

Anomalous Origin and Course of Left Vertebral Artery with its Clinical Significance - A Case Report

Raviprasanna KH^{1*}, Aditya Krishna Das² and Anand L Kulkarni³

¹Associate Professor, Department of Anatomy, Mamata Medical College, Khammam, Telangana, India

²Associate Professor, Department of Anatomy, Sree Narayana Institute of Medical Sciences, Chalakka, North Kuthiyathodu PO, Ernakulam, Kerala, India

³Professor and Head, Department of Anatomy, Sree Narayana Institute of Medical Sciences, Chalakka, North Kuthiyathodu PO, Ernakulam, Kerala, India

***Corresponding Author:** Raviprasanna KH, Associate Professor, Department of Anatomy, Mamata Medical College, Khammam, Telangana, India.

Received: April 16, 2019; **Published:** May 02, 2019

Abstract

Vertebral arteries are the first branch of subclavian arteries one on each side which forms important source of blood supply to posterior aspect of brain. Adequate knowledge of arterial anomalies of vertebral arteries is necessary for clinicians or surgeons as its injury may occur during fracture or dislocation of cervical vertebrae. The present case was observed during routine dissection of thorax in the Department of Anatomy. Multiple variations of left vertebral artery (LVA) were observed in male cadaver; variant origin from arch of aorta, entry of LVA through foramen transversarium of C₅, LVA artery dividing into 2 divisions in the space between C₂ and C₁, no foramen transversarium on left side in C₁. The case demonstrated fenestrated variation in VA at the craniovertebral junction and an anomalous origin. Variations in VA at craniovertebral junction may influence treatment options for upper cervical spine pathologies. Knowledge of these variations can help surgeon to plan necessary interventions. The variation is explained on embryological basis.

Keywords: Vertebral Artery; Variation; Intersegmental Artery; Foramen Transversarium

Abbreviations

BCT: Brachiocephalic Trunk; LCCA: Left Common Carotid Artery; LVA: Left Vertebral Artery; LSCA: Left Subclavian Artery; RVA: Right Vertebral Artery; BA: Basilar Artery; FIA: First Intersegmental Artery; VA: Vertebral Artery; PICA: Posterior Inferior Cerebellar Artery, (In figure 1, 2 and 3 A: Persistent first intersegmental artery, B: Small division of vertebral artery passing through bony canal, C: 1st cervical spinal nerve, D: Posterior arch of atlas)

Introduction

Vertebral artery (VA) arises from the superoposterior aspect of the first part of the subclavian artery. It passes through the foramina transversaria of all the cervical vertebrae except the seventh, curves medially behind the lateral mass of the atlas and enters the skull via foramen magnum. The artery joins its fellow to form the basilar artery (BA) at the lower pontine border. Each VA is divided into four parts. The segment of the artery from its origin to its entry into foramen transversarium of 6th cervical vertebra is called V1 segment, part of the artery which passes through the transverse foramina of 6th cervical to 2nd cervical vertebrae for better protection is V2 segment, part which lies over the arch of atlas is V3 or Sub-occipital segment and part which enters foramen magnum is V4 segment [1]. Vertebral artery

can arise from many sources such as from the arch of aorta, between the left common carotid artery and left subclavian artery or after left subclavian artery, from the thyrocervical trunk, from the brachiocephalic trunk, from the common carotid artery, from the external carotid artery, from a common carotid trunk formed by left subclavian artery and left vertebral artery. Left vertebral artery (LVA) arising from arch of aorta is described with a frequency of 2.5 to 5.8% in cadaveric specimens [2]. It is important to recognize such variants to avoid any complications during head and neck surgery, supra-aortic arch surgery and non-invasive vascular procedures [3]. Developmentally, Vertebral arteries are formed by the longitudinal anastomoses which link the intersegmental arteries in the cervical region. Eventually the longitudinal anastomoses regresses except for the seventh, which is called proximal part of subclavian artery including the point of origin of the adult VA [4].

Case Report

The present variant related to origin and course of left vertebral artery was observed in the Department of Anatomy, Sree Narayana Institute of Medical Sciences, Ernakulam, India. During routine dissection of thorax to expose branches of arch of aorta for first year MBBS students four branches were observed from right to left; brachiocephalic trunk, left common carotid artery, accessory branch and left subclavian artery (Figure 1). The accessory branch was traced into the neck where it entered the foramen transversarium of 5th cervical vertebra. This accessory branch from arch of aorta was identified as left vertebral artery (LVA). Left vertebral artery aroused from the arch of aorta instead of from 1st part of left subclavian artery. LVA passed through foramen transversarium of 5th cervical vertebra instead of 6th cervical vertebra upto 2nd cervical vertebra. In between 2nd and 1st cervical vertebrae, the artery split into two branches: smaller branch passed through a bony tunnel in the posterior arch of atlas as there was absence of foramen transversarium on the left side of atlas (Figure 2). The larger branch traversed along the inferior surface of posterior arch of atlas to enter spinal canal. Both (smaller and larger) branches united near foramen magnum to form common trunk. The common trunk united with the right vertebral artery (RVA) in front of clivus to form basilar artery (Figure 3). Right vertebral artery demonstrated normal origin, course and distribution. No variations were detected in the basilar artery and its branches.

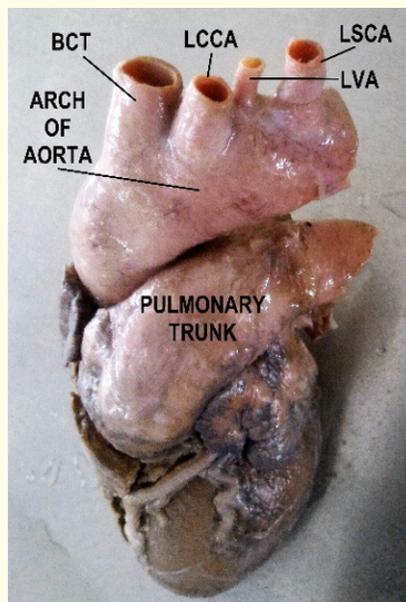


Figure 1: Showing anomalous origin from arch of aorta.

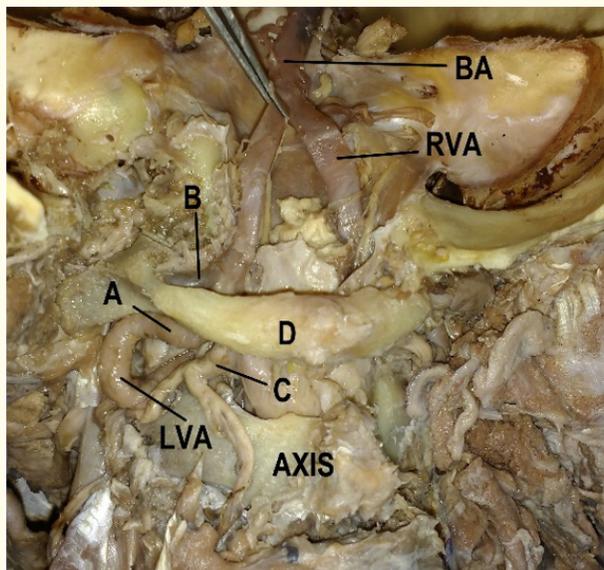


Figure 2: Showing the anomalous division of vertebral artery.

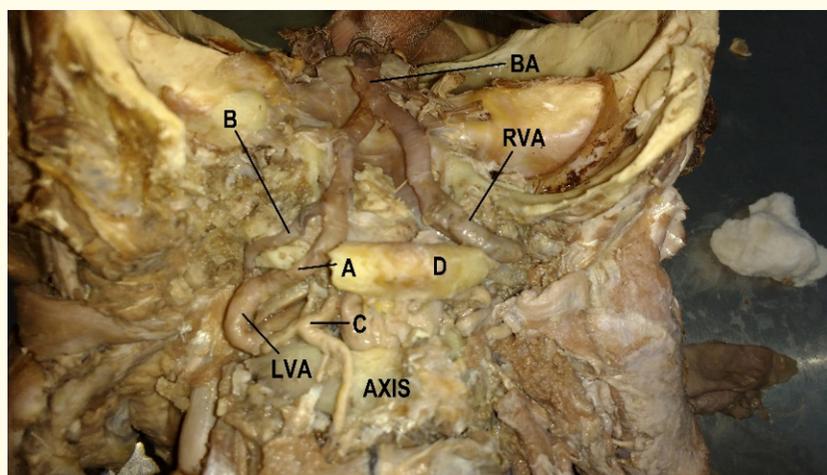


Figure 3: Showing anomalous course of 3rd part of vertebral artery.

Discussion

Origin and course of left vertebral artery is frequently asymmetric. Detection of small vertebral artery by angiography will be difficult. This small VA if ends in the basilar trunk it will be termed as ‘hypoplastic’ and termed as ‘atretic’ if not connected to the basilar artery. Complete absence of vertebral artery will be replaced by a persistent congenital anastomosis called proatlantal artery [5]. Rhoton., *et al.* observed that vertebral artery was covered partially by the posterior atlanto-occipital membrane and the bony canal was formed by groove which surrounded a short segment of artery completely. Out of 50 specimens observed by Rhoton., *et al.* 24 (48%) were observed

to be in a shallow groove, 12 (24%) were partially, but incompletely, surrounded by bone, and 14 (28%) coursed through a bony ring that completely surrounded the artery [6]. Senoglu., *et al.* reported that eight out of 166 first cervical vertebrae showed complete bilateral osseous bridge and ten out of 166 first cervical vertebrae were observed to have unilateral osseous bridges which formed a canal on the superior surface of the posterior arch of 1st cervical vertebra [7]. In the present case, the small branch of vertebral artery was observed to pass through a completely ossified bony tunnel in the left side of posterior arch of atlas. These variants of bony tunnel may act as barrier to protect artery during injury but have intraoperative complications. The anomalous course of vertebral artery near cranial part of neck might change the treatment approach for pathologies involving cervical vertebra where prior identification can help surgeon to plan appropriately to avoid risk. The normal anatomy and variants in the course of vertebral artery can be understood through its development. Series of cervical intersegmental arterial anastomoses connect to form vertebral arteries. There will be degeneration of proximal connections of the upper 6 intersegmental arteries. The persistent 7th cervical intersegmental artery develops into the proximal part of adult subclavian artery including origin of vertebral artery. First part of VA is formed from the dorsal division of 7th cervical intersegmental artery. The second part, which lies in the foramen transversarium of upper 6 cervical vertebrae, is formed from post-costal anastomoses between C₁ to C₆ intersegmental arteries. The third or the horizontal part develops from the spinal branch of first cervical intersegmental artery. The fourth part which pierces dura and arachnoid to join with the contralateral artery to form basilar artery develops from pre-neural division of the spinal branch [4]. Persistence of first intersegmental artery in the left side correlates with the division of LVA in the space between C₂ and C₁ into two divisions as in the present case. Persistence of 6th intersegmental artery correlates with VA arising from arch of aorta and entering foramen transversarium of C₅ instead of C₆. Development of vertebral artery on the right side is normal without any variation in the present case. Persistent first intersegmental artery (FIA) is the common type of variant in course of vertebral artery which makes vertebral artery to take variant course and enter spinal canal between the 2nd and 1st cervical vertebrae. 3.2% of patients show this type of variant in course of vertebral artery according to a study based on magnetic resonance angiography. Persistent FIA and normal course of vertebral artery which reunite within the spinal canal gives rise to one more type of variant called fenestration of vertebral artery which was observed in 0.9% of patients. In the present case, the smaller division of vertebral artery passed through a bony canal as foramen transversarium was absent. With the above discussion, the present case is a rare variety where there is persistent FIA and a smaller division of vertebral artery which passes through bony canal and both the branches unite to form single artery in the spinal canal before entering the foramen magnum. The prevalence of variant course of vertebral artery at craniovertebral junction was 5% and 11% it was bilateral according to the study done by Uchino., *et al.* on 2739 patients MRA report [8]. The incidence of anomalous origin and course of vertebral artery was more in down syndrome patients and with anomalies related to formation of vertebrae according to Yamazaki., *et al.* [10,11].

Conclusion

Variations in the origin and course of vertebral artery can be put forward by understanding the embryological basis. Any change in the origin and course of vertebral artery with respect to cervical region would alter the options available for treatment of pathologies related to cervical vertebrae. It is advisable for identification of any variant origin and course of vertebral artery preoperatively to avoid the risk and to minimize the complications during any surgical interventions at the craniovertebral junction.

Acknowledgements

We wish to thank with due respect and deep gratitude to the staff from the Department of Anatomy, Sree Narayana Institute of Medical Sciences, Ernakulam for suggestions and advice that helped us to a great extent.

Conflict of Interest

Nil.

Bibliography

1. Standring S. "Neck". In: Gray's Anatomy. The anatomical basis for clinical practice. 41th edition. Elsevier Saunders (2016): 457.
2. Yamaki K., *et al.* "Anatomical study of the vertebral artery in Japanese adults". *Anatomical Science International* 81.2 (2006): 100-106.
3. Matula C., *et al.* "The course of the prevertebral segment of the vertebral artery: anatomy and clinical significance". *Surgical Neurology* 48.2 (1997): 125-131.
4. Datta AK. "The circulatory system In essentials of human embryology". 6th Edition. Current books international. Kolkata 183-184.
5. Muralimohan S., *et al.* "Suboccipital segment of the vertebral artery: A cadaveric study". *Neurology India* 57.4 (2009): 447-452.
6. De Oliveira E., *et al.* "Microsurgical anatomy in the region of the foramen magnum". *Surgical Neurology* 24.3 (1985): 293-352.
7. Senoglu M., *et al.* "The effect of posterior bridging of C-1 on craniovertebral junction surgery". *Journal of Neurosurgery Spine* 5.1 (2006): 50-52.
8. Uchino A., *et al.* "Vertebral artery variations at the C1-2 level diagnosed by magnetic resonance angiography". *Neuroradiology* 54.1 (2012): 19-23.
9. Amir M., *et al.* "Lawrence Vertebral Artery Anomalies at the Craniovertebral Junction: A Case Report and Review of the Literature". *Evidence-Based Spine-Care Journal* 5.2 (2014): 121-125.
10. Yamazaki M., *et al.* "Anomalous vertebral artery at the extraosseous and intraosseous regions of the craniovertebral junction: analysis by three-dimensional computed tomography angiography". *Spine (Phila Pa 1976)* 30.21 (2005): 2452-2457.
11. Yamazaki M., *et al.* "Abnormal course of the vertebral artery at the craniovertebral junction in patients with Down syndrome visualized by three-dimensional CT angiography". *Neuroradiology* 50.6 (2008): 485-490.

Volume 2 Issue 3 May 2019

©All rights reserved by Raviprasanna KH., *et al.*