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Bilateral ophthalmic arteries arising from the cavernous segments of the internal carotid arteries and entering the orbits via the superior orbital fissures: a case diagnosed by magnetic resonance angiography

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Research Article

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Abstract

Purpose

To describe a case of bilateral ophthalmic arteries (OAs) arising from the cavernous segments of the internal carotid arteries (ICAs) and entering the orbits via the superior orbital fissures (SOFs).

Methods

A 75-year-old woman with a cerebral aneurysm underwent follow-up cranial magnetic resonance angiography (MRA) using a 3-T scanner. MRA was performed using a standard three-dimensional time-of-flight technique.

Results

MRA revealed an aneurysm at the junction of the left ICA and posterior communicating artery (PCoA), which showed no interval change over the preceding 9 months. The right OA arose from the cavernous segment of the ICA at a typical location and entered the orbit via the SOF. The left OA also arose from the cavernous segment of the ICA and entered the orbit via the SOF; however, its origin was approximately 5 mm distal to that of the right OA.

Conclusion

An OA arising from the cavernous segment of the ICA and entering the orbit via the SOF was previously considered to represent a persistent primitive dorsal OA. However, this variation is now thought to result from persistence of the lateral branch of the primitive maxillary artery and is most commonly associated with an origin from the inferolateral trunk. In the present case, both OAs arose from the cavernous segments of the ICAs, and the left OA originated from an unusually distal portion of the cavernous ICA. To our knowledge, no similar case has been reported in the English-language literature.

Introduction

Variations in the origin and course of the ophthalmic artery (OA) have been extensively investigated using cadaveric dissection and various imaging modalities, including catheter angiography, magnetic resonance angiography (MRA), and computed tomography angiography (CTA). Numerous variations in OA origin have been reported, and two main routes of entry into the orbit have been described: through the optic canal (OC) and through the superior orbital fissure (SOF) [1, 2, 6]. An OA arising from the cavernous segment of the internal carotid artery (ICA) and entering the orbit via the SOF is relatively rare. This variation is thought to result from persistence and enlargement of the lateral branch of the primitive maxillary artery (PMA), with the OA typically originating from the inferolateral trunk (ILT) [1]. The first

author previously reported a prevalence of this variation of 0.42% among OAs, with a tendency toward right-sided predominance [14].

We herein report a case of bilateral OAs arising from the cavernous segments of the ICAs and entering the orbits via the SOFs. The left OA originated from an unusually distal portion of the cavernous ICA, approximately 5 mm distal to the usual origin of the ILT. To our knowledge, no similar case has been reported in the relevant English-language literature.

Case report

A 75-year-old woman with a cerebral aneurysm underwent cranial MRA using a 3-T scanner (MAGNETOM Skyra; Siemens Healthineers, Erlangen, Germany) for aneurysm follow-up. MRA was performed using a standard three-dimensional time-of-flight technique. The imaging parameters were as follows: flip angle, 15°; repetition time, 38.0 ms; echo time, 3.7 ms; slice thickness, 0.5 mm; number of slices, 190; slab thickness, 95 mm; field of view, 28.0 × 20.0 cm; and imaging matrix, 320 × 272.

Volume-rendering (VR) images of the MRA showed an aneurysm at the junction of the left ICA and posterior communicating artery (PCoA). The aneurysm showed no significant interval change in size or shape over the preceding 9 months. The right OA arose from the cavernous segment of the ICA, as did the left OA. However, the origin of the left OA was approximately 5 mm distal to that of the right OA (Fig. 1). Examination of the MRA source images revealed that both OAs entered the orbits via the SOFs rather than through the OCs (Fig. 2).

No additional imaging studies, such as CTA or catheter angiography, were performed. No surgical treatment was undertaken for the aneurysm, and the patient's clinical course was uneventful.

Discussion

Numerous variations in OA origin have been reported [1, 2, 6]. Among these, an OA arising from the middle meningeal artery (MMA) is the most prevalent, followed by an OA arising from the cavernous segment of the ICA. Using 3-T MRA, the first author previously reported a prevalence of 1.45% for OAs arising from the MMA, with a tendency toward right-sided predominance. Bilateral OAs arising from the MMA were identified in four cases (0.5%) [14]. As mentioned in the **Introduction**, the prevalence of OAs arising from the cavernous segment of the ICA was 0.42% (right/left, 6/1) [14]. To our knowledge, the present case is the first reported case of bilateral OAs arising from the cavernous segments of the ICAs diagnosed by MRA.

According to the review by Toma [9], the primitive dorsal and ventral OAs give rise to the ocular branches, whereas the supraorbital division of the stapedial artery gives rise to the orbital branches of the OA. Subsequently, numerous anastomoses develop between the ICA and external carotid artery (ECA) systems in association with the OA. These developmental processes can give rise to anatomical variations of the OA.

An OA arising from the cavernous segment of the ICA and entering the orbit via the SOF was formerly considered to represent a persistent primitive dorsal OA [5, 6, 14, 15]. However, this variation is now thought to result from persistence and enlargement of the lateral branch of the PMA [1]. The ILT is considered to represent the remnant of the primitive premandibular artery [4]. An OA arising from the cavernous segment of the ICA typically originates from the ILT, although it may rarely arise from the meningohypophyseal trunk [11, 13]. In the present case, the left OA originated approximately 5 mm distal to the origin of the ILT.

An OA may rarely arise from the basilar artery [8], anterior inferior cerebellar artery (AICA) [3], persistent trigeminal artery (PTA) [7], or a common trunk associated with an AICA-type PTA variant [12]. Duplication of the OA, in which one OA follows the normal course and the other arises from the cavernous segment of the ICA, has also been reported, although it is extremely rare [13]. These anomalous OAs arising from proximal arterial segments usually enter the orbit via the SOF. However, the first author previously reported a case in which the left OA arose from a location similar to that of the left OA in the present case but entered the orbit through the OC rather than the SOF [10]. The primitive dorsal OA does not arise from the cavernous segment of the ICA [4]. Nevertheless, excessive caudal migration of the primitive OA has been proposed as a possible explanation for this variation [10].

An OA may also rarely arise from a more distal location than usual, such as the PCoA, carotid bifurcation, anterior cerebral artery, or middle cerebral artery [1, 2, 6]. These distally originating OAs are thought to result from failure of caudal migration of the primitive ventral OA and typically enter the orbit through the OC.

The clinical significance of variations in OA origin is generally limited. Nevertheless, recognition of arterial variations before surgical or endovascular procedures is important for preventing procedural complications. When interpreting MRA, careful examination of both VR images and source images can facilitate the identification of rare arterial variations.

Conclusions

We report a case of bilateral OAs arising from the cavernous segments of the ICAs and entering the orbits via the SOFs. The left OA originated from an unusually distal portion of the cavernous ICA. To our knowledge, no similar case has been reported in the relevant English-language literature. Careful examination of both VR images and source images is useful for identifying rare arterial variations on MRA.

Declarations

Conflict of interest

The authors declare no competing interests.

Ethical approval and consent to participate

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Consent for publication

The patient signed informed consent regarding publishing her data and figures.

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Author Contribution

AU designed the study and drafted the manuscript. AU and RK critically reviewed the manuscript and read and approved the final manuscript.

Data availability

Not applicable.

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Figures



Fig. 1a



Fig. 1b,c

Figure 1

Inferosuperior (**a**), left lateral (**b**), and right lateral (**c**) views of a volume-rendered (VR) image of magnetic resonance angiography (MRA).

The right ophthalmic artery (OA) arises from the cavernous segment of the internal carotid artery (ICA) (*long arrows*). The left OA also arises from the cavernous segment of the ICA (*short arrows*). However, the site of origin of the left OA is approximately 5 mm distal to that of the right OA. The *dotted arrow* in **b** indicates an aneurysm at the junction of the left ICA and the posterior communicating artery.

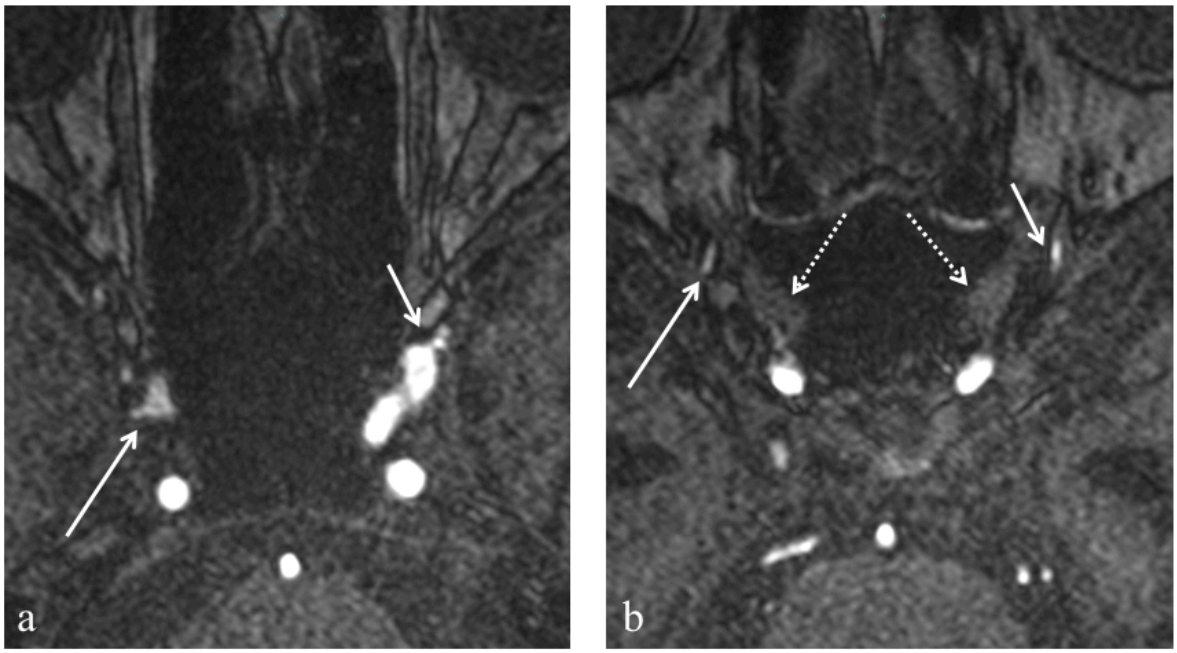


Fig. 2

Figure 2

a,b. Source images of MRA.

The right OA arises from the cavernous segment of the ICA and enters the orbit through the superior orbital fissure (SOF) (*long arrows*). The left OA also arises from the cavernous segment of the ICA and enters the orbit through the SOF (*short arrows*). However, the site of origin of the left OA is apparently distal to that of the right OA. The *dotted arrows* in **b** indicate the bilateral optic nerves.