Anomalous Origin of the Right Vertebral Artery from the Right Carotid Artery Associated with an Aberrant Right Subclavian Artery: Case Report

Aberran Sağ Subklavyen Arter ile Birliktelik Gösteren Anormal Olarak Sağ Karotid Arterden Köken Alan Sağ Vertebral Arter

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ABSTRACT The individual variations or anomalies in the origin and course of the vertebral arteries are uncommon, and mostly identified as an incidental finding at conventional angiography or autopsy. A rare combination of an anomalous origin of the right vertebral artery from the right carotid artery and an aberrant retrooesophageal right subclavian artery is uncommonly reported in the literature. The knowledge of the variations in the aortic arch branching pattern is important prior to endovascular interventional procedures or surgical repair of the aortic arch branches. Multidetector computed tomographic angiography is able to display the detailed anatomy of the aorta and supraaortic branches with high spatial resolution. In this report, we present the multidetector computed tomographic angiography findings of an unusual case with an anomalous origin of the right vertebral artery from the right carotid artery and an aberrant retrooesophageal right subclavian artery.

Key Words: Vertebral artery; subclavian artery; congenital abnormalities; tomography, X-Ray, Computed; angiography

ÖZET Vertebral arterlerin orijin ve seyrindeki bireysel varyasyon ya da anomaliler nadirdir ve çoğunlukla konvansiyonel anjiyografi veya otopside rastlantısal bir bulgu olarak tespit edilirler. Nadir bir kombinasyon olan sağ vertebral arterin sağ karotis arterden anormal orijini ve aberran retroözofageal sağ subklaven arter literatürde yaygın olmayarak bildirilmiştir. Aortik arkın dallanma paternindeki varyasyonları bilmek, endovasküler girişimsel işlemler ve ya aortik ark dallarının cerrahisi öncesinde önemlidir. Multidedektör bilgisayarlı tomografik anjiyografi, aorta ve supraaortik dalların detaylı anatomisini yüksek uzaysal çözünürlükle gösterebilme yeteneğindedir. Bu raporda sağ vertebral arterin sağ karotis arterden anormal orijini ve aberran retroözofageal sağ subklaven arteri olan nadir bir olgunun multidedektör bilgisayarlı tomografik anjiyografi bulgularını sunuyoruz.

Anahtar Kelimeler: Vertebral arter; subklaven arter; konjenital anomaliler; bilgisayarlı tomografi; anjiyografi

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The vertebral artery (VA) normally arises from the posterosuperior surface of the first part of the subclavian artery and passes backward to enter the transverse foramina of sixth cervical vertebra. Variations in the origin of the VA are uncommon and regarded as a congenital anomaly occuring in the early stages of embryonic development. The VA can arise from the aortic arch, the common, external or internal carotid arteries or the subclavian artery branches such as thyrocervical trunk. It may also ha-

ve a duplicate origin from the aortic arch and subclavian artery.[1] The most common variant (2.4-5.8%) is the left VA originating directly from the aortic arch between the left common carotid and left subclavian artery.[2] On the other hand, the right VA originating from the right carotid artery is a rare variant, with a reported incidence of 0.18%.[3] This anomaly associated with an aberrant retrooesophageal right subclavian artery, which is also a congenital anomaly, is more unusual.[4] Various anatomic variants of the anomalous origins of the VA have been reported in the literature and most of them are identified as an incidental finding at conventional angiography or postmortem examinations. In this report we present the multidetector computed tomographic (MDCT) angiography findings of an unusual case with anomalous origin of the right VA from the right common carotid artery associated with an aberrant right subclavian artery.

CASE REPORT

A 48-year-old woman with a history of peptic ulcer underwent a barium study that showed signs of upper oesophageal compression from the left posterior aspect. The surface of the oesophagus was regular, but showed a small localized indentation. MDCT angiography was performed on suspicion of aortic aneurysm with a 16-row MDCT (Lightspeed Ultra, General Electrical Medical Systems, Milwaukee, Wisc.; USA). The main acquisition parameters for MDCT angiography were as follows: tube voltage of 100 kV, the detector collimation of 16 x 1.25 mm, the table feed of 27.5 mm/rotation, gantry speed of 0.5 sec/rotation, pitch value of 1.375:1. After determining the contrast agent transit time using the smart prep bolus technique, we acquired the image data during an intravenous injection of 100 mL iodinated contrast agent (Iodixanol, Visipaque 320 mgI/mL, GE Healthcare, Milwaukee, Wisc.; USA) at a rate of 4 mL/sec. For three-dimensional image reconstruction, all acquired data were processed on a separate workstation (Advanced Workstation 4.2, GE Healthcare, Milwaukee, Wisc.;USA) with multiplanar reformatting, maximum intensity projection and volume rendering. MDCT angiography revealed the left sided aortic arch and its major branches: the first branch was right carotid artery, followed in order by left carotid artery, left subclavian artery and an aberrant right subclavian artery (Figure 1). The aberrant right subclavian artery crossed the mediastinum from left to right passing behind trachea and oesophagus and caused mild compression of the latter (Figure 2). There was no dilatation of the oesophagus above the compression level. MDCT angiography also showed an anomalous origin of the right VA originating from the right common carotid artery coursing superiorly to enter the right transverse foramina of the fourth cervical vertebra. There was also an aneurysm of ascending aorta (4.8 cm in diameter). No further evaluation was necessitated because the diagnosis of an aberrant subclavian artery and anamolous origin of the right vertebral artery was incidental and without significant clinical consequences. The ascending aortic aneurysm is being followed up.

DISCUSSION

Embryologically, the earliest development of the VA begins at approximately 32 days and is comleted by 40 days, between the 12.5 and 16 mm stages. The VA is formed by the fusion of the longitudinal anastomoses that link the cervical intersegmental arteries, which branch off the primitive dorsal aorta. The intersegmental arteries eventually regress, except for the seventh artery, which forms the proximal portion of the subclavian artery, including the point of origin of the vertebral artery. A failure of involution in one of the first six intersegmental arteries causes a variety of abnormal origins of the VA. If the upper (first or second) cervical intersegmental arteries persist, the result is an anomalous origin of the VA from the internal or external carotid artery. If the third through sixth cervical intersegmental arteries persist, the result is an anomalous origin the of the VA from the aortic arch or the common carotid artery.[5,6]

Variations of the vertebral artery frequently occur mostly on one side and usually on the left. An anomalous origin of the right VA is uncommon and usually found out as an incidental finding at surgery or autopsy. Several types of abnormally ori-

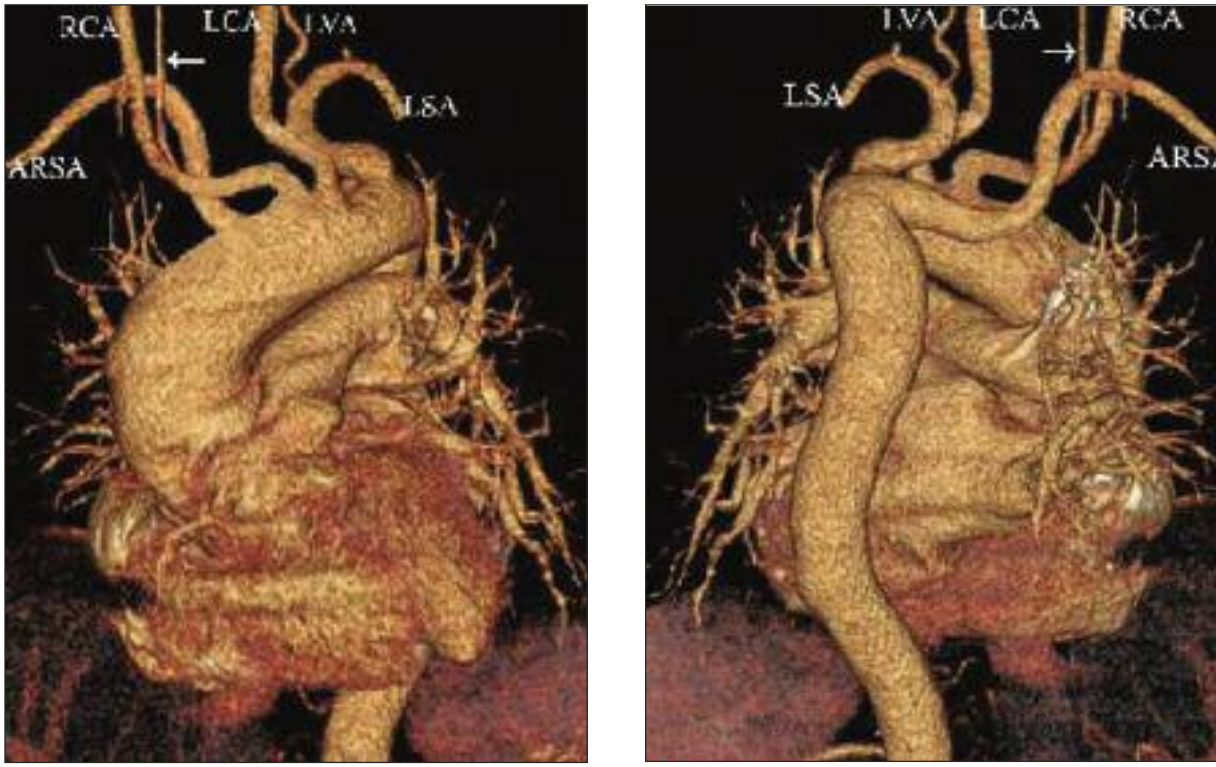

FIGURE 1: Coronal anterior (A) and posterior (B) three dimensional volume rendering multidetector computed tomography images show four supraaortic branches: right common carotid artery (RCA), left common carotid artery (LCA), left subclavian artery (LSA) and aberrant right subclavian artery (ARSA). Anomalous origin of the right vertebral artery (arrow) from the RCA is also present. The left vertebral artery (LVA) originates from the LSA.

ginating the right VA have been described. These include the right VA originating directly from the aorta, those originating from the carotid and brachiocephalic arteries, and those with duplicate origins.[2]

The clinical significance of anomalous vertebral artery origins is not clear. In most cases described in the literature, the anomalous VA origins do not result in clinical symptoms. Theoretically, altered hemodynamics cause turbulence, which may predispose the patients to aneurysms and, therefore, increase the risk of a cerebrovascular accident. However, there is no conclusive evidence that these variants lead to a predisposition to cerebrovascular disorders.[1,2] The anatomic variation of the origin of the VA are important for diagnostic and surgical procedures in the head and neck region.

FIGURE 2: Axial image shows aberrant right subclavian artery (arrow) courses behind the oesophagus and trachea causing mild compression of the latter.

An aberrant right subclavian artery is the most common type of the aortic arch anomalies, with a reported incidence of 0.5-2%.[7] In this anomaly, the right carotid artery arises as the first branch directly from the aortic arch, which is followed by the left carotid and left subclavian artery. The aberrant right subclavian artery takes its origin from

descending aorta at a distal point to the left subclavian artery, instead of arising from the innominate artery, and crosses the mediastinum from left to right passing behind oesophagus and trachea.[8] The anomalous right subclavian artery is thought to develop as a result of the involution of the right fourth aortic arch, which normally forms the innominate artery and persistence of the seventh intersegmental artery. An aortic diverticulum, also known as Kommerell's diverticulum, may be present at the origin of this vessel is reported in up to 60% of cases.[7] Although most cases are asymptomatic, only 10% of adults have symptoms of dysphagia because of extrinsic compression on the posterior aspect of the oesophagus. Anomalous origin of the VA is only present at the 15.7% of cases with aberrant right subclavian artery.[9]

Although, conventional angiography remains the gold standard method for imaging the supraortic branches, MDCT angiography is playing increasingly important role in assessment of the thoracic vascular pathologies including supraaortic branches. The advantages of MDCT angiography in comparison with conventional angiography include its ability for unrestricted reconstruction of the images, more rapid image acquisition, and the lack of potential angiographic complications. Moreover, it is able to display the detailed anatomy of the vascular structures. With MDCT, images can be reconstructed in various planes and be used as a roadmap for interventional and surgical treatment planning. The supraaortic branches can be well delineated with an excellent image quality by MDCT.[9-11] The disadvantages of this method are to need iodinized contrast material and radiation exposure.

In summary, the knowledge of the variations in the aortic arch branching pattern is important prior to endovascular interventional procedures or surgical repair of the aortic arch branches. MDCT angiography is an excellent noninvasive alternative imaging modality to conventional angiography for the evaluation of thoracic vascular anomalies because it is able to display the detailed anatomy of the aorta and supraaortic branches with high spatial resolution.

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