CASE REPORT

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A Rare Variant of Right Vertebral Artery from the Aorta After the Level of the Left Subclavian Artery: Review of the Literature and Reporting a Case

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ABSTRACT The aim of this study is to review the reported cases in the literature due to a rare variant of the right vertebral artery (VA) origin of the aorta after the left subclavian artery. We reviewed the literature and provide information about this rare variant, summarizing cases reported (21 similar cases) previously by Google Academic and PubMed screening and discussing the importance of embryological development underlying this variant. Based on our current case and previously reported cases, this abnormality is a very rare finding. In these cases, it is important to understand the abnormal anatomy and embryological basis. This abnormality should be considered during endovascular treatment and-or thoracic surgery for the prevention of injury and complications, and in the case of VA catheterization, which cannot be found during diagnostic cerebral angiography, and also for the prevention of injuries and complications.

Keywords: Subclavian artery; right vertebral artery; variant

Conventionally, the vertebral artery (VA) is anatomically the first branch of left or right subclavian artery (SCA). The variation of the right VA originating from the left SCA is a very rare variation. In recent years, technological advances in computed tomography (CT) and magnetic resonance angiography (MRA) imaging have resulted in better visualization of anatomical variations as well as vascular pathologies in intracranial and cervical arteries. Although, it is typically a coincidental finding, the association with arteriovenous malformations or cerebral aneurysms has been previously reported.[1] A total of 21 cases with this specific variation have been reported in clinical studies (Google Academic and PubMed). In this article, we presented an abnormal right VA originating from the left SCA which was detected at the time of the computed tomography angiography (CTA), and, as a result, of the previously reported cases and the basic embryological mechanisms for this specific variation.

A literature review was conducted using internet databases (PubMed and Google Scholar) to screen published articles on this subject. Only clinical studies were included in the analysis. The author, year and accompanying left vertebral artery variation studies are summarized in Table 1. Figure 1 shows schematically the abnormal output and course of the right VA.

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Cerebral-neck CT angiography was performed in a 52 year old man who was consulted to the hospital with the complaint of a headache and no vascular lesion was detected in the CTA. However, the right vertebral artery was found to have an abnormal origin,

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TABLE 1: Right vertebral artery from the aortic arch distal to the left subclavian artery.

No	Author	Year	Finding left VA imaging finding
1	Lemke, et al.[2]	1982	None
2	Kodama K.[5]	2000	None
3	Karcaaltincaba, et al.[6]	2003	Left VA between the left carotid and the left SCA
4	Ligepe P, Scholtz L.[1]	2004	None
5	Goray, et al.[7]	2005	Left VA from the aortic arch
6	Satti, et al.[4]	2005	None
7	Al-Okaili R, Schwartz ED.[8]	2007	Left VA between the left carotid and the left SCA
8	Karcaaltincaba, et al.[6]	2009	None
9	Hsu, et al.[9]	2010	Left VA from the aortic arch
10	Dabus G, Walker MT.[10]	2010	None
11	Ushino, et al.[11]	2013	None
12	Lale, et al.[12]	2014	None
13	Soo HB, Hye JB.[13]	2014	None
14	David C.[14]	2015	None
15	Maiti TK, et al.[15]	2016	None

VA: Vertebral artery; SCA: Subclavian artery.

which should normally originate from the right SCA (Figure 2). It was found that the right VA was directly originating from the aorta behind the last branch (fourth branch) and found to be retro-esophageal and retro-tracheal, and entered the transverse foramen at the 7th vertebral level. Also right vertebral artery was hypoplasic. The left VA was normally derived from the left SCA. Patient approval was obtained for publication of this case report.

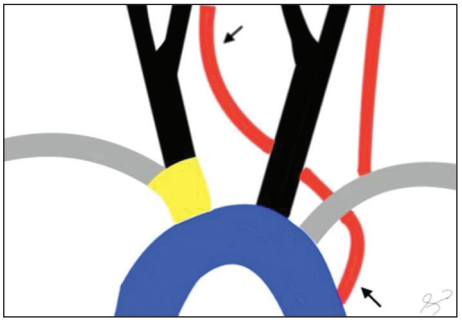

FIGURE 1: Schematic illustration of the case.

DISCUSSION

In many reports, abnormal VA's origin is a coincidental finding. In this article, we present a rare case of abnormal right VA which is rarely seen as the last branch of the aortic arch. Normally, both left and right VAs show an exit from the posterior-superior of SCA's the first part. VAs tend to proceed medially and cranially, extend to the C6 vertebrae transverse process, pass through the entire upper cervical foraminas, advance the medial mass towards the atlas lateral mass then they enter the

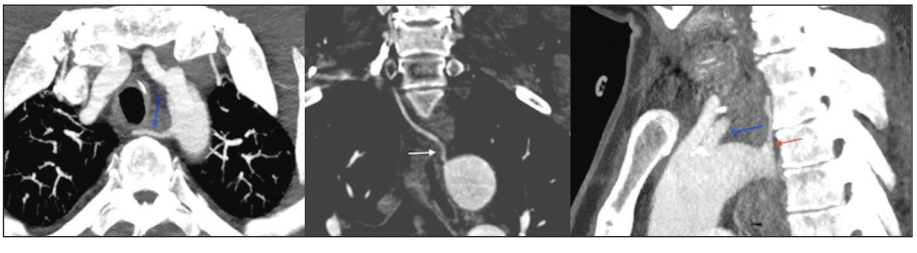

FIGURE 2: Computed tomography angiography shows the right vertebral artery distal to left subclavian artery and retroesophageal-tracheal course. A) Axial. B) Coronal. C) Sagittal curved reformated maximum intensity projection (MIP) images.

cranium within the foramen magnum. In this literature review, only the right VA scan was performed.

Previously, more than one abnormal origin of right and left VA has been reported in the literature.[1] The most common abnormality is that the left VA origins directly from the aortic arch between the left main carotid artery to the left SCA. In a previously reported autopsy serie, this abnormal output rate was reported as 2.4-5.8%.[2]

The abnormal origin of the right VA is quite uncommon and divided into three categories. These are in the form of aortic origin, carotid artery or brachycephalic artery origin and their duplications.[3]

As in our case, 21 cases with the origin of the right VA (Google Academic and PubMed) have been reported so far in the literature (Table 1).

The developmental embryology of VA is complex and there are various hypotheses in the literature. To understand this variation, it is necessary to have knowledge about the embryological mechanisms of aortic arch, brachycephalic artery and subclavian arteries.

As far as is known, the clinical signs or symptoms associated with abnormal VA origins have not yet been reported. In our case, it was a coincidental finding. The importance of understanding this abnormal anatomy is very important in the planning of cardiothoracic surgery and diagnostic and/or endovascular interventions. This abnormality should be considered when VA catheterization is difficult or unsuccessful. Failure to perform catheterization during angiography in either or both of the VAs or in cases such as CTA, MRA or Doppler ultrasonography can't reveal the outflow location may lead to misinterpretations such as vascular disease and occlusion. CTA is a reliable imaging method to demonstrate the anatomical features and variations of vascular structures. It is useful to be aware of this variation in order to prevent the occurrence of vertebra-basilar ischemia during bypass surgery in this region.

CONCLUSION

Although some researchers have assumed that the abnormal cervical arteries may cause impairment of cerebral hemodynamics due to secondary cerebral changes, there is currently no evidence of abnormal origin of VA. Abnormal VA origins also represent a potential trap in diagnostic cerebrovascular imaging. Although this is often a coincidence, detailed information may be needed before surgical or endovascular procedures to prevent any misreading and unintended damage to the VA.

Source of Finance

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

This study is entirely author's own work and no other author contribution.

REFERENCES

1. Ligege P, Scholtz L. Rare variation in the origin of the right vertebral artery. SA J Radiol. 2004:34-5. [Crossref]
2. Lemke AJ, Benndorf G, Liebig T, Felix R. Anomalous origin of the right vertebral artery: review of the literature and case report of right vertebral artery origin distal to the left subclavian artery. AJNR Am J Neuroradiol. 1999; 20(7):1318-21. [PubMed] [PMC]
3. Albayram S, Gailloud P, Wasserman BA. Bilateral arch origin of the vertebral arteries. AJNR Am J Neuroradiol. 2002;23(3):455-8. [PubMed]
4. Satti SR, Cerniglia CA, Koenigsberg RA. Cervical vertebral artery variations: an anatomic study. AJNR Am J Neuroradiol. 2007;28(5): 976-80. [Link]
5. Kodama K. Vertebral artery In: Sato T, Akita K, eds. Anatomic Variations in Japanese. Tokyo: University of Tokyo Press (in Japanese); 2000. p.213-5. (in Japanese).
6. Karcaaltincaba M, Strottman J, Washington L. Multidetector-row CT angiographic findings in the bilateral aortic arch origin of the vertebral arteries. AJNR Am J Neuroradiol. 2003;24(1): 157. [PubMed]
7. Goray VB, Joshi AR, Garg A, Merchant S, Yadav B, Maheshwari P. Aortic arch variation: a unique case with anomalous origin of both vertebral arteries as additional branches of the aortic arch distal to left subclavian artery. AJNR Am J Neuroradiol. 2005;26(1):93-5. [PubMed]
8. Al-Okaili R, Schwartz ED. Bilateral aortic origins of the vertebral arteries with right vertebral artery arising distal to left subclavian artery: case report. Surg Neurol. 2007;67(2): 174-6; discussion 176. [Crossref] [PubMed]
9. Karcaaltincaba M, Haliloglu M, Ozkan E, Kocak M, Akinci D, Ariyurek M. Non-invasive imaging of aberrant right subclavian artery pathologies and aberrant right vertebral artery. Br J Radiol. 2009;82(973):73-8. [Crossref] [PubMed]
10. Dabus G, Walker MT. Right vertebral artery arising from the aortic arch distal to the left subclavian artery diagnosed with magnetic resonance angiography. Arch Neurol. 2010; 67(4):508. [Crossref] [PubMed]
11. Uchino A, Saito N, Takahashi M, Okada Y, Kozawa E, Nishi N, et al. Variations in the origin of the vertebral artery and its level of entry into the transverse foramen diagnosed by CT angiography. Neuroradiology. 2013;55(5):585-94. [Crossref] [PubMed]
12. Lale P, Toprak U, Yağız G, Kaya T, Uyanık SA. Variations in the branching pattern of the aortic arch detected with computerized tomography angiography. Adv Radiol. 2014;2014:1-6. [Crossref]
13. Soo HB, Hye JB. Aberrant right vertebral artery originating from the aortic arch distal to the left subclavian artery: a case report. J Korean Soc Radiol. 2014;70(3):191-4. [Crossref]
14. Case D, Seinfeld J, Folzenlogen Z, Kumpe D. Anomalous right vertebral artery originating from the aortic arch distal to the left subclavian artery: a case report and review of the literature. J Vasc Interv Neurol. 2015;8(3):21-4. [PubMed] [PMC]
15. Maiti TK, Konar SK, Bir S, Nanda A, Cuellar H. Anomalous origin of the right vertebral artery: incidence and significance. World Neurosurg. 2016;89:601-10. [Crossref] [PubMed]