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Case Report

Persistent second cervical intersegmental artery diagnosed by MR angiography

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ARTICLE INFO

Article history:
Received 23 April 2019
Revised 10 May 2019
Accepted 10 May 2019
Available online 30 May 2019

Keywords:
Carotid-vertebrobasilar anastomosis
Cerebral arterial variation
External carotid artery
Vertebral artery

ABSTRACT

Anastomosis between the external carotid and vertebral (VA) arteries is extremely rare. A well-recognized manifestation of such anastomosis is the Type 2 proatlantal artery, which commonly demonstrates anastomosis of the occipital artery with the VA at the level of the foramen magnum and is considered to represent a persistent first cervical intersegmental artery. Using magnetic resonance angiography, we observed anastomosis of the external carotid and VA at the level of C1 and C2 vertebrae without anastomosis of the occipital artery and diagnosed this vessel as a persistent second cervical intersegmental artery.

Introduction

Types of persistent primitive carotid-vertebrobasilar anastomosis, from cranial to caudal, include persistent trigeminal artery, persistent hypoglossal artery, and proatlantal artery. Two types of proatlantal artery anastomose with the extracranial vertebral artery (VA) at the level of the foramen magnum. Type 1 arises from the internal carotid artery (ICA), and Type 2 arises from the external carotid artery (ECA) and is regarded as a persistent first cervical intersegmental artery [1,2]. We observed anastomosis of the ECA and VA located more caudally than a Type 2 proatlantal artery and considered it to represent a persistent second cervical intersegmental artery [3].

Case report

A 72-year-old man with headache underwent magnetic resonance (MR) imaging and MR angiography using a 1.5-tesla unit (Achieva Nova Dual, Philips Medical Systems, Best, the Netherlands). MR angiography was obtained using the standard 3-dimensional time-of-flight technique. MR imaging showed no

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.
Competing Interests: The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.
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https://doi.org/10.1016/j.radcr.2019.05.014

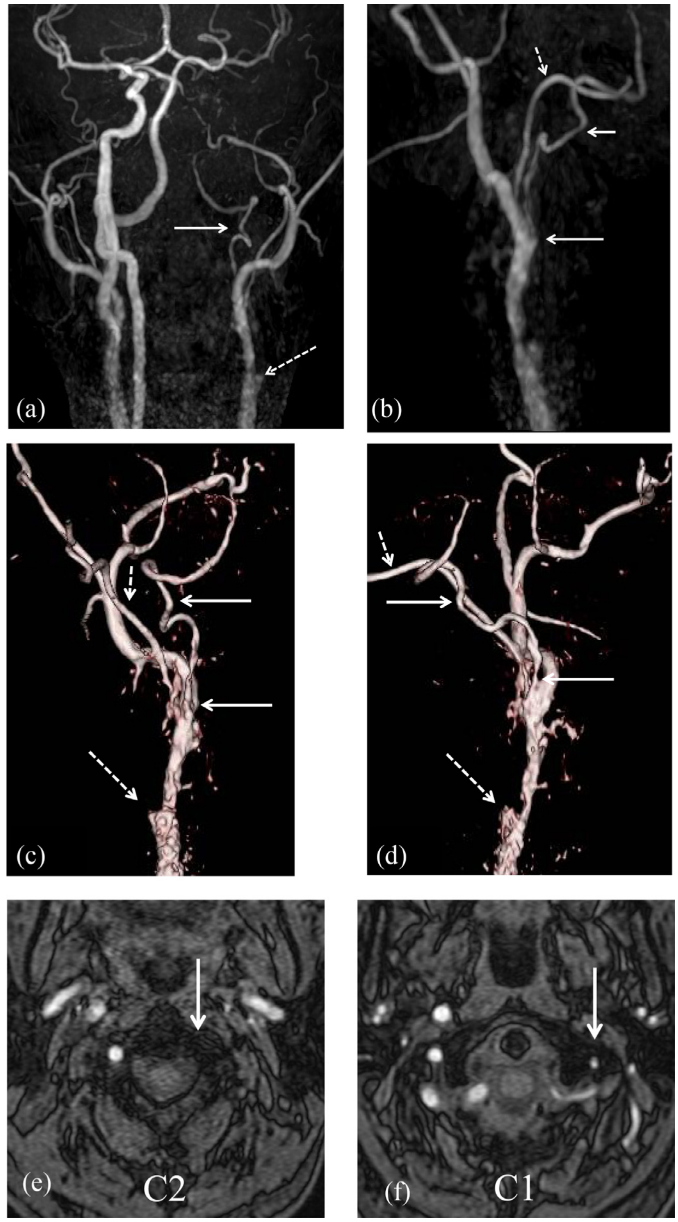

Fig. 1 – Magnetic resonance (MR) angiography from the cervical to intracranial region (a-f).
(a) Antero-posterior projection of MR angiography shows occlusion of the left internal carotid artery (ICA) (*dotted arrow*).The V3 and V4 segments of the left vertebral artery (VA) are hypoplastic (*arrow*), and there is no V2 segment.
(b) Left lateral projection of partial maximum-intensity-projection image of the left carotid system shows an anomalous artery arising from the posterior wall of the left external carotid artery (ECA) (*long arrow*) that continues to the V3 segment of the left VA (*short arrow*). *Short dotted arrow* indicates the left occipital artery.
(c and d) Posterior and right lateral projections of a partial volume-rendering image of the left carotid system clearly show an anomalous artery arising from the posterior wall of the left ECA (*arrows*). The occipital artery arises separately at the same level of the ECA. *Dotted long arrows* indicate occluded left ICA, and *dotted short arrows* indicate the occipital artery.
(e and f) MR angiographic source images show that the left VA passes through the C1 transverse foramen (*arrows*) and not the C2 transverse foramen, thus indicating the point of anastomosis at the level of the C1 and C2 vertebrae.

significant brain abnormality except for multiple small ischemic white matter lesions. MR angiography from the neck to the intracranial region revealed occlusion of the left ICA at its origin and absence of the V2 segment of the left VA (Fig. 1a). Partial maximum-intensity-projection and partial volume-rendering images of the left carotid system (Fig. 1b-d) showed the left VA arising from the ECA and the OA arising separately from the ECA. The proximal course of this anastomotic artery suggested its being a hyperplastic ascending pharyngeal artery. MR angiographic source images (Fig. 1e and f)

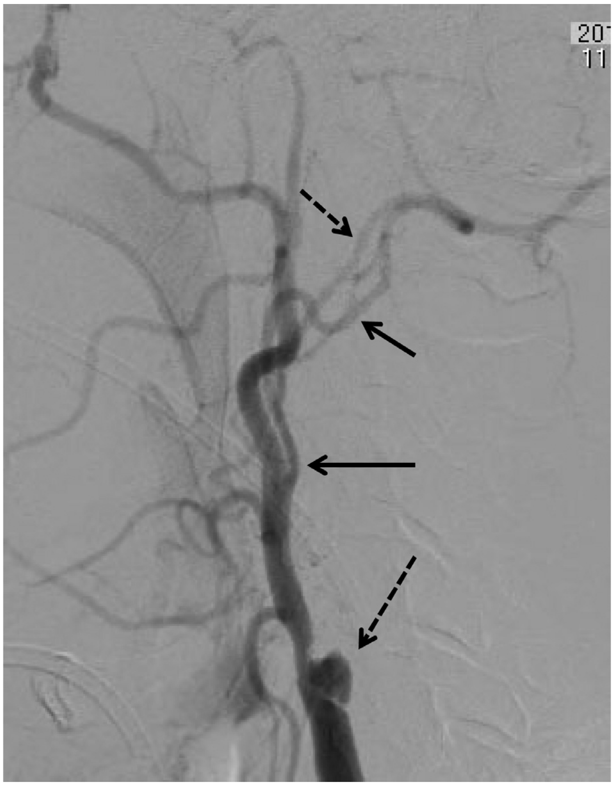

Fig. 2 – Left lateral projection of left common carotid angiography.
The left internal carotid artery is occluded at its origin (*dotted arrow*); the origin of the left external carotid artery (ECA) is stenotic; and an anomalous artery arises from the posterior wall of the left ECA (*long arrow*) and continues to the V3 segment of the left vertebral artery (*short arrow*). Dotted long arrow indicates occluded left ICA, and dotted short arrow indicates the occipital artery.

revealed this anomalous artery passing the C1 transverse foramen but not the C2 transverse foramen. We thus diagnosed this artery anastomosing with the VA at the C1/2 level (V3 segment) as a persistent second cervical intersegmental artery rather than a Type 2 proatlantal artery.

Subsequent catheter angiography using a flat-panel digital subtraction system for further evaluation of the steno-occlusive cerebral arteries depicted on left common carotid angiogram occlusion of the left ICA at its origin and stenotic origin of the ECA, and the presumed ascending pharyngeal artery was hyperplastic and continued to the V3 segment of the left VA (Fig. 2).

The patient demonstrated well-developed collateral circulation and no symptoms of occlusion of the left ICA and experienced an uneventful clinical course with conservative treatment under careful observation.

Discussion

Congenital anastomosis between the ECA and VA is extremely rare, and the persistent hypoglossal artery can arise from the ECA [4,5]. Its entry into the posterior fossa via the hypoglossal canal is the most important diagnostic criterion. The Type 2 proatlantal artery is a large congenital anastomosis between the OA and the VA at the level of the foramen magnum and regarded as a persistent first cervical intersegmental artery rather than true proatlantal artery [1,2,6]. Normally, there are small direct or indirect anastomoses between the OA and the VA, but these anastomoses dilate in the presence of a pressure gradient between the 2 vessels, and it is important not to confuse these postnatal collaterals with the Type 2 proatlantal artery [6].

Our patient showed an anomalous artery arising from the ECA that continued to the VA at the level of the C1 and C2 vertebrae and the OA arising separately from the main trunk

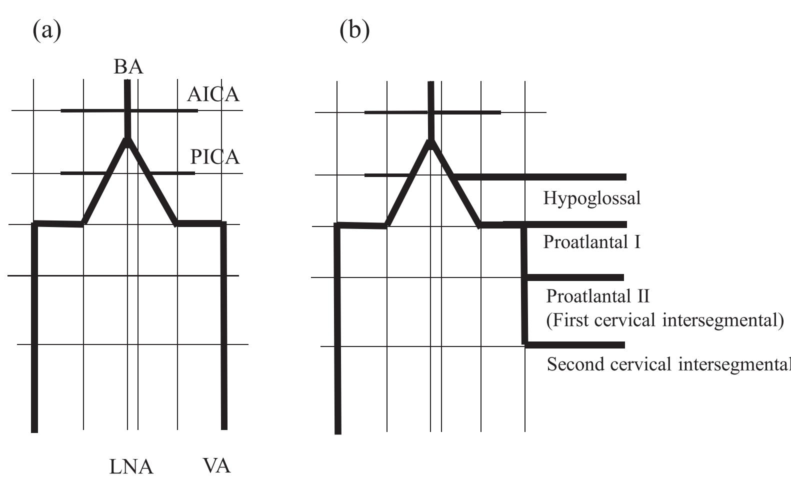

Fig. 3 – Schematic illustration of the development of anastomotic arteries (modified from Reference [7]).
(a) Normal development.
AICA, anterior inferior cerebellar artery; BA, basilar artery; LNA; longitudinal neural artery; PICA, posterior inferior cerebellar artery; VA, vertebral artery.
(b) Four types of persistent primitive anastomotic artery
Our present patient may have a persistent second cervical intersegmental artery.

of the ECA. Thus, we could not regard this anastomotic artery as a Type 2 proatlantal artery (persistent first cervical intersegmental artery) and diagnosed persistent second cervical intersegmental artery [3]. Figure 3 shows a schematic illustration modified from Reference [7].

Padget [8] delineated 4 types of fetal anastomosis between the carotid and vertebrobasilar arteries at 5 weeks' gestation (at stage 3-5 mm). From cranial to caudal, these are the trigeminal, otic, hypoglossal, and proatlantal intersegmental arteries. These primitive anastomotic arteries usually regress with developing carotid and vertebrobasilar arteries. In the 7- to 12-mm embryo, the longitudinal neural arteries fuse to form the BA. At this stage, the VA is formed from transverse anastomoses between adjacent cervical segmental arteries, and abnormal fusion and/or failure of regression in this stage causes variations in the VA at the level of the C1 and C2 vertebrae [9].

Detection and correct diagnosis of anastomoses of the ECA and VA are important when interpreting both MR and computed tomography angiography to prevent dangerous complications during catheter intervention in the ECA system and neck surgery.

Conclusion

We report an extremely rare case of anastomosis of the ECA and VA – a persistent second cervical intersegmental artery. Detection and correct diagnosis of such rare arterial variations require careful scrutiny of MR angiography including its source images.

Ethical standards

We declare that all human and animal studies have been approved by the Melbourne Health Research Ethics Committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Acknowledgments

We thank Rosalyn Uhrig, MA, for editorial assistance in the preparation of this manuscript.

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