The left vertebral artery may arise directly from the left common carotid artery, from the root of the left subclavian artery, and may arise from the arch of aorta. According to few research studies the frequency of origin of the left vertebral artery from the aortic arch was 5.6%.<sup>[7]</sup>

Komiyana et al, reported the incidence of arterial dissection of the vertebral artery of aortic origin and vertebral artery of subclavian origin. According to their studies left vertebral artery of aortic origin was associated with a significantly higher incidence of vertebral artery dissection than left vertebral artery of left subclavian artery origin and right vertebral artery of right subclavian origin.<sup>[8]</sup>

Embryologically the vertebral artery (VA) differs from other vessels and is characterised by great variety of malformations. The anomalous origins reported where vertebral artery of aortic arch between the left common carotid (LCC) and left subclavian (LSA), after left subclavian (LSA) artery, from the thyrocervical trunk, from the brachiocephalic trunk (BCT), from the common carotid artery, from the external carotid artery.<sup>[9-11]</sup>

A vertebral artery of aortic arch origin has been earlier described by different authors in the range of 1.6 - 8.3 % (Table 1). A study by Nayak et al.<sup>[21]</sup> reported the typical branching pattern of the aortic arch in 91.4% of 62 cadavers, and the left vertebral artery arising from the arch of aorta in 1.6% of the cases. C Bhattarai et al.<sup>[22]</sup> had studied 85 cadavers in Nepalese to find out variation in branching pattern of arch of aorta. The typical branching pattern was observed in 68(80%) cases. Variation from common pattern of branches of arch of aorta was found in 17 (20%) cases. In 6(7%) cases left vertebral artery arising from arch of aorta and in 11(12.9%) cases there was common origin of brachiocephalic trunk and the left common carotid artery.

**Table-1: Aortic Origins of vertebral artery described by other studies**

Author (Year)	Incidence
Bean (1905) <sup>[12]</sup>	5.2%
Stein et al. (1962) <sup>[13]</sup>	6%
Argenson et al. (1980) <sup>[14]</sup>	5.8%
Nizanowski et al. (1982) <sup>[15]</sup>	3.1%
Cavdar and Arisan (1989) <sup>[16]</sup>	8.3%
Vorster et al. (1988) <sup>[17]</sup>	5%
Panicker et al. (2002) <sup>[18]</sup>	5%
Komiyama et al. (2001) <sup>[19]</sup>	2.4%
Yamaki K et al.(2006) <sup>[20]</sup>	5.8%
Nayak SR et al. (2006) <sup>[21]</sup>	1.6%
C Bhattarai et al. (2010) <sup>[22]</sup>	7%

Suresh et al.<sup>[23]</sup> had studied twelve cadavers of adult indigenous Trinidadian, out of them he had found direct origin of the left vertebral artery from the arch of aorta in one cadaver and common origin of the brachiocephalic trunk and the left common carotid artery in two cadavers. In the present study left vertebral artery arise from aortic arch between left common carotid and left subclavian artery in one cadaver (3.33%).

## Embryology

Usually the first part of vertebral artery develops from proximal part of dorsal branch of seventh cervical intersegmental artery proximal to postcostal anastomosis. The second part is derived from longitudinal communications of the postcostal anastomosis with the consequent regression of the stems of the upper six intersegmental arteries. Third part develops from spinal branch of the first cervical intersegmental artery. Fourth part owes its development from the pre neural division of the spinal branch.<sup>[24]</sup> In the present study, in left side the left sixth dorsal intersegmental artery might have persisted as the first part of vertebral artery hence left vertebral artery was arising from arch of aorta.

## Conclusion

In present study, variant origins of left vertebral artery were found in one male (3.33%) cadaver out of 30 cadavers. The most important benefit of detecting variations in the origin of the left vertebral artery and other arteries is diagnostic improvements before vascular surgeries of supra-aortic arteries. The knowledge of potential left vertebral artery origin variants is necessary and beneficial for planning aortic arch surgery or endovascular interventions. As it is the main source of blood supply to the brain, clinicians must be aware of its normal and abnormal origins. Failure to recognize such an anomaly might result in nonindicated therapeutic intervention.

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