Terminal Triplication of the Left Vertebral Artery: a Unique Variation

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Key words: anatomy, PICA, vertebral artery

Summary

This report describes a unique case of triPLICATION of the terminal left vertebral artery, forming the basilar artery in a 75-year-old male. CT angiography of cranio-cervical vessels also demonstrated the right vertebral artery originating from the right common carotid and an aberrant right subclavian artery. To the best of our knowledge this is the first report of a variation of this nature. The embryology and the clinical importance are discussed.

Introduction

The vertebral artery normally originates as the first branch of the subclavian artery and ends at the lower border of pons by uniting with its counterpart to form the basilar artery^{1,2}. Multiple variations of the origin have been reported in the literature including origin from the arch of the aorta, from the common carotid and distally from the subclavian artery. Anomalies affecting the vertebral termination are less common, with various duplications and fenestrations described^{3,4,5}.

Case Report

A 75-year-old man was referred from the Transient Ischaemic Attack Clinic for CT angiography (CTA) of the cranio-cervical vessels. This was performed on a 64-slice Multi Detector CT (MDCT) scanner (Philips Brilliance 64) with images reformatted using standard soft-

ware. Soft tissue atheroma without significant stenosis was demonstrated affecting the right common carotid bifurcation (figure 1).

Variations were noted in this patient's cranio-cervical vessels (figure 1).

The right vertebral artery originated from the proximal right common carotid artery and ascending upwards and posteriorly to enter the right foramen transversarium of the C5 vertebra (left enters normally at C6).

An aberrant right subclavian artery was also noted in this patient, crossing over posterior to the oesophagus from left to right.

A unique arterial variation of the intracranial portion of the left vertebral artery was also visualised. There were three terminal branches from the left vertebral artery. Branches 1 and 2 joined to form a single vascular trunk uniting with the right vertebral artery to form the basilar artery. A few millimetres cranial to this, the third and largest branch of the left vertebral artery united with the basilar artery further augmenting it (figure 2).

Patency of the vertebral and basilar systems was normal with the posterior cerebral arteries arising from the basilar termination. The vascular anomalies were incidental findings unrelated to the patient's problem.

Discussion

The embryology of the vertebrobasilar arterial system is well recognized, the complexity of its development accounting for the richness of its anatomic variation. Early blood supply to

Figure 1 Note the stenosis as the aberrant right subclavian artery passes behind the oesophagus (arrowheads). The right vertebral arises from the right common carotid and enters the foramen transversarium at C5 (arrows). The right common carotid bifurcation stenosis is also evident.

the brain stem derives purely from the internal carotid arteries (ICA) via a series of transient embryonic anastomoses: proatlantal, hypoglossal and trigeminal and culminating in the posterior communicating arteries (PCoM) (posterior division of the ICA), which continue into the paired longitudinal neural arteries (LNA). The vertebral arteries are yet to develop and blood thus flows from cranial to caudal in the LNAs, the reverse of the adult situation. Progressive fusion of these paired ventral LNAs on the an-

terior surface of the neural tube into a single midline basilar artery occurs by the fifth fetal week approximately, the fusion extending cranio-caudally^{1,6,7}.

Simultaneously, the cervical metameric (segmental) arteries begin to develop intersegmental anastomoses gradually producing paired, longitudinal vessels, the nascent vertebral arteries. At the craniocervical junction, they annex remnants of the embryonic proatlantal arteries, and fuse with the caudal end of the emerging basilar artery. Reversal of blood flow now occurs in the basilar artery and is accompanied usually by regression of the PCoM arteries, thus inaugurating the familiar adult anatomy.

This complex series of fusions, annexations and regressions involves extensive remodelling of the vessels in a coordinated dance of proliferation and apoptosis, providing ample opportunity for intriguing anatomic variants.

The two processes leading to these anatomical variations at the vertebrobasilar junction are fenestration and duplication. Fenestration results from various anatomical structures (usually nerves) piercing the artery, with the two lumina thus corresponding to a single embryonic path. Conversely in duplication, additional fetal vessels (multiple embryonic paths) persist^{1,6}. Lasjaunias has elegantly summarised the possible embryonic vascular pathways available, his graphical schema closely predicting the commonly recognized variants as well as the usual adult configuration¹.

In our case, comparison of the triplicated left side, with the 'normal' right side shows the bizarre initial impression to possess a striking underlying symmetry (figure 2). The most inferomedial channel represents the normal course of the vertebral artery. The middle channel represents the posterior inferior cerebellar artery and arises at the same level as its counterpart on the right.

The superior channel represents the anterior inferior cerebellar artery, again mirroring its counterpart. The lateral, vertically oriented channel linking the vessels follows the course of the lateral spinal artery, axial CT showing the vessel in the typical location of the LSA (figure 2D).

To our knowledge this is the first report of this rare anomaly. Variable anatomy in the vertebrobasilar system is important in diagnosis and during interventional neuroradiological

Figure 2 A) Postero-anterior oblique views of CTA demonstrates the terminal triplication of the left vertebral artery. B) Schematic illustration of the vertebrobasilar system superimposed on a grid representing embryonic pathways and possible arterial variations, with 'normal' adult configuration on the right (based on Lasjaunias Ref. 1) and triplication on the left.

and surgical procedures related to the cerebellum and the brain stem. With the advent of excellent quality MDCT angiography perhaps anomalies previously thought to be rare will be found more frequently as this technology is ap-

plied to a greater number of people than were exposed to catheter angiography. As always, radiologists and surgeons planning interventions should be familiar with the range of possible anatomical variants.

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