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ANATOMIC VARIATIONS

Ophthalmic artery originating from anterior inferior cerebellar artery: a rare variation

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Abstract

Purpose The variations of origin of ophthalmic artery are extremely rare. Here, we aimed to present a patient had a rare variation of the ophthalmic artery.

Clinical presentation The patient had a history of Moyamoya disease. The imaging studies revealed ophthalmic artery origination from basillar artery. In addition, M1-segment fusiform aneurysm, vasculitis and, as a variation, middle meningeal artery originating from the ophthalmic artery were also detected. We presented this case report as it is the first case with ophthalmic artery originating from anterior inferior cerebellar artery.

Conclusion In our case we reported, M1 segment fusiform aneurysm, vasculitis, and as a variation, middle meningeal artery originating from the ophthalmic artery and anterior inferior cerebellar artery as ophthalmic artery origin and hereby present it for inclusion into the literature. Ophthalmic artery anatomical abnormalities occupies so little place in existing literature when nominating rare variations. Ophtalmic artery originating from anterior inferior cerebellar artery firstly defined as an ophthalmic artery variation including its way-out branch structures.

Keywords Anterior inferior cerebellar artery · Endovascular surgery · Neurosurgery · Ophthalmic artery · Surcigal anatomy

Abbreviations

ACA	Anterior cerebral artery
AICA	Anterior inferior cerebellar artery
AVM	Anteriovenous malformation
BA	Basiller artery
ICA	Internal carotid artery
OA	Ophthalmic artery
MCA	Middle cerebral artery
MMA	Middle meningeal artery
PcomA	Posterior communicating artery
PDOA	Primitive dorsal ophthalmic artery
PVOA	Primitive ventral ophthalmic arter
PPTA	Persistan primitive tirgeminal artery
PTA	primitive trigeminal artery

Introduction

Ophtalmic artery (OA) is the first major branch of the supraclinoid segment of the internal carotid artery (ICA). Variations in the origin of the OA are rare. In a previous retrospective study investigating variations of OA origin, only 2 of 62 variations were found to be associated with the basiller artery (BA) and none from anterior inferior cerebellar artery (AICA) [8].

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Case presentation

42-year-old woman, presented with impaired speech, temporary weakness and numbness in left arm. She had history of receiving treatment with bemiparin, atorvastatin, acetylsalicylic acid and clopidogrel due to suspected vasculitis and Moyamoya disease (MMD) and 45 pack-year smoking without other comorbidities. Physical examination, revealed mild ptosis and vision loss in right eye. Diffusion magnetic-resonance imaging revealed acute diffusion restriction consistent with a large lacunar infarct in anterior nuclei of right thalamus. Computed-tomography angiography revealed significant thinning and circumferential capillary cavernous transformation in M1-segment of the right middle cerebral artery (MCA). Digital subtraction angiography revealed OA originated from right AICA (Fig. 1a, b). As a result, the absence of the OA in the right ICA was noted, and a prominent OA originating from BA and connected to right AICA was detected. The right middle meningeal artery (MMA) branched off vaguely from the OA (Fig. 1c**)** In addition, luminal irregularity and significant stenosis in M1-segment of right MCA were detected along with diffuse cavernous transformation in lenticulostriate and other collateral branches (Fig. 1d.). A1-segment of right anterior cerebral artery (ACA) had a hypoplastic appearance. Right MCA and ACA watershed areas were supplied via anterior communicating artery (AComA). Proximal portion of right subclavian artery was variably elongated and tortuous (Fig. 1e). Left posterior communicating artery (PComA) showed fetal continuity. The P2-segment of right posterior cerebral artery (PCA) showed fusiform dilatation and formed collaterals in the right occipitoparietal region (Fig. 1f).

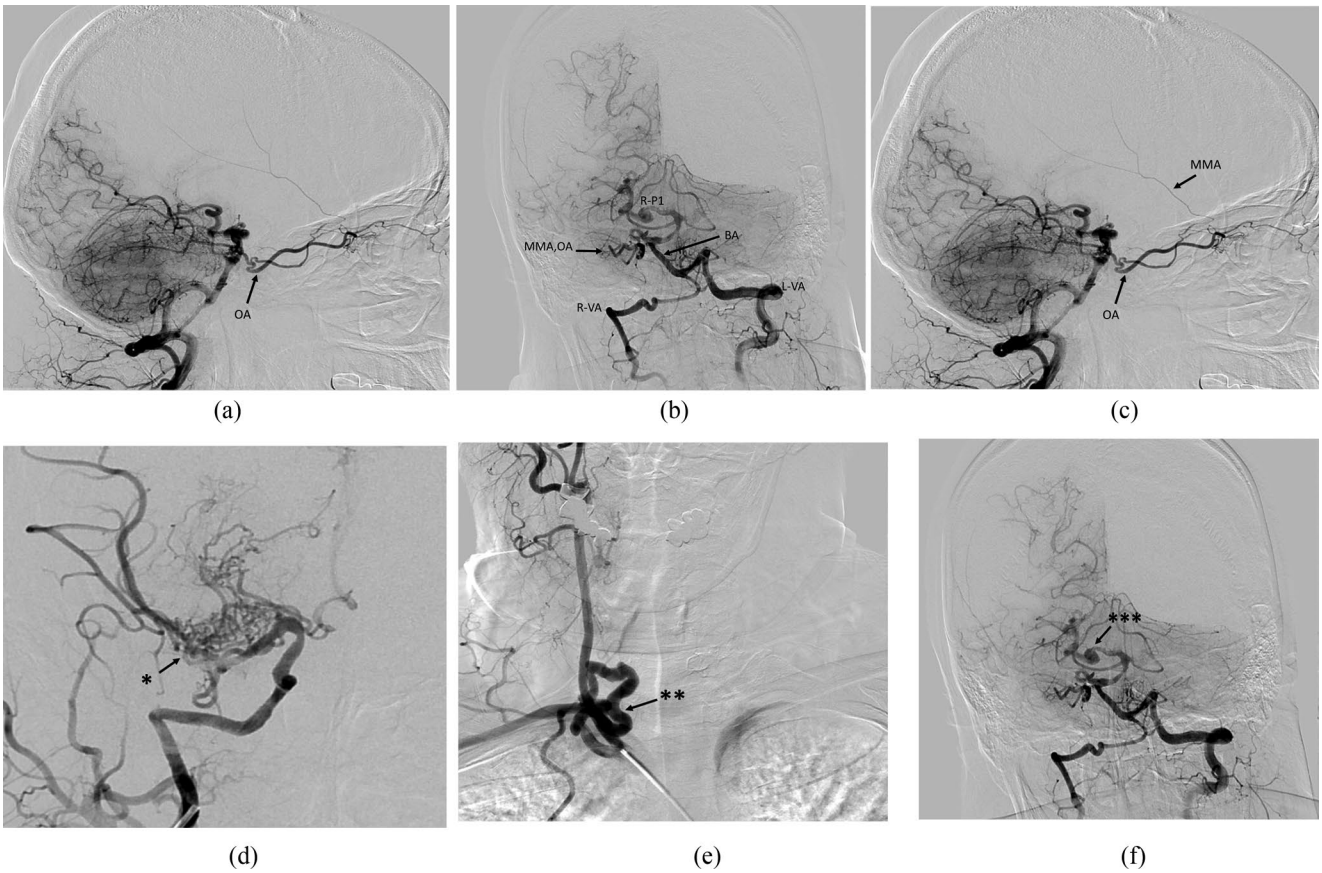

Fig. 1 Digital subtraction angiography findings of our case (**a**) The ophtalmic artery originating from the basillar artery as a continuation of the anterior inferior cerebellar artery (**b**) Anterior view of ophtalmic artery (**c**) The middle meningeal artery originating from the ophtalmic artery (**d**) Cavernous transformation in the right middle cerebral artery (**e**) Elongation and tortuous appearance in the proximal right subclavian artery (**f**) Fusiform tortuous dilatation of the P2 segment of the right posterior cerebral artery. *OA*: ophtalmic artery, *R-P1*: posterior cerebral artery, P1 segment, *BA*: basillar artery, *R-VA*: right vertebral artery, *L-VA*: Left vertebral artery, *MMA*: middle meningeal artery. *: cavernous transformation of M1, **: elongation and tortuosity of the proximal right subclavian artery, ***: fusiform tortuous aneurysmatic appearance in the posterior cerebral artery

Discussion

The OA is the first major branch of the supraclinoid segment of the ICA and variations in the origin of the OA are rare [12]. It was found that the OA originated from either the cavernous roof of the ICA or regions superior to the cavernous roof in 59% of subjects [9]. 6 ACA, 1 MCA, 2 PComA, ICA bifurcation, 19 MMA, 10 cavernous ICA, 2 carotid 52 siphon, 3 double ICA, 16 double ICA and MMA origins were detected in 62 cases [8]. The OA originating from the BA was very rare seen in only 2 cases [8, 12, 15]. OA develops from two ophthalmic branches of the ICA when the embryo size (ES) is around 7–12 mm. These are primitive dorsal OA (PDOA) and primitive ventral OA (PVOA) [8, 11, 12]. While the PDOA supplies the caudodorsal parts of the optic nerve, the PVOA supplies the cranioventral parts. The PDOA originates from the region that will differentiate to the carotid siphon and extend across the superior ophthalmic fissure, while the PVOA extends into the optic canal (OC) from the region that will differentiate to the ACA [8, 11, 12, 19, 20]. The primitive ophthalmic branches subsequently form an anastomosis. Thereafter, both branches partially regress, forming the primitive OA. When ES reaches 18 mm, maxillofacial and supraorbital arteries branch off from the stapedial artery, which originates from the primitive hyoideal artery in petrous segment of the ICA [1, 8, 12]. The supraorbital part of stapedial artery anastomoses with the primitive OA. When ES reaches 40–53 mm, the anastomosis is completed and the primitive OA assimilates the supraorbital branch of stapedial artery to reach its adult configuration.

The ACA, ICA and MMA variations of OA origin can be explained by developmental mechanisms of the primitive OA which are insufficient to explain BA variation [8]. The first case with BA origin was associated with arteriovenous malformation (AVM). However, second case had no pathological basis [12]. Early embryological connections between the caroticobasillar system may appear as variations including proatlantic arteries such as the primitive trigeminal, otic and hypoglossal arteries. The common feature is connection between the vertebrobasillar and the carotid systems provided by these arteries, which can be explained from the embryological perspective. The evolution and regression of these vascular collateral connections was described in detail [15]. However, the vascular variation found cannot be fully explained by the described embryological development features. Firstly, the ICA isn't included in these vascular variations. Secondly, OA development occurs much later than development and regression of the primitive arteries. While primitive caroticobasilar arteries regress at 12 mm of ES at the latest, OA development continues until almost 40 mm ES. Thirdly, rather than from a primitive root, the development of OA results from the anastomosis of several vessels as described by Padget. Thus, possibility of the primitive trigeminal artery (PTA) is insufficient to explain our case.

Anastomosis between stapedial artery and the vertebrobasilar system or the PTA is more likely explanation [12, 15]. To explain BA as the source of MMA; the role of a similar anastomosis between PTA and MMA was suggested [16]. To our knowledge, the first, and so far, the only report showing the BA as the origin of the OA was the study by Schumacher and Wakhloo, reporting that abnormal OA was defined as one of the supplying arteries of the orbital AVM [15]. It is possible to speculate about the role of the AVM in the development of this abnormal OA, but no such malformation was found in our case, similar to the case by Sade et al. [12].

The vascularization of the OC in embryogenesis consists primarily of the ventral part of the ICA and branches of the dorsal OA. Later, the primitive OA is formed from these two arteries [18]. In an estimated 96% of individuals, the OA separates after the ICA passes the internal dural ring and enters the OC [17]. As a variant, the OA originates from the MMA in 4% of individuals [5]. The OA 82 originates from the cavernous segment of the ICA in 7.5–18.3% of subjects. Abnormal OA most commonly originates from the BA [12], MMA [2, 10], ACA [4], and ICA bifurcation [3] and double OA originates from the ICA bifurcation [11]. The OA variations are usually associated with aneurysm, AVM or MCA trifucation ectasia [6, 12, 15]. The dorsal OA originates from the persistent primitive trigeminal artery in the cavernous segment was also shown [7]. It is detected at a rate of 0.1–0.2% in digital subtraction angiograph [13, 14]. In the vertebrobasilar system, anastomosis with the BA is seen [19–21]. In our case we report, M1 segment fusiform aneurysm, vasculitis and, as a variation, MMA originating from the OA and AICA as OA origin and hereby present it for inclusion into the literature. In conclusion, this variation should be considered during posterior fossa surgery or AICA vascular surgery. If this variation is not considered, ipsilateral blindness may occur in the previously mentioned surgical procedures. Ophthalmic artery complications may develop. We believe that the variation of the origin of the OA from the AICA, which we analysed in our case report, will be useful for the literature and for the AICA and posterior fossa surgery.

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Author contributions A.G.: Project development, Data Collection, Manuscript writing H.Y.: Manuscript writing and Data collection E.İ.: Data collection B.Ö. and H.D.: Radiological interventions, A.S.: Project development.

Data availability No datasets were generated or analysed during the current study.

Declarations

Competing interests The authors declare no competing interests.

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