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Case Report

A type II proatlantal artery arising from the external carotid artery: A review of neurovascular anatomy

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ABSTRACT

Background: A type II proatlantal artery is a rare congenital vascular anomaly comprised of a persistent embryologic connection between the carotid and vertebrobasilar circulations. Although generally asymptomatic and detected incidentally, its identification is of clinical importance in neurovascular assessments and interventions.

Case Description: A 70-year-old male presented with acute-onset left lower extremity weakness and numbness, out of the window for thrombolytics; computed tomography angiography of the head and neck incidentally identifying a persistent left type II proatlantal artery originating from the external carotid artery and supplying the vertebrobasilar circulation. Magnetic resonance imaging of the brain the following day was unremarkable for acute infarction or other cerebrovascular pathology.

Conclusion: This case underscores the significance of recognizing congenital vascular anomalies such as the type II proatlantal artery, particularly in the context of cerebrovascular assessment. Although these variants are often incidental and not associated with increased stroke risk, their presence has implications for neuroendovascular procedures and stroke evaluations. Understanding the anatomic and embryologic origins of these vascular anomalies facilitates accurate interpretation of cerebrovascular imaging and enhances clinical decision-making in patients with these anomalies.

Keywords: Endovascular surgical neuroradiology, Neuroanatomy, Neurovascular, Proatlantal artery, Stroke

INTRODUCTION

A type II proatlantal artery is a rare congenital vascular anomaly comprised of a persistent embryologic connection between the carotid and vertebrobasilar circulations. Although generally asymptomatic and detected incidentally, its' identification is of clinical importance in neurovascular assessments and interventions. The following case reports describes a patient with one such rare anomaly as well as the potential implications for clinical decision making.

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CASE PRESENTATION

A 70-year-old man with hypertension, diabetes, and active smoking presented with left leg weakness and numbness below the knee. On arrival, he was hypertensive and hyperglycemic, with a National Institutes of Health Stroke Scale of 4 for left leg weakness and sensory loss. He was not administered thrombolytics due to presenting out of the window. Computed tomography (CT) head non-contrast showed no hemorrhage. CT angiogram (CTA) head and neck with contrast showed no large vessel occlusion. CT perfusion (CTP) of the brain showed no perfusion mismatch deficit. CTA did, however, reveal an anatomic variant of his cervical external carotid artery – by which a left persistent type II proatlantal artery arose from the external carotid artery – which is detailed further in the next section. He was loaded with dual antiplatelet therapy consisting of aspirin 81 mg and clopidogrel 75 mg, then admitted. The following morning, his magnetic resonance imaging brain was unremarkable for acute stroke or other acute neurologic abnormality. He was found to be in opioid withdrawal with a urinary tract infection and thereafter transferred to the internal medicine service for further workup and management.

DISCUSSION OF IMAGING FINDINGS

As noted above, CTA head and neck with and without contrast demonstrated a left persistent type II proatlantal artery originating from the external carotid artery see Figures 1 and 2, which thereafter fed into the vertebrobasilar circulation. In general, in normal anatomy, the vertebral artery arises from the first part of the subclavian artery, coursing through various C1–C6 transverse foramina to enter the skull through the foramen magnum and then contribute toward the basilar artery in the posterior cerebral circulation.[7]

The proatlantal artery is a variant of the vertebral artery, in which the ipsilateral or bilateral vertebral arteries themselves are aplastic or hypoplastic, while the proatlantal artery arises from the internal or external carotid artery, coursing through the foramen magnum to create the main blood supply for the posterior circulation.[7] The vessels typically self-obliterate early in life; however, rare anatomic variants may occur, and they may persist into adulthood, creating a resultant anastomosis between the carotid and vertebrobasilar vasculatures.[7] In addition, there are two subcategories of proatlantal arteries, type I and type II. A type I proatlantal artery, or persistent proatlantal intersegmental artery, arises from the internal carotid artery, traversing the anterior aspect of the vertebral bodies without directly passing through any transverse foramen.[6] In comparison, a type II proatlantal artery is a persistent C1 intersegmental artery and much rarer; it originates specifically from the external carotid artery and then enters the foramen magnum.[1] Bilateral vertebral arteries are hypoplastic with additional detail as noted above.

REVIEW OF EMBRYOLOGY/DEVELOPMENT

Variants of the cervical vertebral arterial tree are common and may be found in approximately 1 in six patients, most

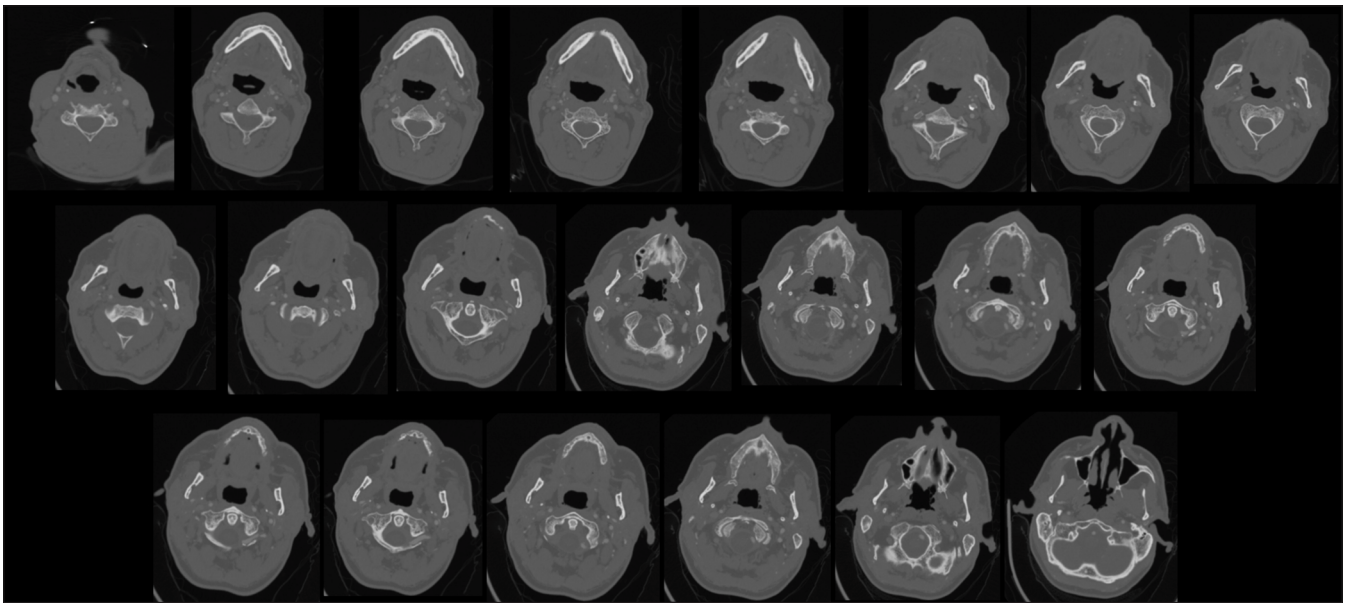

Figure 1: Representative computed tomography angiography images. All images shown are cross-sectional axial slices from the patient's head-and-neck angiography.

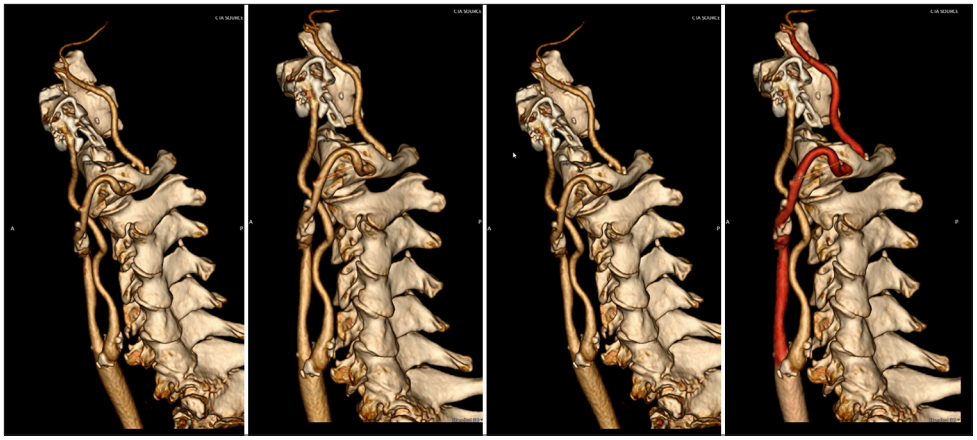

Figure 2: Rendered images of type II proatlantal artery – all images generated by Dr. Michael Hurley, MD.

commonly related to the anomalous origin of the left vertebral artery of the aortic arch, hypoplastic vertebral arteries, fenestration (which can be misinterpreted as intraluminal thrombus), duplication at the origin,[3] and the related persistent trigeminal artery. *In utero*, the vertebral arteries originate from seven paired cervical intersegmental arteries (CIAs) that branch off from paired dorsal aortae.[4] Normal formation occurs through longitudinal anastomosis of the CIAs as the horizontal portions of the first six CIAs involute and the 7th CIA becomes the subclavian artery and base of the vertebral artery.[4] Failure of involution, the persistence of intersegmental arteries, results in vascular anomalies. Cervical segment variants of the vertebral artery can occur in several different aspects, based on the origin of the artery, the course it traverses, tortuosity of the artery, and the vertebral entrance in the transverse foramen, or hypoplasia of the artery as well.[9] A type II proatlantal artery refers to a persistent second intersegmental artery that results in a C2 occipitovertebral anastomosis with a path that originates from the external carotid artery, connects to the vertebral artery at the second cervical space, passes into the C1 vertebral foramen, and then enters the foramen magnum.[7]

CLINICAL IMPLICATIONS

Detection of type II proatlantal arteries is most found incidentally.[5] While cases have previously been linked to pulsatile tinnitus, there has been no proven susceptibility to cerebrovascular issues.[5] However, recognition of vascular anomalies holds significance for procedures that directly involve ligation or embolization of the external carotid artery, carotid endarterectomy, and other vascular procedures, as these anomalous vessels serve as pathways for collateral flow. Posterior laminectomies, foraminotomies, and other surgical approaches that involve the neck, spine, and thorax also require careful planning, especially as other vascular anomalies are associated with type II proatlantal arteries.[10] In addition, altered hemodynamics should be considered during treatment as increased pressure can put patients at risk for hemorrhage, and occlusion can cause ischemia in the posterior circulation.[8] In theory, additionally, emboli from the anterior circulation may result in posterior circulation infarcts due to abnormal anastomosis, as noted in a case report showing occlusion of the tip of the basilar artery secondary to large artery atheroembolism from internal and common carotid artery atherosclerosis.[2] In our patient's case, the left persistent type 2 proatlantal artery did not hold meaningful clinical significance as it pertained to his primary presentation, given that he had no acute infarction or other cerebrovascular consequence of this variant anatomy.

Take home bullet points.

- A type II proatlantal artery refers to the persistent embryological variant of an external carotid to the vertebral arterial anastomosis.
- It is formed congenitally via embryological failure of involution in the developing vertebral artery system, leading to the persistence of intersegmental arteries.
- Cases of proatlantal artery variants have not been proven to increase susceptibility to cerebrovascular complications. Some cases have been reported with pulsatile tinnitus as a presenting feature.
- It holds significance anatomically for neuroendovascular procedures and stroke workups.

CONCLUSION

In this review, we discussed a case of a man with a proatlantal artery type II, an embryological derivative of expected vasculature whereby an intersegmental artery creates an anastomosis between the external carotid artery and the vertebral artery. As in this case, many are found incidentally.

When found, it remains important to note that they may hold significance clinically for neuroendovascular interventions and stroke workups.

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