



Anatomical variation of the origin of the left vertebral artery from the arch of aorta — a case report

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Abstract

We present a case report whereby a variation in the origin of the left vertebral artery was seen, arising directly from the arch of aorta proximal to the origin of left subclavian artery. The diameter of this artery was less than that of its counterpart on the right which showed no variation in its origin. Accurate knowledge of the normal and variant arterial anatomy of the vertebral artery is important for vascular radiology and will provide an anatomical basis to assist surgeons in performing safe vascular surgery involving the arch of aorta and its branches. The relative literature, its potential embryologic development will be discussed in detail.

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Key words [vertebral artery] [subclavian artery] [arch of aorta]

Introduction

The vertebral artery (VA) normally arises from the supero-posterior aspect of the first part of the subclavian artery. It enters through the foramen transversarium of the 6th cervical vertebra, then passes upwards through the foramina in the transverse processes of all of the cervical vertebrae above, curves medially behind the lateral mass of the atlas and enters the cranium via the foramen magnum. At the lower pontine border, it joins its fellow to form the basilar artery, thus supplying the brainstem and the posterior part of cerebrum [1]. The segment of the artery from its origin at the subclavian artery to the foramen transversarium of the 6th cervical vertebra is called as the pretransverse or prevertebral segment [2]. The course and variability in the origin of left vertebral artery and its importance in cerebral disorders has been described clinically [3] and surgically [4]. Its importance in head and neck surgery, angiography and arterial dissection has also been mentioned in the literature [5].

Case Report

During routine dissection in an adult male cadaver, at the institute of T. N. Medical College & B. Y. L. Nair Ch. Hospital, Mumbai, the left vertebral artery (LVA) was seen arising from

the aortic arch, between the origins of left common carotid artery and left subclavian artery while the right one was usual in origin (Figures 1, 2).

After its origin, the first part of the artery followed its normal course to enter the foramen transversarium of the sixth cervical vertebra.

Discussion

VA is an important source of blood supply to the brain and spinal cord. The most frequent pathology affecting the extracranial vertebral artery is atherosclerosis. According to Fischer et al., the commonest site is at the origin of vessel from the subclavian artery. The prevertebral segment of VA is frequently affected with atherosclerosis [3]. While performing various procedures like cannulation of vertebral artery for evaluating vertebro-basilar insufficiency [6] or its manual compression used for positional hemodynamics or any other surgical intervention, these anatomic and morphological variations of the vertebral artery must be kept in mind [7]. Though the incidence of these variations is much less (2.4–8.3%) nevertheless, an incomplete knowledge or lack of awareness of these variations can lead to serious complications.

A VA of aortic arch origin has been earlier reported by different authors in the range of 2.4 -8.3 % (Table 1).

Nanthan et al [8] had reported a LVA of aortic origin associated with retro-esophageal right subclavian artery and thoracic duct terminating on right side, though the origin of the right vertebral artery was normal.

According to Bernardi et al [4] the unusual origin of VA “may favor cerebral disorders because of alterations in cerebral hemodynamics.” Shear stress may be larger in VA of aortic origin than that of subclavian artery origin, as it may receive direct arterial pulsatile flow while the VA of the subclavian artery origin may receive dampened blood flow due to the presence of the proximal subclavian artery.

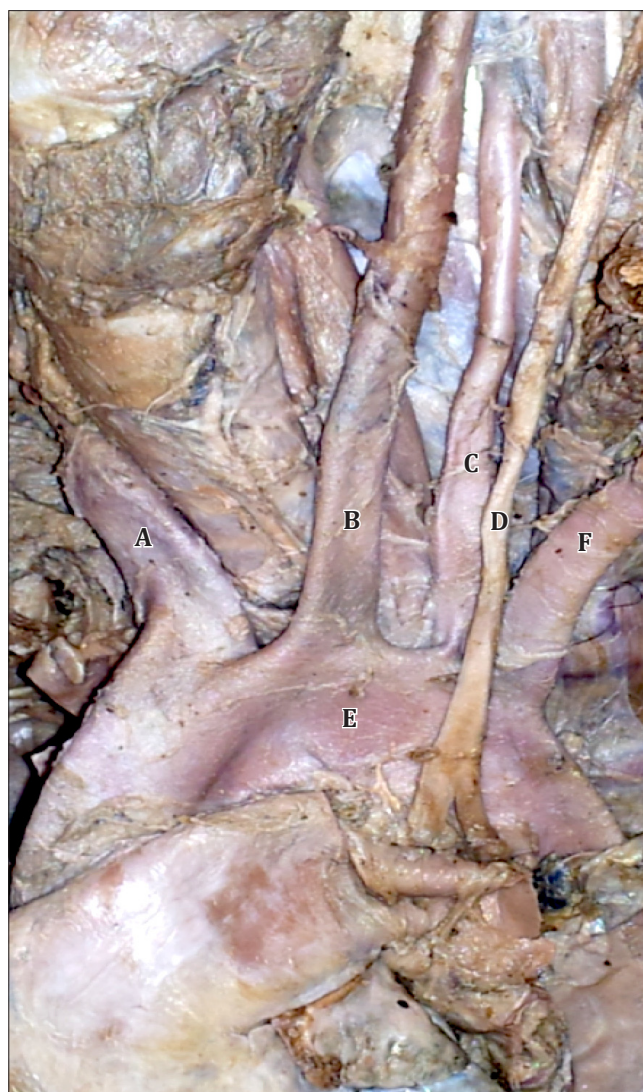


Figure 1. Photograph of the variant origin of the left vertebral artery from the arch of aorta. (A: Brachiocephalic trunk; B: left common carotid artery; C: left vertebral artery; D: left vagus nerve; E: arch of aorta; F: left subclavian artery)

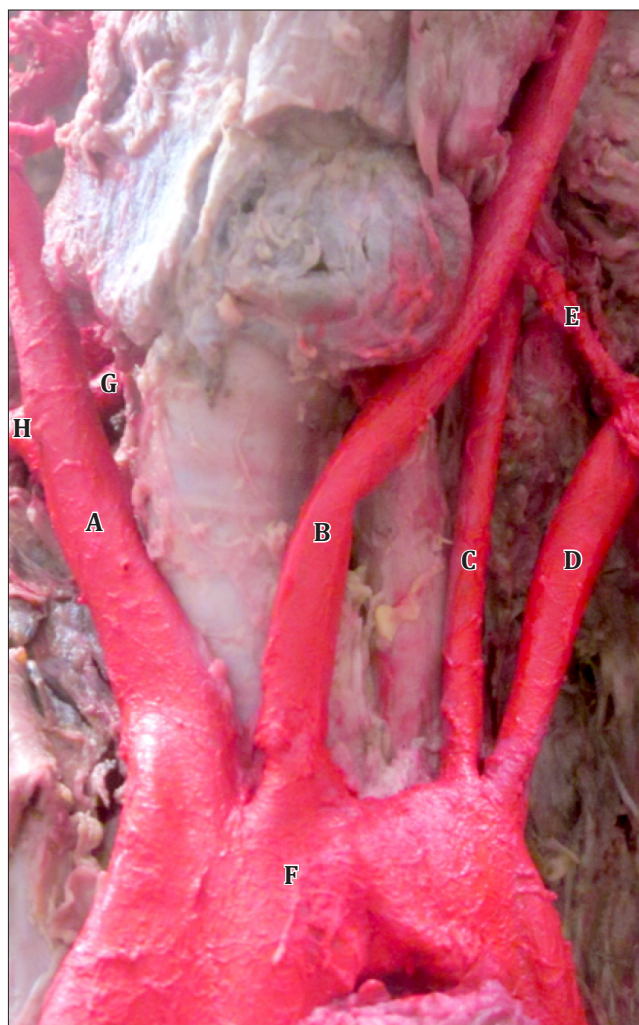


Figure 2. Photograph of the variant origin of the left vertebral artery from the arch of aorta. (A: brachiocephalic trunk; B: left common carotid artery; C: left vertebral artery; D: left subclavian artery; E: common stem of the left inferior thyroid artery and the left ascending cervical artery; F: arch of aorta; G: right vertebral artery; H: right subclavian artery)

According to Vorster et al [9] the proximal parts of the segmental arteries are exposed to longitudinal tension and bending due to caudal shifting of the aorta resulting in retarded blood flow and abnormal connections between longitudinal channels (vertebral artery) and subclavian artery or aorta.

A variant origin of VA from arch of aorta is almost always accompanied by the narrowing of its diameter, and the length of the artery is more than its right counterpart. Panicker et al [10] reported 5% incidence of origin of the LVA from aortic arch. The diameter of LVA at origin was 3.1 mm as compared to that of the right, which had a diameter of 6.5 mm at origin. The length of right VA was 3.8 cm while that of the left vertebral was 9.2 cm. In our case, the diameter of LVA at origin was 3.74

millimeter while it was 5.38 millimeter on the right side and the prevertebral length of right vertebral artery was 3.1 cm while that of left vertebral was 10.2 cm.

Imre et al [11] also reported origin of LVA from the aortic arch between the origins of the left common carotid artery and the left subclavian artery (as reported in our case), whereby the origin distances between the LVA and these arteries were 3.96 mm and 5.10 mm, respectively; while in our case these distances 6.3 mm from left common carotid artery and 2.96

Table 1. Incidence of left vertebral artery of aortic arch origin.

| Author (Year) | Incidence (%) |
|-------------------------------|---------------|
| Bean (1905) [13] | 5.2 |
| Mori (1941) [14] | 6.9 |
| Stein et al. (1962) [15] | 6.0 |
| Argenson et al. (1980) [16] | 6.8 |
| Nizanowski et al. (1982) [17] | 3.1 |
| Vorster et al. (1988) [9] | 5 |
| Cavdar and Arisan (1989) [18] | 8.3 |
| Komiyana et al. (2001) [5] | 2.4 |
| Panicker et al. (2002) [10] | 5 |
| Yamaki et al. (2006) [19] | 5.8 |
| Imre et al. (2010) [11] | 2.5 |

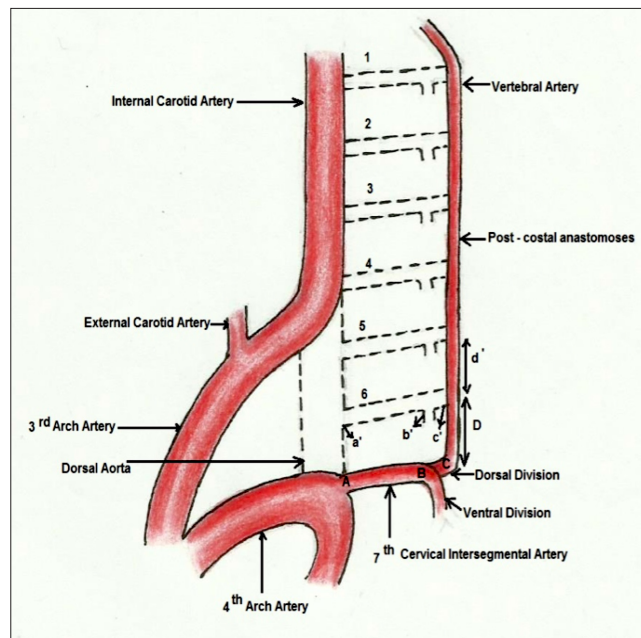


Figure 3. Diagrammatic representation of the development of the vertebral artery.

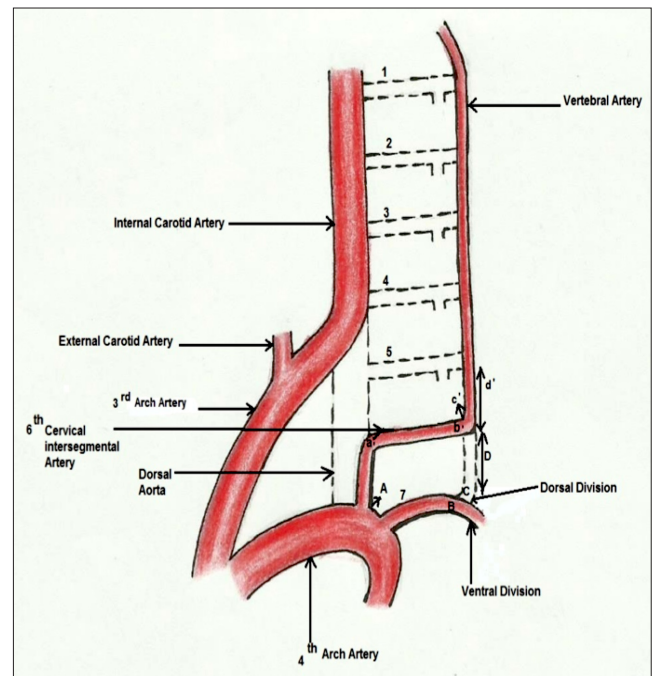


Figure 4. Diagrammatic representation of the development of the variant origin of the left vertebral artery from the arch of aorta.

mm from left subclavian artery. They also reported a reduced diameter (5.51 mm) of the variant LVA at its origin. The length of their prevertebral segment was 8.85 cm.

Komiyana et al [5] reported LVA of aortic origin in vertebral artery angiograms of 21 out of 860 patients (incidence of 2.4%). Two patients had dual origin of LVA with one leg originating from the aorta and another leg from the left subclavian artery. Satti S et al [12] also reported LVA with two limbs, one originating from aortic arch and other from the left subclavian artery in digital subtraction angiography.

Out of these 21 patients, 4 were associated with significantly higher incidence of VA dissection. Extracranial VA dissection causes brain ischemia and intracranial VA dissection causes subarachnoid hemorrhage or brain ischemia [10].

Embryological Basis

The first part of VA is derived from the dorsal division (segment BC) of the 7th cervical intersegmental artery (segment AB), which itself forms proximal part of left subclavian artery. The 6th intersegmental artery (segment a'b') and its dorsal division (segment b'c') and the segment of dorsal aorta (Aa') usually disappear (Figure 3).

In the present case left 6th dorsal intersegmental artery (a'b'), its dorsal branch (b'c') and the adjacent segment of dorsal aorta (Aa') failed to disappear, so blood flow through these persisted, forming a vertebral artery of aortic arch origin. Reduced flow through the channel (B-C-D) caused that segment to regress and ultimately disappear (Figure 4).

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