

# High Ascending Vertebral Artery: Case Report

## Yüksek Girişli Arteria Vertebralis

Ercan TANYELİ, MD,<sup>a</sup>  
Güler KAHRAMAN, MD,<sup>a</sup>  
Mehmet ÜZEL, MD,<sup>a</sup>  
Ali İhsan SOYLUOĞLU, MD,<sup>a</sup>  
Yakup TUNA, MD<sup>a</sup>

<sup>a</sup>Department of Anatomy,  
İstanbul University  
Cerrahpaşa Medical Faculty, İstanbul

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Yazışma Adresi/Correspondence:  
Mehmet ÜZEL, MD  
İstanbul University  
Cerrahpaşa Medical Faculty,  
Department of Anatomy, İstanbul,  
TÜRKİYE/TURKEY  
muzel@istanbul.edu.tr

**ABSTRACT** We noted that right vertebral artery of a 59-year-old male cadaver run towards the skull base and entered transverse foramen of fourth cervical vertebra (C4) after it branches from right subclavian artery. The length of the vertebral artery between its origin and the entrance point to the C4 (first part of the artery, V1 segment) was 11.8 cm and showed no tortuosity. The left vertebral artery was found normal. The frequency of this variation was reported between 0.5% and 2.08% in the literature. This type of variation of the vertebral artery may cause iatrogenic injuries during surgery of this region, especially when performing anterior and lateral approaches, and may cause difficulties in interpretation of the radiologic images, so it should be kept in mind.

**Key Words:** Anatomy; vertebral artery; embryology

**ÖZET** Bölümümüzdeki disseksiyon uygulamaları sırasında 59 yaşında erkek bir kadavrada sağ a. vertebralis'in a. subclavia'dan çıktıktan sonra kafa tabanına doğru yükselirken dördüncü servikal vertebra'nın (C4) foramen transversarium'undan girdiği görüldü. Arteria vertebralis'in çıkış yeri ile vertebra'ya girdiği yer arasındaki (birinci parça, V1 segmenti) uzunluğu 11.8 cm idi ve kıvrımlı değildi. Sol a. vertebralis normal olarak bulundu. Literatürde bu varyasyonun sıklığının %0.5 ilâ %2.08 olduğu bildirilmiştir. Böyle bir a. vertebralis varyasyonunun, özellikle boyun anterior veya lateral yaklaşımları olmak üzere bölgede uygulanan cerrahi girişimler sırasında hasarlanmalara ve radyolojik görüntülerin yorumlanması sırasında zorluklara neden olabileceği düşünüldü.

**Anahtar Kelimeler:** Anatomi; vertebral arter; embriyoloji

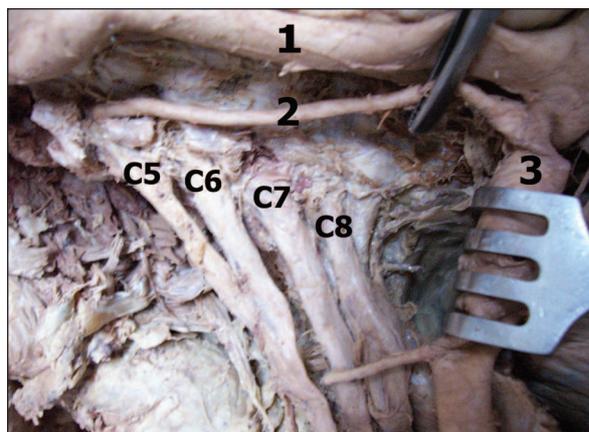
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The vertebral artery (VA) branches from the superoposterior aspect of the first part of the subclavian artery (SA) and ascends to enter the transverse foramen of the sixth cervical vertebra (C6); it ascends through the transverse foramina of the remaining vertebrae and goes behind the lateral mass of the atlas and then enters the cranial cavity through the foramen magnum. The VA has spinal and muscular branches in the neck region; in the cranium, it gives rise to anterior and posterior spinal arteries, meningeal arteries, and posterior inferior cerebellar artery. After giving their branches, two VA's unite with each other to form the basilar artery. The VA is divided into four parts according to the regions it passes. The first part (V1 segment) is the part between the its origin on the SA and the respective foramen transversarium, the second part (V2 segment) is the part

which ascends through the foramina transversaria, the third part (V3 segment) is the part between the foramen transversarium of atlas and the dura mater, and the fourth part (V4 segment) is the part after the dura mater. Most commonly, the VA enters to the foramen transversarium of the C6 but it may enter to the C7, C5 and C4 as well.<sup>1</sup> When the VA enters to a higher foramen transversarium (i.e. C5 or above), it can be prone to iatrogenic traumas during anterior and lateral approaches at the region. In addition, high access of the VA should be remembered when a foramen transversarium of C6 or above vertebra seems “empty” or “small” in radiologic examinations. The incidence of high access of the VA is different for each vertebral level. The C4 entrance of the VA, as in our case, was reported as between 0.5% and 2.08% in different studies.<sup>2-8</sup>

### CASE REPORT

During the dissection of a 59-year-old male cadaver, we encountered the right VA branching from the superior aspect of the right SA medial to the scalenus anterior muscle, and entering to a foramen transversarium of a higher vertebra (Figure 1). The VA was the first branch of the SA and originated from the first part of the artery. The VA was anterior to pleura, lung and longus colli muscle, and posterior to the common carotid artery. The distance between the origin of the SA and the origin of the VA was 0.5 cm. The diameters of the



**FIGURE 1:** Photograph of the case. 1, the right common carotid artery; 2, right vertebral artery; 3, right subclavian artery; C5-C8, cervical roots of the brachial plexus.

right VA and right SA was 0.6 and 1.8 cm, respectively. After removing the longus colli muscle, it was found that the VA entered to the foramen transversarium of the C4. The length of the V1 segment (pretransverse or prevertebral segment<sup>4,9</sup>) of the artery was 11.8 cm; it was not tortuous, and gave off small branches to the surrounding tissues. The V2 segment ascended normally in the foramina transversaria of the C4 through C1. The left VA was similar to the right VA in diameter (0.8 cm), and no other variation was observed in both VAs.

### DISCUSSION

The VA has been subject to many studies because of its clinical importance. There are studies in the literature about the origin, number (duplication, fenestration), relationships, level of entrance to foramen transversarium, hypoplasia or aplasia, and clinical interventions of the VA. Variations in the anatomy of the VA are closely related to its embryology. In the neck region, the dorsal aorta (both left and right) has seven intersegmental arteries, which pass between the somites. These intersegmental arteries connect to each other via communicating arteries (longitudinal neural artery). All of these communicating arteries between the intersegmental arteries form the VA; original communications of the first six intersegmental arteries to the dorsal aorta disappear, and seventh intersegmental artery becomes the subclavian artery. Therefore, the right VA becomes a branch of the right SA<sup>10-12</sup> and the VA enters to the foramen transversarium of the C6 and ascends through the foramina transversaria of the remaining vertebrae to reach the foramen magnum. It can also enter the foramina transversaria of the second to seventh cervical vertebrae.<sup>2</sup> Entering of the VA to a foramen transversarium other than the C6 is more commonly seen on the left side.<sup>5</sup>

The distance between the origin point of the VA and the origin point of the SA is also important, and was investigated in various studies. This distance (0.5 cm) was considerably smaller than normal in our case. Yamaki et al. reported that the mean distance between the origins of the right SA and right VA was 20.9 mm, 23.9 mm, and 18.0 mm,

in their study, in Adachi's study, and in Miyashita's study, respectively.<sup>8</sup> It has been considered that if the right vertebral artery originates from a proximal segment of the right SA, it tends to enter the foramen transversarium of a higher vertebra.<sup>13</sup> The possible embryologic mechanism underlying this situation can be that the communicating artery between the seventh and sixth intersegmental arteries regresses, the sixth intersegmental artery (instead of the communicating artery between the seventh and the sixth intersegmental arteries) persists as the proximal segment of the right VA, so the origin of the right VA is located closer to the origin of the right SA and the VA enters to a higher vertebra. There are plenty of case reports and studies, in which VA entering the foramen transversarium of the C4 is mentioned. C4 entrance was reported as 2.08% by Soyluoğlu et al.,<sup>7</sup> 2% by Lippert & Pabst,<sup>5</sup> 1.5% by Bergman et al.,<sup>2</sup> 1.4% by Matula et al.,<sup>6</sup> 1% by Bruneau et al.,<sup>3</sup> 0.7% by Yamaki et al.<sup>8</sup> and by Agur et al.,<sup>4</sup> and 0.5% by Reiger et al.<sup>4</sup> In the case of a VA, which has an abnormal level of entrance higher than the C6 level, the VA will run unprotected by bony structure at the level of transverse process above the C6 level and can be prone to iatrogenic traumas during surgery. Especially, during the resection of the longus colli muscle in the lateral

approaches to the region, the surgeon can find an unprotected V1 segment of the VA in front of the transverse process(es). In order to prevent this kind of undesired iatrogenic complications, it will be beneficial to investigate the region prior to the surgery.<sup>3</sup> In addition to the anterior and lateral approaches to the region, care should be taken during the common carotid artery surgeries.<sup>9</sup>

When the VA enters to foramen transversarium of C5 or above, and does not fill distal foramina, distal foramina may be observed smaller than normal in radiologic examinations.<sup>3</sup> This observation should be interpreted cautiously when contrast medium is not used. When a foramen is observed as smaller than normal size, it should suggest that either (i) the VA is not existing (aplasia), or (ii) hypoplastic, or (iii) the VA is ascending outside the respective foramen. So, when an intervention is being considered in the region in regard to those radiograms, surgeon should remember the possibility of a VA ascending outside the cervical spine.

In conclusion, although a vertebral artery with a high entrance to a vertebra on the right side is uncommon, it should be kept in mind and investigated before planning any surgery in the region to avoid unpleasant complications.

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