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Research Article

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Cases of vertebral arterial variations with an emphasis on its development

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ABSTRACT

During routine dissection of 1st year MBBS students we encountered with different variations in relation to origin and thickness of vertebral artery. One of the cases was with bilateral variation in the origin of vertebral arteries; in the second cadaver variation in the origin of vertebral artery is unilateral, in third case thickness of vertebral artery was reduced very much. Abnormal origin of vertebral artery ''may favor cerebral disorders because of alterations in cerebral hemodynamics. 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

Key words: Vertebral artery, Brachiocephalic trunk, Arch of aorta

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INTRODUCTION

The vertebral artery is important to posterior cerebral circulation. According to the standard textbooks of anatomy, vertebral artery is the largest and most constant stem of subclavian artery, both in origin and distribution. It arises from the superior surface of the first part of the subclavian artery medial to the scalenus anterior muscle. The vessel takes a vertical posterior course to enter into the transverse process of the sixth cervical vertebra by passing through scaleno-vertebral triangle. It continues through the transverse foramina of the cervical vertebrae and after passing through the transverse foramen of the atlas, turns posteromedially on its posterior arch, pierces the atlantooccipital membrane and the dura mater, respectively and then enters the foramen magnum [1]. The segment of the vertebral artery from its origin at the subclavian artery to its entry into the respective transverse foramina is called the pretransverse or prevertebral segment [2]. Both Vertebral arteries unite at the caudal border of the pons to form unpaired basilar artery. This vessel courses along the ventral aspect of the brainstem [3,4].

Arterial derangements within the thorax are common, complex and can assume many diverse forms. These derangements in origin and course of main vessels occurring either individually or in combination with other cardiovascular defects are mostly explainable on ontogenic basis, which can thus be blamed for a myriad of clinically relevant anomalies [5]. The major branches of arch of aorta are the great ways for blood supply to the head and upper limb, and are of particular interest in clinical angiography. The proximal segment of these branches and of the aortic arch is common sites for atherosclerosis with clinical consequences for blood supply to brain [6]. Anomalies of origin and distribution of these branches can cause changes in cerebral hemodynamic that may lead to cerebral abnormalities [7].

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 [8].

CASE REPORT:

During routine cadaveric dissection for undergraduate students in the department of anatomy Shri B M Patil Medical College, Hospital & Research centre, BLDE University, Bijapur we found variation in the origin of vertebral artery, there were three body found with abnormal origin. All the variations were dissected, examined & photographed. Variations include,

Case 1 Unilateral variation in the origin of vertebral artery: left vertebral artery originated directly from arch of aorta between the origin of left common carotid artery and left subclavian artery. The origins distance between the left vertebral artery and the neighboring arteries were 3 mm and 4 mm respectively. Diameter of the left vertebral artery at its origin was 6 mm. The variant left vertebral artery coursed upward to the transverse foramen of the C6. The length of the prevertebral segment of the variant left vertebral artery was 93 mm. The right vertebral artery originated from the right subclavian artery like normal right vertebral artery. Its origin was 7 mm distal from the origin of the right subclavian artery. Diameter of right vertebral artery at its origin was 5 mm. The artery entered the transverse foramen of the C6. The length of the prevertebral segment of the right vertebral artery was 32 mm (fig - 1).

Case 2 Bilateral variation in the origin of vertebral artery: left vertebral artery originated directly from arch of aorta between the origin of left common carotid artery and left subclavian artery. The origins distance between the left vertebral artery and the neighboring arteries were 3 mm. Diameter of the left vertebral artery at its origin was 6 mm. The variant left vertebral artery coursed upward to the transverse foramen of the C6. The length of the prevertebral segment of the variant left vertebral artery was 89 mm. The right vertebral artery originated directly from the brachiocephalic trunk, where in brachiocephalic trunk is terminated by trifurcating into three branches. The terminal branches are right common carotid artery, right vertebral artery and right subclavian artery left to right. Diameter of right vertebral artery at its origin was 8 mm. The artery entered the transverse foramen of the C6. The length of the prevertebral segment of the RVA was 41 mm (fig -2).

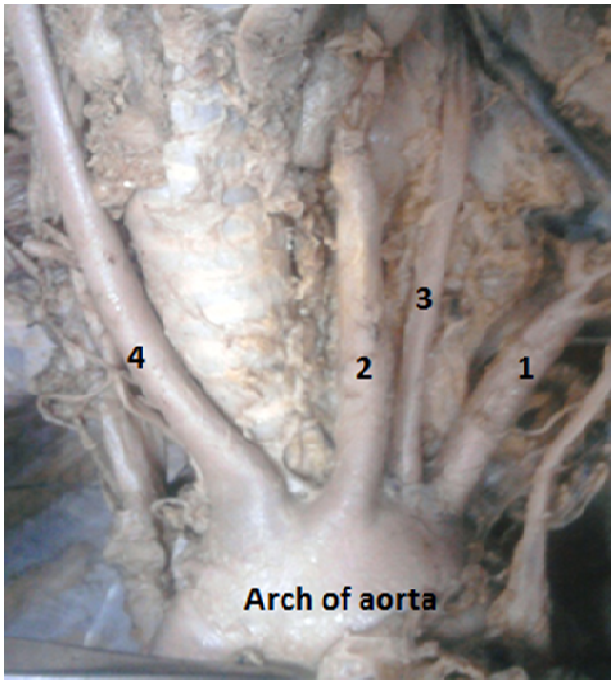

Figure 1: Unilateral variation in the origin of left vertebral artery
1-Left subclavian artery, 2- Left Common carotid Artery, 3-Left vertebral artery, 4- Brachiocephalic trunk

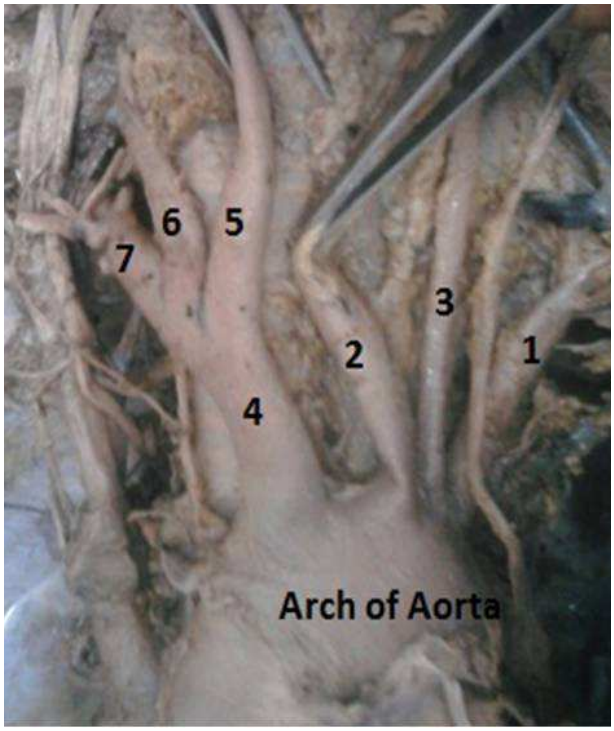

Figure 2: Bilateral variation in the origin of vertebral artery; 1-Left subclavian artery, 2- Left Common carotid Artery, 3-Left vertebral artery, 4- Brachiocephalic trunk, 5- Right common carotid artery, 6- Right vertebral artery, 7- Right subclavian artery

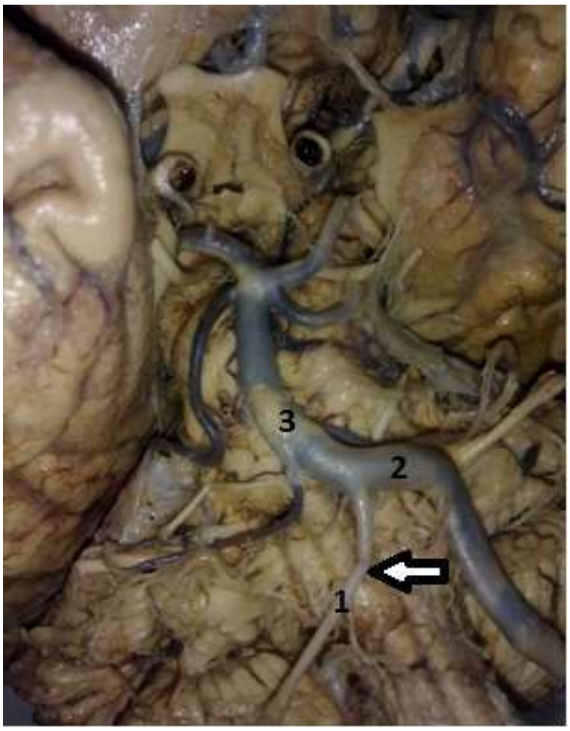

Figure 3: Variation in the diameter of vertebral artery; 1-Right vertebral artery, 2- Left vertebral artery, 3- Basilar artery

Case 3 Variation in the diameter of vertebral artery: in the third and last case origin of both vertebral arteries was normal; diameter of the right vertebral artery was 2 mm throughout its length. Diameter of first (prevertebral) part of left vertebral artery was 9 mm. Diameter of fourth (cranial) part of left vertebral artery at its termination before forming basilar artery was 7 mm (fig -3). Undue reduction in the diameter of the right vertebral artery is noticeable, in relation with this diameter of the left vertebral artery is increased.

DISCUSSION

The vertebral artery is not simple; it is complicated. Because of the interrelationship between the carotid and vertebral systems, and because perfusion of the entire brain is dependent on this relationship, the vertebral artery is an important part of the circle of Willis and must be approached from this point of view.

Anatomical variations in the major vessels of have been reported earlier. The review of literature shows many variations. It is very common to find the variation in the origin of left vertebral artery especially from arch of aorta, but it is not common to find the bilateral variation in the origin of vertebral artery and variation in the diameter of vertebral artery. However, bilateral variation in the origin of vertebral artery and variation in the diameter of vertebral artery has not been reported to the best of our knowledge.

A study by Nayak et al reported the classical branching pattern of the aortic arch in which 91.4% of 62 cadavers, and the left vertebral artery arising from the arch of aorta in 1.6% of the cases. This anomalous branching pattern of the arch of aorta can be attributed to developmental changes in the fusion process and the absorption of some of the aortic arches into the aortic sac [9]. According to few research studies the frequency of origin of the left vertebral artery from the aortic arch was between 5.6 - 6% [10 & 11].

According to *Bernardi and Deton (1975*), the abnormal origin of vertebral artery ‘‘may favor cerebral disorders because of alterations in cerebral hemodynamics [12].’’

The left vertebral artery may arise directly from left common carotid artery, left subclavian artery or from arch of aorta. The frequency of left vertebral artery arising from arch of aorta in Japanese study was 5.8%. There was no difference between male and female [13]. In the Indian study 1.6% had left vertebral artery as branch of arch of aorta. Five out of six cadavers with the anomalous aortic arch branching were females. One male cadaver presented an anomalous origin of left vertebral directly from arch [9].

Embryogenesis

Arey is of the view that the anomalous blood vessels may be due to (i) the choice of unusual paths in the primitive vascular plexus, (ii) the persistence of vessels normally obliterated, (iii) the disappearance of vessels normally retained, (iv) incomplete development, and (v) fusions and absorption of the parts usually distinct [14]. 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 [1]. In the first case, 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. In the left side of the second case same might have happened as explained above, but on the right side right limb of aortic sac might have terminated in short distance gives rise to trifurcation of brachiocephalic trunk. In third case postcostal anastomosis might have been regressed in thickness on the right side with the progressive development on the left side to meet the nutritional demand by the brain.

The vertebral artery is subject to mechanical stress, dynamic obstructions, thrombosis that propagates to brain infarction and traumatic dissecting aneurysms in addition to constriction, embolism, and occlusive disease. Pathology of the vertebral artery is characterized by catastrophic strokes in the young and by disability without stroke.

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