International Journal of Orthopaedics Sciences

ISSN: 2395-1958
IJOS 2017; 3(2): 914-917

www.orthopaper.com
Received: 18-02-2017
Accepted: 22-03-2017

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A case study on left vertebral artery development which on affects cervical surgery

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DOI: https://doi.org/10.22271/ortho.2017.v3.i2j.3540

Abstract
Background: Even though aortic arch anomalies are very prevalent, affecting 3-5% of all cadavers, the surgical treatment of these atypical branches in the cervical region is still up for debate. The patient was a 73-year-old Caucasian woman who died from renal failure brought on by a severe urinary tract infection. The AA between the left common carotid and the subclavian arteries served as the patient's left vertebral artery.
Methods: The study carried out at Department of Orthopaedics, Sree Lakshmi Narayana Institute of Medical Sciences, Puducherry, India from January 2016 to December 2016. During this study, a cadaver was obtained from a willed body programme for medical students to dissect. This helped students obtain practical experience. The 75-year-old white donor died unexpectedly from a serious urinary tract infection.
Results: Left preforaminal VA was more tortuous than right. Right and left VAs entered the foramen transversarium at the 5th and 6th cervical vertebra, respectively. The right VA was wider and had a greater lumen than the left. Right and left distal VAs had the same lumen width and size. Right and left VAs 'kinked' and distended before going through the foramen transversarium. As the VA became the basilar artery, its intracranial segment decreased.
Conclusion: People who have LVA as a result of AA might not show any symptoms. When considering an anterior approach for cervical spine surgery and other head-neck procedures, the anatomical position of a left vertebral artery is important. This is because reaching the cervical spine using an anterior approach requires retracting soft tissues like arteries, veins, and muscles.

Keywords: Developmental error, cerebral circulation, cervical surgery, clinical correlation

Introduction
An anterior circulation and a posterior circulation are both components of the blood supply to the brain. Blood is supplied to the majority of the cerebral hemispheres by the anterior circulation, which receives its supply of blood from the bilateral internal carotid arteries [1, 2]. This includes the frontal lobes, parietal lobes, and lateral temporal lobes, as well as the anterior part of the deep cerebral hemispheres [3, 4]. The blood that flows through the posterior circulation comes from the bilateral vertebral arteries (VA). It provides blood to the cerebellum, brainstem, occipital lobes, medial temporal lobes, and the posterior half of the deep hemisphere (mainly the thalamus). There is no correlation between the origin of the vertebral arteries and their contribution to the circulation in the back of the brain. Anatomically speaking, the circle of Willis is a structure that allows for an anastomotic link to be made between the anterior circulation and the posterior circulation [5-7].
From a developmental embryological standpoint, the VA begins to take shape between weeks four and eight. At this point in development, the horizontal portions of the inter-segmental arteries (ISA) 1 through 6 begin to regress, and as a result of the development of longitudinal anastomoses linking the cervical ISA, the seventh ISA transforms into the proximal subclavian artery, which is the point of origin of the adult VA [8-10]. Because it originates in the embryo as a longitudinal channel linking the cranial inter-segmental arteries, the vertebral artery is typically a branch of the subclavian artery. This is because the vertebral artery develops as a connection between the cranial inter-segmental arteries. Because of the incorporation of the proximal left seventh inter-segmental artery into the growing aorta, the left vertebral artery originates straight from the aortic arch [11].

This allows the left vertebral artery to supply blood to the left side of the spine. A variety of atypical origins of the VA can be traced back to a failure of involution in any one of the first six ISAs (also referred to as a persistent ISA) [12, 13]. There are few instances in which the left VA originates directly from the aorta in the region between the common carotid and subclavian arteries. The vertebral artery can have a variety of aberrant origins if one of the proximal six ISAs doesn't undergo proper involvement during development. If the persistent ISA occurs in the upper ISAs, the result is an abnormal origin of the vertebral artery from the internal or external carotid artery. If the persistent ISA occurs in the lower ISAs, the result is an abnormal origin of the vertebral artery from the aortic arch or the common carotid artery. If the persistent ISA occurs in the lower ISAs, the result is an abnormal origin of the vertebral Due to the fact that the left vertebral artery originates directly from the aortic arch in 3-5% of patients; this anatomical feature is of clinical relevance when operating on the neck [14-16].

Anatomically, the vertebral artery is broken up into four different segments the pre-foraminal segment, also known as the proximal segment, which travels from the origin to the transverse foramen of C5/C6, the intra-foraminal segment, which travels through the transverse foramen of the cervical vertebrae, the extramural segment, which travels from the second cervical transverse foramina to the base of the skull, and the intracranial segment [17-21].

Materials and Methods

The study carried out at Department of Orthopaedics, Sree Lakshmi Narayana Institute of Medical Sciences, Puducherry, India from January 2016 to December 2016. During the course of this inquiry, a cadaveric specimen was procured from a willed body programme in order for it to be utilised by medical students for the purpose of carrying out dissections. This was done so that the students could gain practical experience in their studies. The donor, who was a white woman 75 years old at the time of her death, passed suddenly due to a severe urinary tract infection that she had been suffering from for some time. She had been experiencing symptoms of renal failure for a considerable amount of time. During a routine cadaveric dissection of the thorax, we discovered that the left vertebral artery a typically originated from the aortic arch in the space between the common carotid and subclavian arteries. This was discovered by the fact that the AA was located between the two sets of arteries. This was a finding that was made available to the public.

Results

The pre-foraminal length of the right and left VA are significantly different from one another, as can be shown in Tables 1 and 2. The pre-foraminal VAs on the left and right sides revealed some natural tortuosity, but the left VA was more tortuous than the right VA. In this scenario, it is important to take note that the right VA and the left VA entered the foramen transversarium at the 5th and 6th cervical vertebra, respectively. In addition, the proximal right VA had a wider width and a larger lumen size than the proximal left VA did. There was no discernible change in the width of the lumen or the size of the lumen between the right and left distal parts of the VAs. Before passing through the foramen transversarium, the right VA as well as the left VA exhibited a 'kink' and distension. As the VA branched out to become the basilar artery, the intracranial section of both the right and left VA shrank in diameter.

Table 1: A number of different measurements taken of the right side's vertebral arteries

Sr. No	Vertebral artery	Right
1.	Proximal VA diameter	6.6mm
2.	Proximal VA lumen diameter	5.9mm
3.	Length	5.6cm
4.	Distal VA diameter	5.2mm
5.	Distal VA lumen diameter	4.3mm

Table 2: A number of different measurements taken of the vertebral arteries located on the left side

Sr. No.	Vertebral artery	Left
1.	Proximal VA diameter	4.9.0mm
2.	Proximal VA lumen diameter	5.6mm
3.	Length	9.1cm
4.	Distal VA diameter	5.1mm
5.	Distal VA lumen diameter	4.3mm

Discussions

People who are born with left VA that originate from the aortic arch may live their entire lives without experiencing any symptoms. However, increased blood flow has been shown to be a contributing factor in the development of cerebrovascular illnesses as well as atherosclerotic alterations, which have been linked to secondary dilatation of the right VA. When considering an anterior approach for cervical spine surgery and other head-neck procedures in which soft tissue structures such as nerves, arteries, veins, and muscles are retracted to reach the cervical spine, it is important to be aware of the anomalous origin and anatomical positioning of a left Vertebral Artery (VA). This is because a left VA has an abnormal origin, and its anatomical positioning is abnormal. It is typical for atherosclerosis to affect the extra cranial region of the VA, particularly the paravertebral part of the VA, and this area is also the most common location of stenosis [21-23]. As a result of the case study that is being described here, we came to the conclusion that the LVA was sclerotic and had become narrower, while the RVA had become larger as a result of an increase in blood flow. This served to protect the brain from ischemia. In accordance with a previous report, the paravertebral VA can be seen to follow a circuitous and winding path. In addition, there was a disparity between the tortuosity of the right and left VAs, with the former having a tortuosity percentage of 32% while the latter had a tortuosity percentage of 68%. Tortuosity of the proximal or pre-foraminal segment of VA does not have any hemodynamic repercussions; nonetheless, it has been observed that the loops of the proximal segments can elicit radicular symptoms by compressing nerve roots [24-26].

Some writers suggest that variations in cerebral hemodynamics can be caused by aberrant origins and the distribution of the major aortic arch arteries, and that these changes can lead to abnormalities in the brain. Changes in cerebral hemodynamics that may lead to cerebral disease were brought to the attention of the readers in a review of abnormal origin of right VA that was written by its authors. Prior to the operation on supraaortic arteries, the diagnostic gain represented by the detection of aberrant sources is the genuine benefit of doing so. In most cases, the untypical origin of the left vertebral artery from the aortic arch is harmless; however, it is important to pay attention to this phenomenon whenever anterior cervical surgery or any other diagnostic vascular examination is planned [26, 27]. When surgery on the supraaortic arch is planned to treat conditions such as aortic dissection, aneurysm, or another form of disease, this is

another important factor that should be carefully considered. There is no data that can be considered conclusive that these variations contribute to an increased risk of cerebrovascular diseases. However, there are writers who believe that anomalous origins and the distribution of the big aortic arch vessels can produce alterations in cerebral hemodynamics. If these changes occur, it is possible that these changes will result in cerebral abnormalities. Lemke and colleagues drew attention to variations in cerebral hemodynamics that may lead to cerebral disease in their review of anomalous origin of right VA. This was done in the context of a review of anomalous origin of right VA [28].

There are many medical indications that call for anterior cervical decompression surgery to be carried out. Spondylosis, spinal stenosis, a ruptured intervertebral disc, tumour, infection, or trauma is some of the operative indications for surgery in the cervical region. Other possible indications include: It is necessary to have a solid understanding of the anatomy of both these arteries and the skeletal structure that surrounds them in order to prevent iatrogenic VA damage. During anterior cervical spinal surgery, a laceration of the VA is one of the most severe surgical dilemmas that might arise; it is difficult to acquire control of the large haemorrhage that results from a ruptured VA, which could perhaps result in an unclear neurological morbidity. In surgery, angiography, and in all non-invasive procedures, it is of utmost importance to know the exact details of the course of the proximal segment of the VA in order to prevent catastrophic laceration of the VA during the surgical procedures. This is because catastrophic laceration of the VA can have catastrophic consequences. The incidence of vascular anomalies and aberrant Right Subclavian Carotid Artery in patients with Down syndrome is 40% and 36%, respectively, according to previous studies, which found a greater incidence of vascular anomalies in people with Down syndrome. A patient with Down syndrome was found to have an abnormal right superior carotid artery as well as an abnormal origin of the right vertebral artery from the right common carotid artery. DiGeorge syndrome, conotruncal anomaly face syndrome, and velocardiofacial syndrome are all conditions that have been linked to chromosome deletion, often known as CATCH. Individuals who have the deletion are more likely to have associated malformations of the aortic arch, aortic branches, ductus arteriosus, and pulmonary arteries than patients who do not have the deletion [25, 16, 29].

When there is severe stenosis or occlusion of the subclavian artery proximal to the origin of the VA, a process known as "subclavian steal" might take place. When this occurs, blood travels from the contralateral VA to the basillar artery and then backwards through the ipsilateral VA to reach the subclavian artery further downstream from the blockage. This setup ensures that the injured arm receives collateral blood flow. Vertigo and ataxia are examples of symptoms of posterior circulation ischemia that can be brought on by exertion of the upper extremity, which is fed by the stenotic subclavian artery. Subclavian steal syndrome is another name for this condition [30]. In the event that the AA is the source of the left VA, then a technique of this sort will not be of any use.

Conclusions

This study not only explains the embryological cause of the origin of the left vertebral artery from the aortic arch, but it also explains the clinical significance of this finding in cervical region and supraaortic arch surgery. The study was carried out by the University of California at San Francisco. The authors of the study were the ones who were responsible for conducting the research. Additionally, there is a connection between the winding nature of the proximal vertebral artery, the origin of the left vertebral artery (LVA) from the aorta, and the significance of these factors to the hemodynamics of cerebral circulation. This connection exists because there is a connection between the winding nature of the proximal vertebral artery and the origin of the LVA from the aorta. This investigation, in contrast to others that have only reported the anomaly, investigates the clinical significance of and the frequency of occurrences in other birth defects such as down syndrome and other conditions that are of a nature that is comparable to it. Specifically, the anomaly was found in Down syndrome.

Funding: None

Conflict of Interest: None

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