


# Two Vertebral Arteries Running Above the Articular Pillars of the Cervical Vertebrae: A Case Report

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**Purpose:** This report discusses a rare case of a vertebral artery that runs above the articular pillars of the cervical vertebrae.

**Methods:** A 19-year-old male patient presented after a fall due to paroxysmal dizziness and gait abnormalities, and underwent cervical computed tomography angiography (CTA) for preoperative assessment before posterior cervical surgery.

**Results:** Through cervical CTA imaging, we unexpectedly discovered two variant vertebral arteries positioned superficial to the articular pillars of the cervical vertebrae.

**Conclusion:** This rare case emphasizes the importance of vascular evaluation prior to cervical surgery. CTA imaging is necessary before patients requiring posterior cervical surgery. This unusual vertebral artery may have contributed to the patient's symptoms.

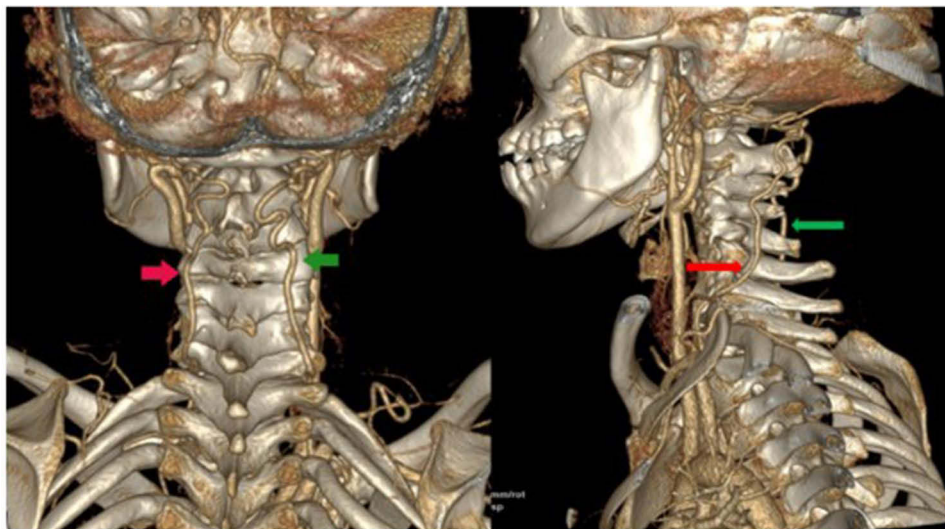
**Keywords:** paroxysmal dizziness, gait disturbance, vertebral artery, cervical vertebrae, computed tomography angiography, CTA

## Introduction

Vascular variations in the neck are relatively rare in clinical practice and are usually discovered incidentally. An accurate understanding of the anatomy of the cervical arteries and their variations is crucial for ensuring the safety of cervical surgery. The normal vertebral artery originates from the subclavian artery, traverses the transverse foramina of the cervical vertebrae, and ultimately enters the cranial cavity. It primarily contributes to the posterior circulation system, working in concert with the internal carotid artery system to maintain cerebral blood supply. Pathological variations of the vertebral artery include anomalous origins and aberrant courses, such as duplicated arteries, duplication, fenestration, tortuosity, elongation, kinking, arachnoid cysts, aneurysmal formation, and associated hereditary connective tissue disorders, which are typically implicated in cerebrovascular events.<sup>1</sup> While there are some reports on anatomical variations of the vertebral artery, most focus on anomalous origins.<sup>2,3</sup> Furthermore, these anomalous origins and courses of the vertebral artery represent congenital variations resulting from alterations in embryonic development, typically occurring during the early stages of embryogenesis. In human embryos, two dorsal aortae connect six pairs of aortic arches to the aortic sac. Through selective cellular apoptosis, these structures remodel to form the definitive aortic arch and great vessels. During embryonic development, the vertebral artery forms through the longitudinal anastomotic fusion of cervical intersegmental arteries, which branch from the primitive paired dorsal aortae; abnormal origins arise from aberrant anastomosis occurring at any stage of arch embryogenesis.<sup>4-6</sup> This report describes a unique anatomical variation of cervical vessels: a pair of vertebral arteries that originate from the subclavian artery and then emerge below the transverse process of the seventh cervical vertebra, following a tortuous course along the articular pillars of the cervical vertebrae. While there are some reports on anatomical variations of the vertebral artery, most pertain to anomalous origins of the vertebral artery.<sup>1,2</sup> We believe this variation may be related to the patient's symptoms and significantly increases the risk of vascular injury during posterior cervical surgery, thereby emphasizing the importance of reporting this rare arterial malformation.

## Case Presentation

The patient presents with a 7-year history of paroxysmal dizziness and gait disturbance, experiencing vertigo when tilting the head downward, He is unable to heel-strike with the right foot while walking, and experiencing lower limb spasms



**Figure 1** CTA three-dimensional reconstruction images vividly illustrate the vertebral arteries running above the articular pillars of the cervical vertebrae. The red arrow points to the left vertebral artery, and the green arrow points to the right vertebral artery.

after long-distance walking. The patient has been unable to walk since sustaining a fall 9 days ago. During the diagnostic and treatment process at our hospital, a cervical CTA unexpectedly revealed an abnormal course of the vertebral arteries (Figure 1). The patient presents with a history of multiple skeletal developmental abnormalities, which include hypoplasia of the nasal bone, asymmetric scapular dysplasia, impaired hearing in the right ear, and lifelong feeding difficulties. Radiological assessments, including X-ray and CT examinations showed abnormal morphology of the C3-6 vertebrae, characterised by significant flattening of the C5 vertebra, Grade II anterior spondylolisthesis of the C4 vertebra, and subluxation of the atlantoaxial joint. Notably, the patient has no history of trauma. Routine blood tests indicated significantly low levels of 25-hydroxyvitamin D, while other parameters were remained within normal limits. Electromyography did not reveal peripheral nerve abnormalities but showed damage to the corticospinal tract. The primary diagnosis was incomplete quadriplegia resulting from cervical spinal cord injury, atlantoaxial joint subluxation, cervical instability, and developmental abnormalities of the vertebral arteries. The patient’s disease timeline, relevant symptoms, and diagnoses are summarized in the table below (Table 1). Written informed consent was obtained from the patient for the publication of this case report and accompanying images. Ethical approval was not required for this case report. The consent form explicitly authorizes the use of radiographic data and clinical details in scientific publications, in accordance with the Declaration of Helsinki.

## Discussion

Cervical vascular variations significantly increase the risk of vascular injury during surgical procedures involving the neck. In the present case, we incidentally discovered a rare vascular anomaly in a patient with cervical spine complications. The report primarily emphasises the anatomical variation rather than the patient’s diagnosis and treatment. Currently, several methods are available for vascular examination, including Doppler ultrasound, computed tomography

**Table 1** The Patient’s Clinical Course

Timeline	7-Year Ago	9 Days Ago	Now
Symptoms	Paroxysmal dizziness, gait disturbance, vertigo, lower limb spasms	Unable to walk since falling	Unable to walk
Diagnoses	Undiagnosed	Undiagnosed	Spinal cord injury, atlantoaxial joint, cervical instability, and developmental abnormalities of the vertebral arteries subluxation

angiography(CTA), and Magnetic Resonance Angiography (MRA).<sup>7</sup> We chose CTA to evaluate the neck vessels due to its capability to concurrently assess the bony structures of the cervical spine and the vascular conditions.

From the imaging results of the CTA, it is evident that two vertebral arteries originating from the subclavian artery without traversing through the transverse foramen. Instead, these arteries exit beneath the transverse process of the C7 vertebra and follow a convoluted course above the articular pillars of the cervical vertebrae before entering the cranial cavity. To date, there have been no related reports pertaining to this specific anatomical variation. Variations in the vertebral artery may include abnormalities in origin, course, and development.<sup>8</sup> Previous studies have reported instances of duplicated vertebral arteries, characterised by multiple origins, including double and triple origins.<sup>9,10</sup> However, these variations are typically unilateral variations, with duplicated vertebral arteries converging into a single artery that passes through the transverse foramen before entering the cranial cavity. The presence of bilateral vertebral arteries following a convoluted course directly above the cervical articular pillars is an extremely rare anatomical variation that not only significantly increases the risk of vascular injury during posterior cervical surgery but may also alter the cerebral blood supply to the patient. It is well established that abnormalities of the vertebral artery can lead to symptoms such as dizziness, headaches, nausea, and gait instability.<sup>7</sup> In this case, the patient had experienced paroxysmal dizziness and gait abnormalities prior to the fall, which may have been caused by the vertebral artery anomaly. We hypothesize that a vertebral artery coursing external to the transverse foramina possesses an increased range of motion. Cervical movements may subject the artery to compression or traction, thereby compromising blood flow within it. This, in turn, affects cerebral blood supply, as the vertebral artery is a primary component of the posterior circulation system. For such complete extraforaminal variants, reshaping their course is exceedingly challenging, thus managing this condition presents a significant clinical challenge. Cervical fixation may represent the most effective and potentially sole approach to prevent mechanical impact on the vertebral artery, necessitating appropriate limitations on cervical mobility. Furthermore, the precise cause of the patient's vertebral artery variation remains unclear.

Given that the patient exhibits multiple developmental abnormalities, we speculate that it may be related to genetic variations. However, the identification of this variant reveals a novel extraforaminal course of the vertebral artery. Clinically, patients presenting with symptoms analogous to those described in this case should undergo a comprehensive evaluation of the vertebral artery. Concurrently, cervical computed tomography angiography (CTA) is essential prior to posterior cervical surgery in patients with congenital developmental anomalies, as it facilitates the detection of variant cervical vasculature, thereby mitigating the risks of intraoperative vascular injury.

## Conclusion

We present a case of cervical vascular variation and aim to draw the attention of our colleagues, particularly spine surgeons. It is essential to perform routine cervical computed tomography angiography (CTA) examinations prior to posterior cervical surgery, especially in patients with a history of developmental anomalies, which may include congenital skeletal, nervous system, or visceral organ abnormalities. CTA is an effective modality for simultaneously evaluating both bony structures and vascular conditions.

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## Disclosure

The authors report no conflicts of interest in this work.

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