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Vertebral Artery Arising From the Aortic Arch - A Study of Its Incidence

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Abstract: *- The vertebral artery (VA) is clinically described as the first branch of the ipsilateral subclavian artery. However, multiple variations in the origin of that vessel have been reported in the literature. This variation in the origin of VA is asymptomatic. Although anomalous origins of the aortic arch branches are merely anatomic variants, knowledge of variations in the branching pattern of the aortic arch is of great importance. In patients who have to undergo four-vessel angiography, aortic instrumentation, or supra-aortic thoracic, head and neck surgery. It has been reported that anomalies of the aortic arch branching pattern could lead to cerebral abnormalities by altering the pattern of flow in cerebral vessels. In addition, knowledge of abnormal branches originating from the aortic arch is also important in the diagnosis of intracranial aneurysms following subarachnoid hemorrhage.*

Methodology: *Formalin fixed cadavers given to I MBBS students of DR B R Ambedkar Medical College, for dissection of Head & Neck, by dissection method.*

Results: *2 cadavers had vertebral artery arising from the arch of aorta.*

Keywords: ***Vertebral artery, variations, incidence, clinical implications.***

Introduction:

The vertebral arteries are major arteries of the neck. They arise as branches from the subclavian arteries and merge to form the single midline basilar artery. As the vertebrobasilar system, they supply blood to the upper spinal cord, brainstem, cerebellum, and posterior part of brain. The vertebral arteries arise from the subclavian arteries, one on each side of the body, then enter deep to the transverse process at the level of the 6th cervical vertebrae(C6), or occasionally (in 7.5% of cases) at the level of C7. They then proceed superiorly, in the transverse foramen of each cervical vertebra. Once they have passed through the transverse foramen of C1 (also known as the atlas), the vertebral arteries travel across the posterior arch of C1 and through the suboccipital triangle and enter the foramen magnum.

The vertebral artery may be divided into four parts: The first part runs upward and backward between the Longus colli and the Scalenus anterior. The second part runs upward through the foramina in the transverse processes of the C6 to C2 vertebrae. The third part issues from the C2 foramen transversarium on the medial side of the Rectus capitis lateralis. It is further subdivided into the vertical part V3v passing vertically upwards, crossing the C2 root and entering the foramen transversarium of C1, and the horizontal part V3h, curving medially and posteriorly behind the superior articular process of the atlas, The fourth part pierces the dura mater and inclines medial ward to the front of the medulla oblongata. At the lower border of the pons it unites with the vessel of the opposite side to form the basilar artery.

Variation

The left vertebral artery is usually larger and carries more blood. In 3-15% of the population, a bony bridge called the arcuate foramen covers the groove for the vertebral artery on vertebra C1.

It supplies the upper spinal cord, brainstem, cerebellum, posterior part of brain.

Multiple variations in the origin of the vertebral artery have been reported in the literature. Though these asymptomatic, knowledge of variations in the branching pattern of the aortic arch is of great importance in patients who have to undergo instrumentation & diagnostic & therapeutic procedures in the supra-aortic thoracic, head and neck region. It has been reported that anomalies of the aortic arch

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branching pattern could lead to cerebral abnormalities by altering the pattern of flow in cerebral vessels.

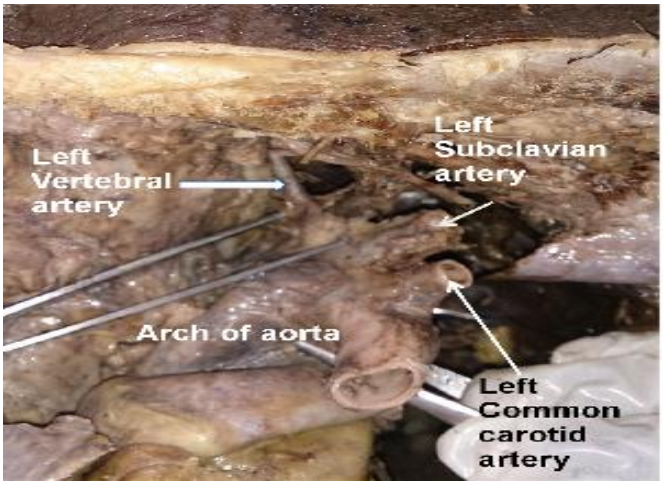
Methodology:

Formalin fixed cadavers given to I MBBS students for dissection of Head & Neck, by dissection method

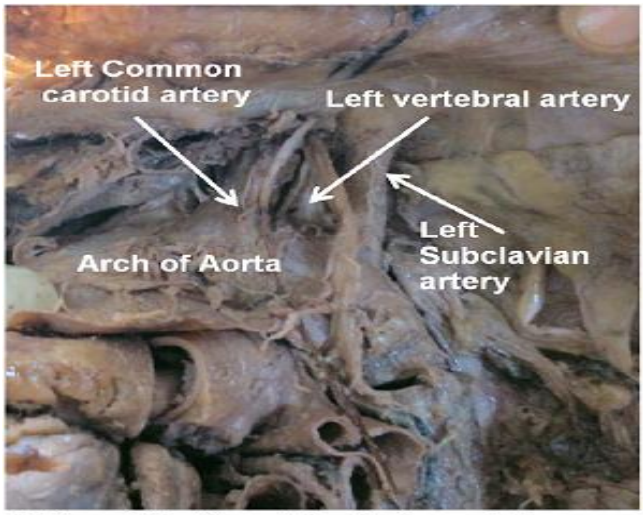
Observations:

2 cadavers had vertebral artery arising from the arch of aorta while the other cadavers showed normal origin (first branch) from the Left subclavian artery. In one (fig.1) it was arising from the Left of left subclavian artery. In the second (fig.2) it was arising between the left common carotid & subclavian arteries.

On the right side there was no variation in the origin of the vertebral artery. They were arising from the right subclavian artery in all the 15 cadavers



Picture 1: Left vertebral artery arising from the arch of aorta from the left of the left subclavian artery (Posterior view)



Picture 2:Left vertebral arter arising from arch of aorta in between the left common carotid artery & left subclavian artery respectively

Discussion:

W Henry Hollinshead 1974: Daseler & Anson reported 2.5% cases of Left vertebral artery from arch of aorta.

Ronald A. Bergman et al 1988: In their studies Pelligrini, Bean, Canivares & Dubreuil-Chambardel reported variation in; 3 out of 104 specimens; 3/129 specimens; 2/80 individual hearts; 2 /250 subjects respectively. The total number of specimens studied by the above mentioned authors was 563 & the incidence reported was 1.79%.

Panicker, H.K et al 2002: reported the anomalous origin of left vertebral artery along with variations in the branching pattern of subclavian artery. Left vertebral artery originated from the aortic arch while the right from the subclavian artery.

Vaishali B Goraya 2005: found bilateral anomalous origin of both vertebral arteries (VAs) in a 20-year-old male patient who presented for routine contrast-enhanced CT follow-up examination of the chest. Contrast-enhanced CT revealed abnormal origins of both the VAs from the aortic arch distal to the origin of the left subclavian artery.

S.R.Sattia, C A Cernigliab and R A Koenigsberga 2007: Reported 05 cases of uncommon anomalous vertebral arteries and discussed the possible embryologic etiologies. These cases include (i) a left vertebral artery as the 2nd branch off the left subclavian, (ii) a left vertebral artery with 2 origins, (iii) a right vertebral artery arising as the last branch off the aorta, (iv) a right vertebral artery arising as the 2nd branch off the right subclavian artery, and (iv) right vertebral artery with proximal duplication as the 2nd branch off the right subclavian artery & (v) the left vertebral artery originated as the 2nd branch of the left subclavian artery just distal to the thyrocervical trunk.

Nurcan imre, Bulent yalcin, Hasan ozan 2010: The left vertebral artery originated from the aortic arch between the origins of the left common carotid artery and the left subclavian artery. They measured the origin distances between the left vertebral artery and the arteries and they were 3.96 mm and 5.10 mm, respectively. Diameter of the left vertebral artery at its origin was 5.51 mm. They were of the opinion that variant origin of the VA may favor cerebral disorders because of alterations in the cerebral haemodynamics.

Mange Manyama et al 2011, observed the left vertebral artery to arising from the arch of the aorta proximal to the origin of the left subclavian artery.

G. A. Hadimani et al 2013: They encountered variations in relation to origin of vertebral artery bilaterally. On right side vertebral artery arise from brachiocephalic trunk and on left

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side vertebral artery arises from arch of aorta. They opined that the vertebral artery is an important part of the circle of willis and it is important to posterior cerebral circulation and any abnormal origin of vertebral artery ‘‘may favor cerebral disorders because of alterations in cerebral hemodynamics.

Neelesh Kanasker, P. Vatsalaswamy, Preeti Sonje 2014: They observed that the vertebral artery arising from the aortic arch is the third most common aortic arch branching pattern, with an incidence of 0.79-8%.

In the present case we found 2 cadavers out of 15 on the left side, presenting Left vertebral arteries arising from the arch of aorta making an incidence of 13.3% out of 15, considering that variation is seen on the left side only (pictures 1 & 2.). Considering both sides the incidence is 6.7%. On the right side their origin was from the vertebral artery itself. We did not observe any vertebral artery arising from the Brachiocephalic trunk.

Embryological Basis:

Multiple variations in the origin of the vertebral artery have been reported in the literature, the most frequent variant (2.4-5.8%) is the left vertebral artery arising directly from the aortic arch between the left common carotid artery and left subclavian artery. Developmental anomalies in aortic arch branching pattern arise from unusual patterns of development of the embryonic aortic arch system of the pharyngeal arches, such that there may be persistence of aortic arches that normally disappear or disappearance of parts that normally persist. Several kinds of uncommon defect occur when arches persist instead of becoming obliterated or vice versa. The proximal part of the third aortic arch normally gets extended and absorbed into the left horn of aortic sac. If it gets absorbed into the right horn of the aortic sac, it can lead to anomalies where the left common carotid artery arises from the brachiocephalic trunk. Origin of vertebral arteries from the aorta suggests that part of the aortic arch arises from the left 7th inter-segmental arteries or there was increased absorption of embryonic tissue of the left subclavian artery between origin of aortic arch and the vertebral artery.

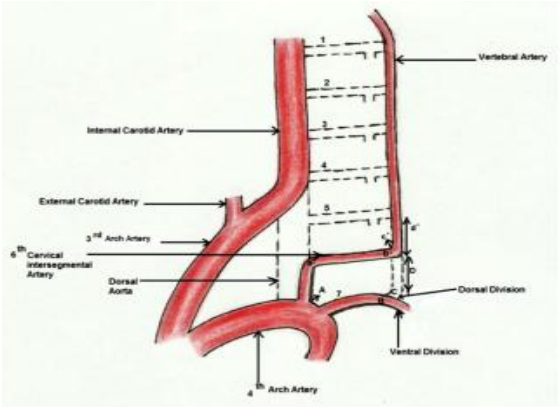

Fig 3: Development of left vertebral artery

Conclusions:

Knowledge of variations in the branching pattern of the aortic arch is of great importance in patients who have to undergo four-vessel angiography, aortic instrumentation, or supra-aortic thoracic, head and neck surgery. Diagnosis of these abnormalities in cases of vascular diseases such as arteriovenous malformations or aneurysms, before cerebral angiography, is important to avoid wrongly interpreting nonopacifiation of VAs as a blockage or stenosis that may prove dangerous during the endovascular surgeries in the head and neck region. In addition, knowledge of abnormal branches originating from the aortic arch is also important in the diagnosis of intracranial aneurysms following subarachnoid haemorrhage.

Conflict of Interest: None

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