Variation of Origin of Left Vertebral Artery: Phylogenic Correlation and Clinical Implication

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ABSTRACT
Variations in the branching pattern of aortic arch are caused by alterations in embryological mechanisms and are implicated in certain clinical manifestations. Anomalous origin of supra aortic arch vessels are common and their detection is important for vascular surgeries of thorax and head and neck. Stenosis of Vertebral Artery (VA) is an important etiological factor for stroke involving posterior cerebral. Advanced imaging studies like angiograms reveal conditions like VA occlusion prior to surgery. During the course of routine cadaveric dissection for student demonstration a 62 year old male cadaver presented unusual origin of Left Vertebral Artery (LVA). Anomalous of origin and distribution of LVA and its branches can lead to impaired cerebral hemodynamics and cerebral dysfunctions.

KEYWORDS: Aortic arch, Phylogeny, Subclavian artery, Unusual origin, Vertebral artery.

INTRODUCTION
Anatomic and morphologic variations of the arteries are important for diagnostic and surgical procedures. An understanding of the variability of vertebral artery is critical for angiography and surgical procedures of thoracic and head and neck regions where an incomplete knowledge of anatomy can lead to complications. Most common branching pattern of aortic arch in human beings comprises of origin of three great vessels with the brachiocephalic being the first branch followed by left common carotid artery and left subclavian artery. This pattern occurs in 65-80% of cases[1-3]. Most frequent variation in the branching pattern of aortic arch is the origin of left vertebral artery directly from arch of aorta between left common carotid artery (LCCA) and left subclavian artery (LSA). This type of four branched arch of aorta was reported with an incidence of 2.4 – 5.8% in literature [3-5].During a routine dissection one such case of anomalous origin of left vertebral artery was observed.

CASE REPORT
During regular Anatomy dissection classes for first year medical students in RIMS Ongole, AP, India an embalmed adult male cadaver of age 62 years presented an unusual origin of Left Vertebral Artery (LVA) as branch from the arch of aorta. We found that a variation of the arch of aorta gave off four branches, Brachio-Cephalic Trunk (BCT), Left Common Carotid Artery (LCCA), Left Vertebral Artery (LVA) and Left Subclavian Artery (LSA). The LVA originated from the arch of aorta between the origins of the LCCA and the LSA. The distance between the origins of LVA and the LCCA and LSA were of 3.10 mm and 4.20 mm respectively. Diameter of the LVA at its origin was 4.8 mm. The LVA was ascending upward to the transverse foramen of the C₆ vertebra. The length of the prevertebral segment of the LVA was 85mm. The right vertebral artery is normal in its origin and course.
DISCUSSION

Vertebral artery normally arises from the upper surface of first part of ipsilateral subclavian artery and passes upwards through the foramina transversaria of upper six cervical vertebrae. Then it winds backward around the lateral mass of the atlas and enters the cranial cavity through the foramen magnum. At the lower border of the pons it unites with the similar artery of the opposite side to form the basilar artery. The course of vertebral artery is divided into four parts. The segment of vertebral artery from its origin to its respective foramen transversarium of 6th cervical vertebra is called prevertebral segment and is important for head and neck surgeries [6]. Its course through the cervical vertebral foramina up to its entry in to the cranial cavity through foramen magnum is its intra vertebral course. The last part from its entry into cranial cavity through foramen magnum up to the lower border of pons is its intra cranial course.

Several researchers have reported anomalous origins of the vertebral artery such as from the aortic arch between the left common carotid artery and left subclavian artery or after left subclavian artery, from thyrocervical trunk/brachiocephalic trunk/common carotid artery/external carotid artery/common carotid trunk formed by left subclavian artery and left vertebral artery [7,8]. Vertebral artery and its branches essentially supply blood to spinal cord, brain stem, cerebellum and a significant but variable part of the posterior cerebral hemispheres. Knowing the origin and course of prevertebral segment of the vertebral artery in detail is of great importance for head and neck surgery and vascular angiography [3,9,10].and its variations can be asymptomatic [7].

Diagnosis of arterial abnormalities in cases of vascular diseases such as arteriovenous malformations or aneurysms, before cerebral angiography, is important to avoid wrong interpretation of nonopacification of vertebral artery as a blockage or stenosis which is dangerous during the endovascular surgeries in the head and neck region [11]. Left vertebral artery of aortic origin is associated with a significantly higher incidence of vertebral artery dissection than LVA of left subclavian artery origin [12].

According to Bernardi and Detori,[13] the unusual origin of the VA “may favor cerebral disorders because of alterations in the cerebral haemodynamics”. The extra cranial portion of VA is frequently affected from atherosclerosis and the most common site of the consequent stenosis is its origin [14]. Occlusive disease proximal to the left vertebral artery causes reversal of left vertebral flow from the right vertebral via the circle of Willis, and subsequently into the left subclavian artery [13].

Several cases of left sided vertebral artery originating from arch of aorta between LCCA and LSA were reported based on observations during routine cadaveric dissection [14-17]. The mean diameter of vertebral artery and length of its prevertebral segment play an important role in development of atherosclerosis.A LVA of less than 3.5 mm diameter is considered hypoplastic[18]. A diameter of less than 3.5 for LVA was reported in literature [16]. The mean diameter of LV at its origin in the present study(4.8mm) is less than that reported in literature [3,14]. The length of pre vertebral segment of left vertebral artery in the present case is greater than that reported in literature [14]. The distance between...
LV and LCCA and LSA in the present case is less than that reported in literature [14].

**Phylogeny**

The final configuration of the arch of aorta and its branches is related to its associated “migration” and “merging” of the branches, together with the different growth rates in various arteries [19]. Variant origin of vertebral artery is attributed to the altered development of certain branchial arch arteries during the embryonic period of gestation [20]. The intersegmental arteries are branches of the dorsal aorta. They originate from the branchial aortic system. Initially the VA emerges being formed by the longitudinal anastomosis of the cervical intersegmental arteries. Usually the first part of vertebral artery develops from proximal part of dorsal branch of seventh cervical intersegmental artery proximal to postcostal anastomosis. In the present case, the left sixth dorsal intersegmental artery might have persisted as the first part of vertebral artery hence LVA was arising from arch of aorta [16,21].

**CONCLUSION**

Preoperative detection of anomalous aortic arch branches such as left vertebral artery are sometimes difficult for visualization by non-invasive or invasive studies and are accidentally identified during surgery. A knowledge of this variation should be kept in mind while performing diagnostic investigations or performing surgical procedures on aortic arch or in head and neck region. Anomalous VA origin may favor cerebral disorders or can cause increased incidence of vertebral artery dissection. In either case knowledge of this type of variation in left vertebral artery is required for planning aortic arch surgery or endovascular procedures.

**REFERENCES**


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