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Independent Anomalous Origin of the Right Vertebral Artery from the Right Common Carotid Artery

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Abstract

An anomalous origin of the right vertebral artery is rare. The left vertebral artery from the aortic arch is where most of the anomalies occur. The next is an origin of the right vertebral artery from the right common carotid artery in association with the aberrant right subclavian artery. However, independent anomalous origin of the right vertebral artery from the right common carotid artery has not been well known in the previous literature. We present this anomaly, and able to understand the mechanism of the occurrence by embryological knowledge. Failure of involution of the fourth segmental artery and the ductus caroticus remaining are associated with this anomaly. To understand this, an aberrant may be helpful to avoid injury of the vertebral artery when performing the surgical procedures and catheterization.

Introduction

Although the vertebral artery is commonly described in the first branch of the ipsilateral subclavian artery, an anomalous origin of the right vertebral artery is rare [1,2]. There were a few studies in which arteries of the vertebral artery occurs; aortic arch, subclavian artery, and common carotid artery and which transverse foramen in spine the vertebral artery enters into [3]. Knowledge of embryonic mechanism of the aortic arch and the brachiocephalic vessels helps to understand an aberrant vertebral artery as the left vertebral artery of the aortic arch between the left common artery and left subclavian artery. Also, predicting these anomalies when the procedure of surgical or endovascular treatments, we may avoid vascular complications and reduce procedure time. We report the rare case that independent anomalous origin of the right vertebral artery from the right common carotid artery, discuss the embryonic mechanism of this anomaly, and emphasize the valuable recognition of knowing these vascular anomalies.

Case Report

A 33-year-old man complained of becoming blind in his right eye of acute onset one day. He went to the nearest hospital, where he was diagnosed the right central retinal artery obstruction and the severe stenosis or obstruction of the right internal carotid artery on Doppler sonography, and introduced to our hospital to inspect the detailed causes.

He was asymptomatic except the blind and has not had a family history, past history, and lifestyle-related diseases.

Sonographic examination of the right internal carotid artery showed no blood flow, and the magnetic resonance angiography (MRA) revealed no signal therein. Diffusion-weighted imaging (DWI) is a small high-intensity area in only the right temporal tip [Figure 1(a)]. In intracranial MRA, the right middle cerebral artery was described clearly by the collateral routes; anterior communicating artery and posterior communicating artery [Figure 1(b)].

Digital subtraction angiography was performed by using the biplanar angiographic equipment. We tried to inject the right common carotid artery, but both the right common artery and right vertebral artery were contrasted at the same time; the vertebral artery from the back side of the right common artery (Figure 2).

Furthermore, the right common artery originated from more distal than the normal in the right subclavian artery. Also, the left vertebral artery originated from the aortic arch between the left common artery and the left subclavian artery. Lately, these anomalies were revealed in detail on the enhanced 3D-CT images (Figure 3).

His blindness was not already treatment adaptation because the ophthalmologist diagnosed with irreversible

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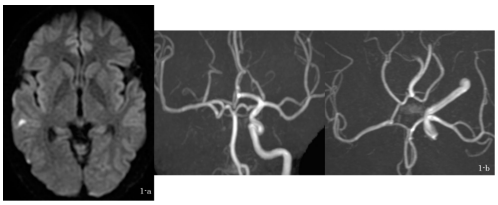

Figure 1. (a) DWI is small high intensity area. (b) in intracranial MRA, the right middle cerebral artery was described clearly by the collateral routes; anterior communicating artery and posterior communicating artery.

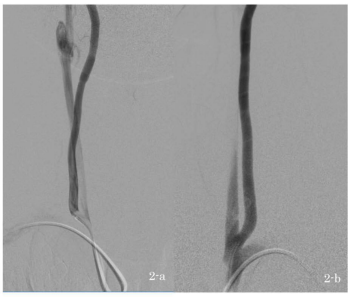

Figure 2. The vertebral artery from back side of the right common artery: (a) front position and (b) oblique position.

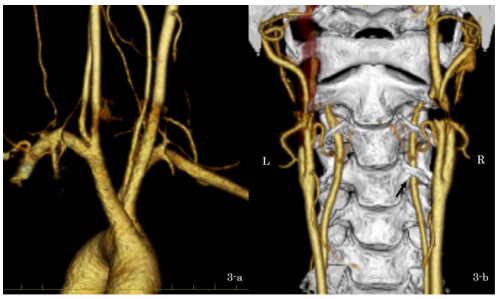

Figure 3. 3D-CT image (a) aorta in left position and (b) the right vertebral artery enters into the C4.

change. He has not had symptomatic worsening and other new symptoms and is currently under observation in the outpatient.

Discussion

Anomalous origin of the vertebral artery is not very common [1]. The most common anomaly is the left vertebral artery of the aortic arch between the left common carotid artery and left subclavian artery, which occurs in 2.4%–5.8% of cases of vascular anatomies [2]. A second variant is an origin of the right vertebral artery from the right common carotid artery in association with an aberrant right subclavian artery, having a reported incidence rate of 0.18% [4]. However, the true incidence of an anomalous origin of the right vertebral artery from the right common carotid artery has not been described [5]. To our knowledge, no case such as this anomaly is reported in the previous studies. To understand this anomaly, knowledge of embryologic mechanisms of vascular development is required.

Embryologically, the right subclavian artery develops partially from the right primitive dorsal aorta. The intersegmental arteries obliterate except the seventh, which becomes the proximal right subclavian artery. The vertebral artery is formed further by the development of longitudinal anastomosis that links the cervical intersegmental arteries.

If longitudinal anastomosis of the right cervical intersegment artery stops between the sixth and seventh cervical intersegment artery and the right side of the dorsal aorta is obliterated proximal to the seventh cervical intersegment artery, then the right side subclavian artery originates from the left side aorta distal to the left subclavian artery (aberrant right subclavian artery) [5,6], and the persistent intersegmental artery occurs in one of the C3–C6, which is an abnormal origin of the vertebral artery from the aortic arch or the common carotid artery [3].

The vertebral artery usually enters into the transverse foramen of the C6 cervical spine [2,3]. When the left vertebral artery origins from the aortic arch, this does not enter the transverse foramen of the C6 in the previous literature [7]. The origin is proximal to the left subclavian artery when the left vertebral artery enters into C3, C4, or C5 higher than C6, or which is distal to the left subclavian artery when into C7 [7]. All the right vertebral artery origin of the right subclavian artery enter C3, C4, or C5, whereas the aberrant right vertebral artery enters C7 [1].

In this case, probably the remaining fifth segmental artery results of the right vertebral artery from the carotid common artery, furthermore the right vertebral artery enters into the C4. And thinking that the right carotid common artery origins from more distal than the normal, the ductus caroticus is expected to remain by the same mechanism of the absence of common carotid artery. This mechanism is associated with these anomalies (Figure 4).

Most cases of anomalous origin of the vertebral artery have been found in asymptomatic cases. The aberrant vertebral artery is not usually symptom [1]. There are

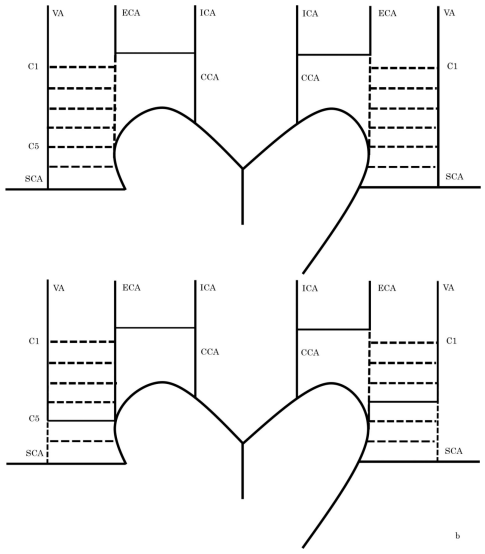

Figure 4. (a) Drawing of the embryologic development of the aorta and brachiocephalic vessels: normal development. (b) the remaining fourth segmental artery results of the right vertebral artery from the carotid common artery because the ductus caroticus remains by the same mechanism of the absence of common carotid artery.

several subjects whether the anomalous origin of the vertebral artery increases the likelihood of cerebrovascular disorders [1]. One literature is that the vertebral artery origin of the aortic arch is associated with arterial dissection [8]. In our case, there was no symptom of posterior circulation, also not associated with dissection and arterial disease.

The literature similar to our case has not been reported. This anomaly is asymptoms, but the recognition of this is important in avoiding vascular complications during the procedure of head and neck surgical or endovascular treatments. Noninvasive studies such as CT angiography, MR angiography, or Doppler sonography before catheterization for angiography and these treatments help for the understanding anatomy and the avoiding vascular injuries.

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