Clinical case

Bilateral ophthalmic origin of the middle meningeal artery

Origine ophtalmique bilatérale de l’artère méningée moyenne

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A B S T R A C T

The origin of the middle meningeal artery (MMA) may vary although it can arise from the ophthalmic artery (OA) with a 0.5% prevalence. We report the exceptional bilateral asymmetric origin from the OAs that has not previously been reported in the literature. Surgeons should be aware of this variation as it could be crucial in the setting of an endovascular approach for meningeal lesions, as in our observation. A 50-year-old male underwent a preoperative cerebral digital subtracted angiography that incidentally revealed MMAs arising from the OA on both sides. In fact, the origin was asymmetric because it was complete on the right side with the anterior and posterior branches of the MMA arising from the OA, whereas it was partial on the left side, with only the anterior branch arising from the OA. The CT scan showed the absence of the foramen spinosum only on the right side. This paper discusses the unique anatomic variation in the light of MMA embryology and its different origins. Knowledge of this variation may have a practical impact in cases of cerebral embolization.

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R É S U M É

L’origine de l’artère méningée moyenne (AMM) peut varier. Elle peut naître de l’artère ophtalmique (AO) dans 0,5 % des cas. Nous rapportons ici l’origine bilatérale et asymétrique des artères ophtalmiques qui est exceptionnelle et encore jamais décrite dans la littérature. Cette variation devrait être connue pour pratiquer des approches endovasculaires des lésions méningées, comme nous allons le voir dans cette observation. Une angiographie cérébrale préopératoire a été réalisée chez un homme de 50 ans qui a révélé de manière fortuite une origine ophthalmonique des deux artères méningées moyennes. Plus précisément cette origine était asymétrique car elle était complète à droite avec les branches antérieures et postérieures de l’AMM naissant de l’AO alors qu’elle était incomplète à gauche avec seulement une branche antérieure naissant de l’AO. Le scanner cérébral montrait l’absence de foramen spinosum seulement à droite. Cet article discute cette variation anatomique, unique jusqu’alors, en éclaircissant les points embryologiques qui expliquent les différentes origines de l’AMM. La connaissance de cette variation a une implication pratique directe en cas d’embolisation cérébrale.

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1. Introduction

The middle meningeal artery (MMA) normally arises from the external carotid system, more precisely from the maxillary artery. However, it can present anatomic variations. Its origin can depend, in rare cases, on the internal carotid system namely the ophthalmic artery (OA). Moreover, an embryologic study of the area explains this type of variation, due to the close developmental relationship between both arteries.

A recent review of the literature has focused on the different origins of the MMA [1] and shows a 0.5% prevalence of an ophthalmic origin [1–3].

Our article presents the vascular embryology of the MMA and describes the MMA’s unique origins from the OAs on both sides.

2. Observation

A 50-year-old male underwent a preoperative arteriography, which suggested the possible embolization of an occipital
meningioma. Embolization was chosen as a bleeding limitation strategy for this recurrent occipital meningioma.

A selective angiography of the external and internal carotid arteries, ipsilateral and contralateral to the tumour was performed.

The right external carotid angiography showed the two terminal branches of the external carotid artery: the internal maxillary artery and the superficial temporal artery. Although the other branches were visible (i.e., occipital artery, pharyngeal ascending artery and posterior auricular artery) the MMA was absent (Fig. 1). In contrast, the right internal carotid artery angiography revealed the MMA arising from the ipsilateral OA (Fig. 2).

On the left side, the anterior branch of the MMA arises from the OA (Fig. 3), while the posterior branch arises from the external carotid system (Fig. 4), rendering this anomaly bilateral and asymmetric.

In view of the aberrant origins of both MMA, embolization was avoided.

Subsequently, retrospective analysis of the CT scan with an osseous algorithm showed the foramen spinosum present only on the left side whereas it was absent on the right side (Fig. 5).

3. Discussion

At the cranial part of the embryo, six aortic arches appear. The first gives birth to the maxillary artery, the second to the stapedial artery and the third to the future internal carotid artery.

The stapedial artery divides into two branches:

• the maxillo-mandibular, penetrates into the spinosum foramen and is annexed by the external carotid artery, thus forming the definitive maxillary artery and the extracranial segment of the MMA;

• the supraorbital division reaches the supraorbital fissure, thus providing intraorbital and retro-orbital branches which

anastomoses with the OA. This division forms the intracranial segment of the MMA.

The proximal part of the stapedial artery is subsequently involuted, while the supraorbital artery becomes the definitive MMA after losing its anastomoses with the OA.
meningeal artery from the ophthalmic and internal carotid arteries, was in 1876 on cadaveric bodies by the Viennese anatomist Emil Zuckerkanarl and in 1967 by Gabriele et al. in an angiographic study [6]. In 1974, Mc Lennan et al. in their reported series discusses the ophthalmic middle meningeal artery [5].

This variation could be explained due to the embryologic characteristics of this region. Maiuri et al. in 1998 explained this abnormality by the combination of two phenomena [7]:

- failure of the proximal intraorbital branches to involute, so that the intracranial segment of the MMA remains in connection with the intraorbital stapedial branches;
- defective involution of the maxillo-mandibular branch, so that the extracranial segment of the MMA is not formed and the foramen spinosum is absent.

Lasjaunias et al.’s study showed that the capture of the maxillo-mandibular artery by the future external carotid artery represents a particularly important event for this system [4]. The arterial flow of the transosseous portion of the stapedial artery becomes reversed and two opposite flows will then compete in this portion. Regression therefore occurs and the endocranial territories of the stapedial artery will be taken over by one of the available anatomic sources.

The supraorbital artery is most often used. If this system has already disappeared, the endocranial territory of stapedial artery will connect with a close accessible system, which then will take over the MMA, thus explaining the numerous origins of the MMA [4].

The particularities of the anomaly observed in our case are the bilateral and mainly the asymmetric status. Indeed, on the left side, the posterior branch of the MMA still arises from the external carotid system while the anterior branch arises from the OA rendering this malformation exceptional.

Maiuri et al. explained this phenomenon by the partial involuion of the supraorbital artery with an extracranial segment of the MMA and presence of the foramen spinosum [7].

On the right side the malformation is complete with the totality of the MMA arising from the OA, with the absence of the foramen spinosum, as shown on the osseus CT scan.

Foramen spinosum formation depends on the presence of the extracranial segment of the MMA.

In clinical practice, this malformation avoids hyperselective catheterisation of the MMA and subsequent embolization. Thus, it protects it from potential neurological damage in cases of intended embolization, while it is well known that ophthalmic assault may occur in cases of OA rising from MMA. This complex anatomy may also be present in cases of other vascular lesions such as dural arteriovenous fistulas, again preventing an endovascular procedure, or only via a perilous approach through the OA.

The bilateral and asymmetric origin of the MMA from the OA is described here. This asymmetric variant has to date, to our knowledge, not been reported. The knowledge of this variation could prevent neurologic damage in cases of MMA embolization.

**Disclosure of interest**

The authors declare that they have no conflicts of interest concerning this article.

**References**

