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ANATOMIC VARIATIONS

Persistent trigeminal artery–superior cerebellar artery segmental fusion diagnosed using magnetic resonance angiography

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Abstract

Purpose To describe a case of persistent trigeminal artery (PTA)–superior cerebellar artery (SCA) segmental fusion incidentally diagnosed on magnetic resonance (MR) angiography.

Case report A 53-year-old woman with a history of facial pain underwent cranial MR imaging and MR angiography. MR angiography showed a left lateral-type PTA arising from the precavernous portion of the left internal carotid artery (ICA). PTA branched into the left distal SCA and showed segmental fusion with the proximal SCA at the distal part of the PTA. We also diagnosed an unruptured cerebral aneurysm at the junction between the left ICA and PTA.

Discussion PTA is the most frequent type of carotid-vertebrobasilar anastomosis. The reported prevalence rate is 0.2% by angiography and 0.34% by MR angiography. There are two types of PTA—lateral (usual) and medial (intrasellar). SCA arising from the lateral-type PTA has rarely been reported. Further, a PTA from which the distal SCA branches and segmentally fuses with the proximal SCA at the distal part of the PTA has not been reported.

Conclusion Using MR angiography, we diagnosed a rare type of PTA that fused segmentally with SCA. No similar case has been reported in relevant English-language literature.

Keywords Carotid-vertebrobasilar anastomosis · Magnetic resonance angiography · Persistent trigeminal artery · Superior cerebellar artery

Introduction

The persistent trigeminal artery (PTA) is the most common anastomosis between the internal carotid artery (ICA) and vertebrobasilar arteries. The reported prevalence is 0.2% by angiography [5] and 0.34% by magnetic resonance (MR) angiography [13]. According to Salas et al. [9], there are two types of PTA—lateral and medial. The medial type is also called intrasellar or transhypophyseal PTA [4, 6]. Approximately 90% of PTAs are classified as the lateral type [7, 13]. The cerebellar artery that arises from the precavernous portion of the ICA without connecting to the basilar artery (BA) is regarded as a PTA variant [12]. Superior cerebellar artery arising from lateral-type PTA has rarely been reported [13].

Herein, we report a rare case of left lateral-type PTA that branched into the distal superior cerebellar artery (SCA) and fused segmentally with the proximal SCA at the distal part of the PTA. No similar case has been reported in relevant English-language literature.

Case report

A 53-year-old woman with a history of facial pain after cosmetic surgery underwent cranial MR imaging and angiography using a 1.5-Tesla scanner (Vantage Elan; Canon Medical Systems, Tochigi, Japan). MR angiography images were obtained using a standard three-dimensional time-of-flight technique. The imaging parameters were as follows: repetition time, 21.0 ms; echo time, 6.8 ms; flip angle, 18°; and slice thickness, 1.1 mm; matrix, 192×272; field of view (FOV), 200×200 mm.

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On MR angiography, a small artery arising from the precavernous portion of the left ICA was incidentally identified. The anomalous artery took a posterosuperior course, which indicated the proximal part of the lateral (usual) type of PTA (Fig. 1). After reviewing partial maximum-intensity projection images, we identified that the PTA branched into the distal SCA and the distal part of the PTA fused segmentally with the proximal SCA. The PTA anastomosed with the distal BA proximal to the origin of the SCA (Fig. 2). Segmental fusion of the PTA and SCA was identified on the reformatted MR angiographic source images (Fig. 3). The left posterior communicating artery (PCoA) was hypoplastic. We also diagnosed an unruptured cerebral aneurysm at the junction between the left ICA and PTA. No further examinations (e.g., computed tomography angiography or three-dimensional digital subtraction angiography [3D-DSA]) were performed.

Discussion

In early embryonic development, there are four types of fetal carotid-vertebrobasilar anastomoses: primitive trigeminal, hypoglossal, otic, and proatlantal intersegmental arteries. Such anastomoses begin to form at the 4- to 5-mm embryo stage and disappear at the 7- to 12-mm embryo stage [8]. As the embryo develops, the PCoAs develop, and the anastomotic arteries begin to regress at days 30–40 of fetal development. The first anastomosis to regress is the otic artery, followed by the hypoglossal, trigeminal, and proatlantal intersegmental arteries [8].

PTA is the most common type of carotid-vertebrobasilar anastomosis. PTA has been classified in several ways by various authors. According to Salas et al. [9], there are two types based on the parasellar or intrasellar course: lateral (usual) and medial (intrasellar). Approximately 90% of PTAs are classified as the lateral type. Our patient had lateral-type PTA. Angiographic anatomy and classification

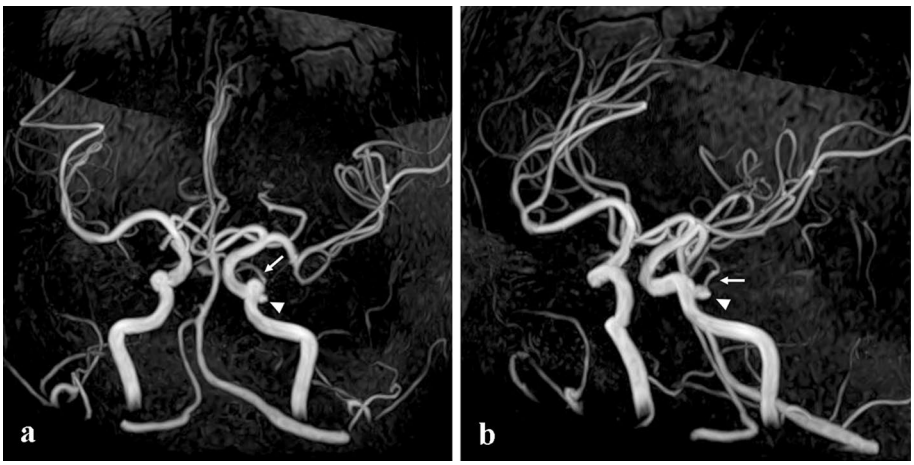

Fig. 1 Anteroposterior (**a**) and left anterior oblique (**b**) projections of cranial MR angiography show an anomalous artery arising from the precavernous portion of the left ICA, indicative of PTA (arrows). An unruptured aneurysm at the junction between the left ICA and PTA is seen (arrowheads)

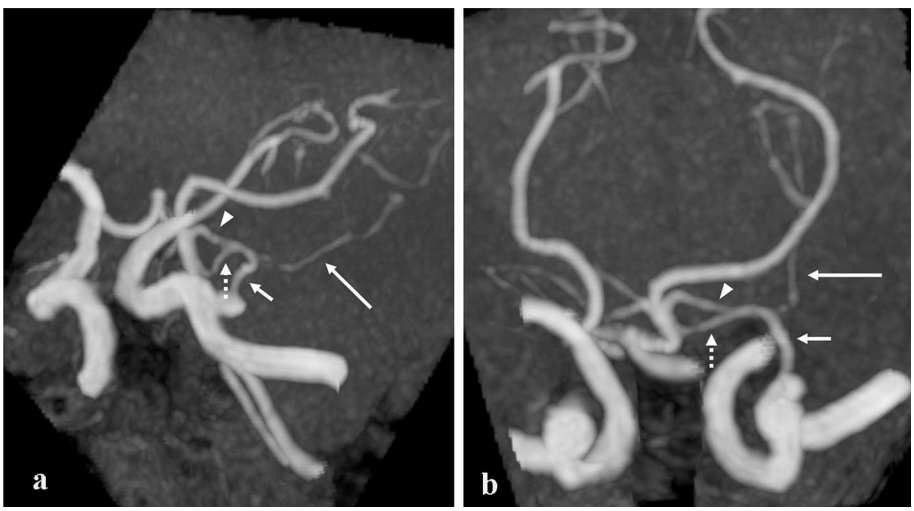

Fig. 2 Left anterior oblique (**a**) and craniocaudal (**b**) projections of partial maximum-intensity projection images show the proximal part of the lateral-type PTA (short arrows) branched into the distal SCA (long arrows). Distal PTA (dotted arrows) fused segmentally with the proximal SCA (arrowheads)

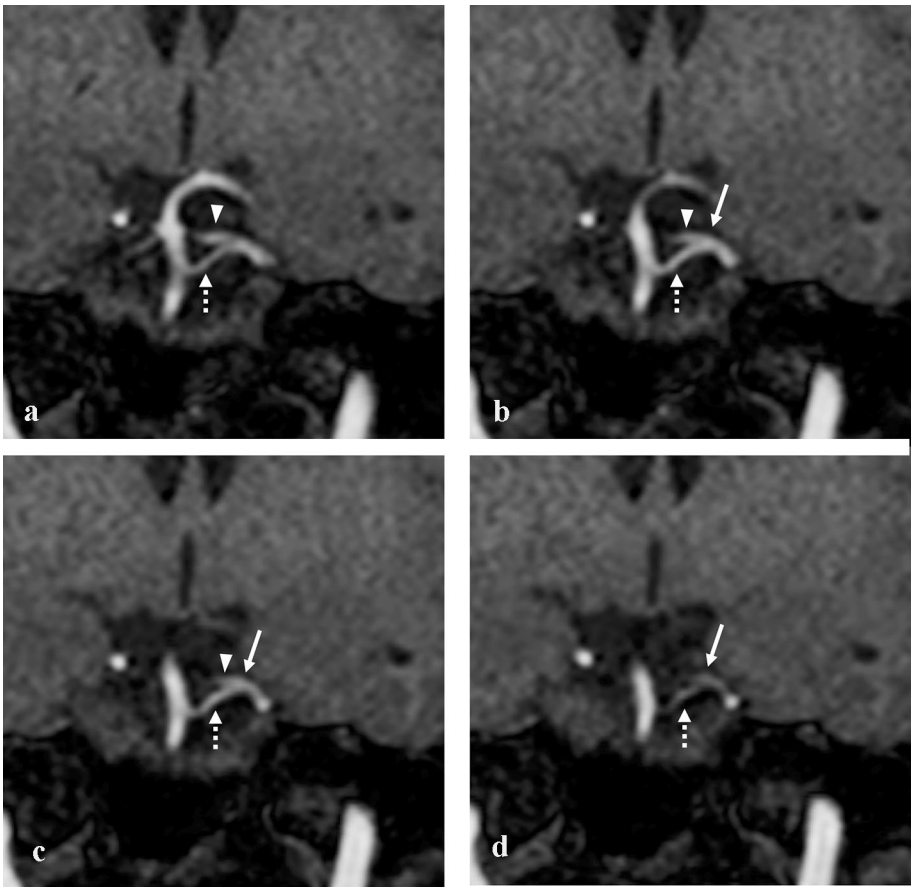

Fig. 3 Coronal reformatted MR angiographic source images **a**–**d** show segmental fusion (long arrow) of the proximal SCA (arrowheads) at the distal part of the PTA (dotted arrows)

were traditionally described by Saltzman in 1959 [10]. The Saltzman type I PTA joins the BA at the level between the SCA and anterior inferior cerebellar artery (AICA), and the ipsilateral PCoA is hypoplastic. The Saltzman type II PTA joins the BA proximal to the origin of the SCA. In this type, the PCoA is patent and supplies the ipsilateral PCA. A cerebellar artery that arises from the precavernous portion of the ICA without connection to the BA is regarded as a PTA variant. Ali et al. [1] divided these cerebellar arteries into Saltzman type III subtypes: those terminating directly in the SCA (type IIIa), AICA (type IIIb), or posterior inferior cerebellar artery (type IIIc). Most PTA variants are of the AICA type [13]. However, the current case cannot be applied to any Saltzman classification because the PTA branched into the distal SCA and showed fusion with the proximal SCA. Thus, it was presumed that PTA and SCA fused segmentally. To the best of our knowledge, no similar cases have been reported. However, there is a limitation in strictly distinguishing vessel fusion from the attachment of the PTA and SCA on MR angiography because of its lower spatial resolution than that of 3D-DSA.

Embryologically, the inadequate fusion of carotid-vertebrobasilar anastomoses and the longitudinal neural artery may be responsible for the variant in our case. In addition, a separate origin of the trunk of SCA from a basilar artery is frequently observed, and such an anomaly may have been associated with our case.

Uchino et al. [13] reported two lateral-type PTAs from which SCA arose. They discussed that this rare type of PTA may be misdiagnosed as a PTA variant if stagnant flow in the distal part of the PTA prevents visualization of the distal segment on MR angiography. In our case, the distal part of the PTA that joined the BA was clearly identified on MR angiography.

Various vascular anomalies are associated with PTA, including aneurysms of the circle of Willis, arteriovenous malformations, carotid-cavernous fistulas, agenesis of the carotid and vertebral arteries, and Moyamoya disease [1, 2]. According to O'uchi et al. [7], the frequency of intracranial aneurysms coexisting with PTA or PTA variants was 4.2% and 4.0%, respectively. Hence, the frequency of intracranial aneurysms coexisting with PTA or PTA variant is thought to be similar (3.7% in the general population). In the present case, an aneurysm was found at the junction of the ICA and PTA, an extremely rare location [3]. Although there is no clear reason, the incidence of PTA aneurysms shows a strong female predominance (77%) [3].

The clinical significance of a PTA or PTA variant is limited because it is usually asymptomatic and is frequently reported as an incidental finding. However, it rarely causes trigeminal neuralgia owing to neurovascular compression. According to Sano et al. [11], 14 cases of trigeminal neuralgia caused by PTA variants have been reported. In the present case, neurovascular compression by the distal SCA arising from the PTA was not observed on MR angiography.

Conclusion

We described a rare type of PTA that branched into the distal SCA and fused segmentally with the proximal SCA at the distal part of the PTA, diagnosed by MR angiography. No similar case has been reported in relevant English-language literature.

Author contributions SS carried out the study design and drafted the manuscript. SS, AU, and AK critically reviewed, read, and approved the final manuscript.

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Availability of data and materials Not applicable.

Declarations

Conflict of interest We declare that we have no conflict of interest to declare.

Ethical approval Not applicable.

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