

Anomalous Origin of the Ophthalmic Artery From the Anterior Cerebral Artery

—Case Report—

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Abstract

A 39-year-old woman presented with left visual disturbance and diplopia. Magnetic resonance imaging revealed a well-enhanced tumor in the left tentorium, cavernous sinus, and suprasellar region. Angiography demonstrated an abnormal origin of the ophthalmic artery from the anterior cerebral artery. The tumor was partially removed by left frontotemporal craniotomy with orbitozygomatic osteotomy. Intraoperatively, the anomalous origin of the ophthalmic artery was confirmed. This anatomical variation is extremely rare.

Key words: ophthalmic artery, abnormal origin, anterior cerebral artery, anatomical variation, pathology

Introduction

The ophthalmic artery (OphA) usually arises from the supraclinoid portion of the internal carotid artery (ICA) within the subarachnoid space shortly after the carotid artery emerges from the cavernous sinus,¹⁶⁾ and is the sole source of the central retinal artery. The OphA may also arise extradurally from the clinoidal segment or the intracavernous portion of the ICA and pass through the superior orbital fissure instead of the optic foramen.^{1,6)} Other origins of the OphA include the middle meningeal artery (MMA),^{4,10-12,14,20,21)} basilar artery (BA),^{17,18)} posterior communicating artery (PCoA),^{13,15)} and ICA bifurcation.²⁾ The OphA originating from the anterior cerebral artery (ACA) is extremely rare.^{3,8,16)}

We present a case of abnormal origin of the OphA from the ipsilateral ACA (A₁ segment) associated with meningioma.

Case Report

A 39-year-old woman presented with left visual disturbance and diplopia. Magnetic resonance imaging revealed a well-enhanced tumor in the left tentorium, cavernous sinus, and suprasellar region (Fig. 1). Left internal carotid angiography showed fine tumor vessels from the MMA, and the left OphA arising from the A₁ segment of ACA (Fig. 2). Right internal carotid angiography showed neither tumor vessels nor abnormal OphA origin. Partial

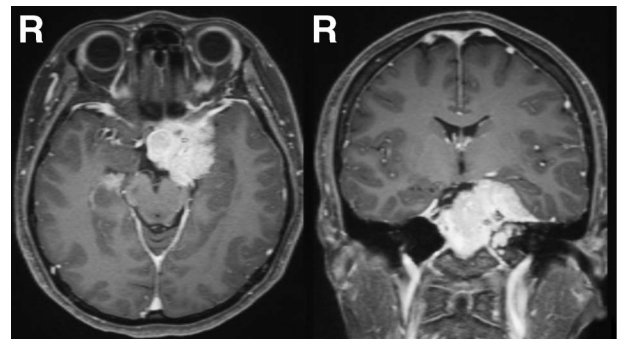


Fig. 1 T₁-weighted magnetic resonance images with contrast medium revealing a well-enhanced mass in the left tentorium, cavernous sinus, and suprasellar region.

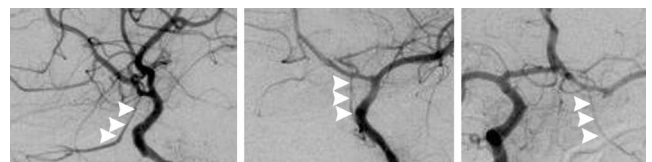


Fig. 2 Left internal carotid angiograms (left: lateral view, center: oblique view) and right internal carotid angiogram with left carotid compression (right: anteroposterior view) showing the ophthalmic artery originating from the A₁ (arrowheads).

removal of the tumor was scheduled for mass reduction and prevention of right visual dysfunction. Left frontotemporal craniotomy with orbitozygomatic osteotomy was performed. The tumor was partially removed under visual evoked potential monitoring. Intraoperatively, the left OphA was found to arise from the anterior aspect of the A₁ segment of the ACA (Fig. 3). The histological diagnosis was meningothelial meningioma. Postoperatively, she underwent radiosurgery for the residual meningioma.

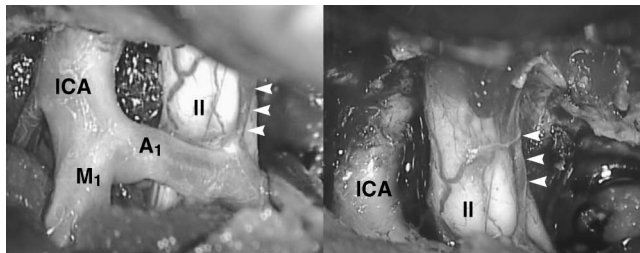


Fig. 3 Intraoperative photographs showing the left ophthalmic artery (arrowheads) arising from the anterior aspect of the A₁ segment (A₁) of the anterior cerebral artery. ICA: internal carotid artery, II: optic nerve, M₁: M₁ segment of middle cerebral artery.

Discussion

The present case of the OphA originating from the A₁ segment of the ACA was associated with meningioma. The remarkable aspect was that the abnormal origin of the OphA was found angiographically and was confirmed intraoperatively.

Embryogenesis of the OphA is highly complex. The primitive ophthalmic artery (POA) is originally formed by the ventral ophthalmic artery (VOA) and the dorsal ophthalmic artery (DOA), which develop from the primordia of the ACA and ICA (C₄ segment), respectively. The VOA courses in the optic canal and the DOA in the superior orbital fissure. Later, these arteries anastomose near the optic nerve. The VOA forms an additional anastomosis with the supra-cavernous portion of the ICA. Both of these primitive arteries show partial regression and give rise to the POA. Finally, the POA transforms into the OphA.^{7,9,17)}

Developmental anomalies involving the origin of the OphA usually originate in persistence of an anastomosis that is normal at one stage of development but undergoes normal developmental regression. During development, collateral connections develop between branches of the OphA (VOA or DOA) and adjacent vessels including the MMA.⁵⁾ However, the abnormal origin of the OphA in our

Table 1 Summary of the literature review about anomalous origin of ophthalmic artery (OphA)

Case No.	Author (Year)	Age (yrs)/ Sex	OphA origin	Side	Presentation	Discovered reason
1	Picard et al. (1975) ¹⁶⁾	52/M	ACA	lt	central scotoma of the lt eye	unknown
2	Weinberg et al. (1981) ²¹⁾	48/F	MMA	lt	transient dimness of vision	external carotid artery emboli
3	Nakagawa et al. (1982) ¹⁴⁾	30/F	MMA	rt	diplopia	meningioma
4		35/M	MMA	rt	lt upper extremity spasm	astrocytoma
5	Nakata and Iwata (1987) ¹⁵⁾	41/F	PCoA	lt	sudden episode of headache	absent lt ICA
6	Konishi et al. (1988) ¹⁰⁾	79/F	MMA	rt	in the course of an anatomic study	in the course of an anatomic study
7	Hassler et al. (1989) ³⁾	7/M	A ₁	rt	retarded growth	craniobasal and medial cystic lesion
8	Hamada et al. (1991) ²⁾	64/F	ICA bif	bil	vertigo with neck pain	rt ICA aneurysm
9	Islak et al. (1994) ⁸⁾	51/F	A ₁	rt	headache, diplopia	intracavernous carotid aneurysm
10	Schumacher and Wakhloo (1994) ¹⁸⁾	3/F	BA	rt	blindness	arteriovenous malformation
11	Watanabe et al. (1996) ²⁰⁾	60/F	MMA	bil	frontal headache and diplopia	lt dural carotid cavernous fistula
12	Morandi et al. (1998) ¹²⁾	26/F	MMA	lt	loss of lt vision	occlusion of the central retinal artery
13	Liu and Rhoton (2001) ¹¹⁾	unknown	MMA	lt	in the course of an anatomic study	in the course of an anatomic study
14	Sade et al. (2004) ¹⁷⁾	48/F	BA	lt	nonspecific symptoms	rt MCA aneurysm
15	Naeni et al. (2005) ¹³⁾	38/F	PCoA	rt	rt-sided headaches	absent rt ICA
16	Hayashi et al. (2007) ⁴⁾	66/M	MMA	lt	lt visual disturbance	meningioma
17		49/F	MMA	rt	vertigo and vomiting	meningioma
18		59/F	MMA	rt	gait disturbance, diplopia, and ptosis	meningioma
19	Present case	39/F	A ₁	lt	visual disturbance and diplopia	meningioma

ACA: anterior cerebral artery, BA: basilar artery, bif: bifurcation, bil: bilateral, F: female, ICA: internal carotid artery, lt: left, M: male, MCA: middle cerebral artery, MMA: middle meningeal artery, PCoA: posterior communicating artery, rt: right.

case cannot be explained by this theory. Embryologically, the VOA forms an anastomosis with the supracavernous portion of the ICA, and both the VOA and DOA show partial regressions. The present abnormal origin of the OphA can be explained as the origin of the OphA from the ACA resulting from persistence of the primitive VOA and atrophy of the primitive DOA.¹⁶⁾

Eighteen cases of anomalous origin of the OphA were reported between 1969 and 2010.^{2-4,8,10-18,20,21)} Table 1 summarizes the clinical characteristics of anomalous origin of the OphA. Mean age of the patients was 44.1 years. Anomalous OphAs arose from the MMA (10 cases), BA (2 cases), ACA (3 cases), PCoA (2 cases), and ICA bifurcation (1 case). Therefore, four cases of ACA origin were reported including the present case. The abnormal OphA originated from the right side in 9 cases, and the left in 8 cases, with only 2 bilateral cases. Abnormal OphA origin showed female predominance (14 cases).

The presence of an infraoptic course of the A1 tract could also represent maldevelopment in the embryogenesis of the anterior circle of Willis, resulting from the persistence of the primitive prechiasmatal arterial anastomosis or an error in the development of the definitive OphA.¹⁹⁾ This extremely rare anomaly is characterized by the following features: the anomalous artery branches off from the ICA at the level of the OphA (just as it becomes intradural) or above; the anomalous artery passes beneath the optic nerve^{19,22)}; and the anomalous vessel is frequently associated with other vascular anomalies secondary to embryogenic disorders and often in association with cerebral aneurysms.^{19,22)} The present anomalous origin of the OphA is different to the infraoptic course of the ACA. In the present case, the left A₁ origin from the normal level of ICA passed over the optic nerve, and supplied the vascular territory of a normal ACA. However, anomalous origin of the OphA has some common characteristics with infraoptic course of the ACA: both are maldevelopments in the embryogenesis of the anterior circle of Willis, and are associated with aneurysms or tumor.

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