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An Unruptured Anterior Communicating Artery Aneurysm with Bilateral Infraoptic Anterior Cerebral Arteries. Case Report and Review of the Literature

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Variations of the anterior cerebral artery-anterior communicating artery complex are commonly identified in aneurysm surgery. An infraoptic course of the anterior cerebral artery is exceedingly rare. Robison first described this anomaly from an anatomic dissection in 1959. A unilateral anomalous infraoptic anterior cerebral artery is more common than anomalies of bilateral infraoptic anterior cerebral arteries. We present the case of an unruptured aneurysm at the anterior communicating artery in a patient with bilateral infraoptic anterior cerebral arteries, identified by computed tomography angiography and verified during surgery. Implications for aneurysm formation and surgical treatment are discussed.

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Keywords Anterior cerebral artery, Aneurysm, Vascular surgical procedure

INTRODUCTION

The A1 segment of the anterior cerebral artery (ACA) usually arises from the internal carotid artery (ICA) bifurcation and extends anteromedially above the optic nerve or chiasm to join the anterior communicating artery (ACoA). Variations of the ACA-ACoA complex are commonly identified in aneurysm surgery. An infraoptic course of the ACA is exceedingly rare. Robinson first described this anomaly from an anatomic dissection in 1959.^{1,2} A unilateral anomalous infraoptic ACA is more common than anomalies of bilateral infraoptic ACAs.⁴ We report on the case of an unruptured ACoA aneurysm in a patient with bilateral infraoptic ACAs. Implications for aneurysm formation and surgical treatment are discussed.

CASE REPORT

Our patient developed symptoms of episodic left arm twitching. His family history included significant intracranial aneurysms. Imaging demonstrated a 5-mm ACoA aneurysm which projected posteriorly with early bifurcations of the ICA bilaterally (Fig. 1, Fig. 2). The A1 segments were identified as they traversed the pituitary fossa in an unusually low and laterally directed course, indicating their infraoptic nature.

Discussion with the patient resulted in the decision to proceed with clip obliteration of the aneurysm due to significant family history and extreme anxiety regarding the diagnosis. A standard right pterional craniotomy was performed and as the optic nerve was exposed for CSF drainage, the infraoptic course of the

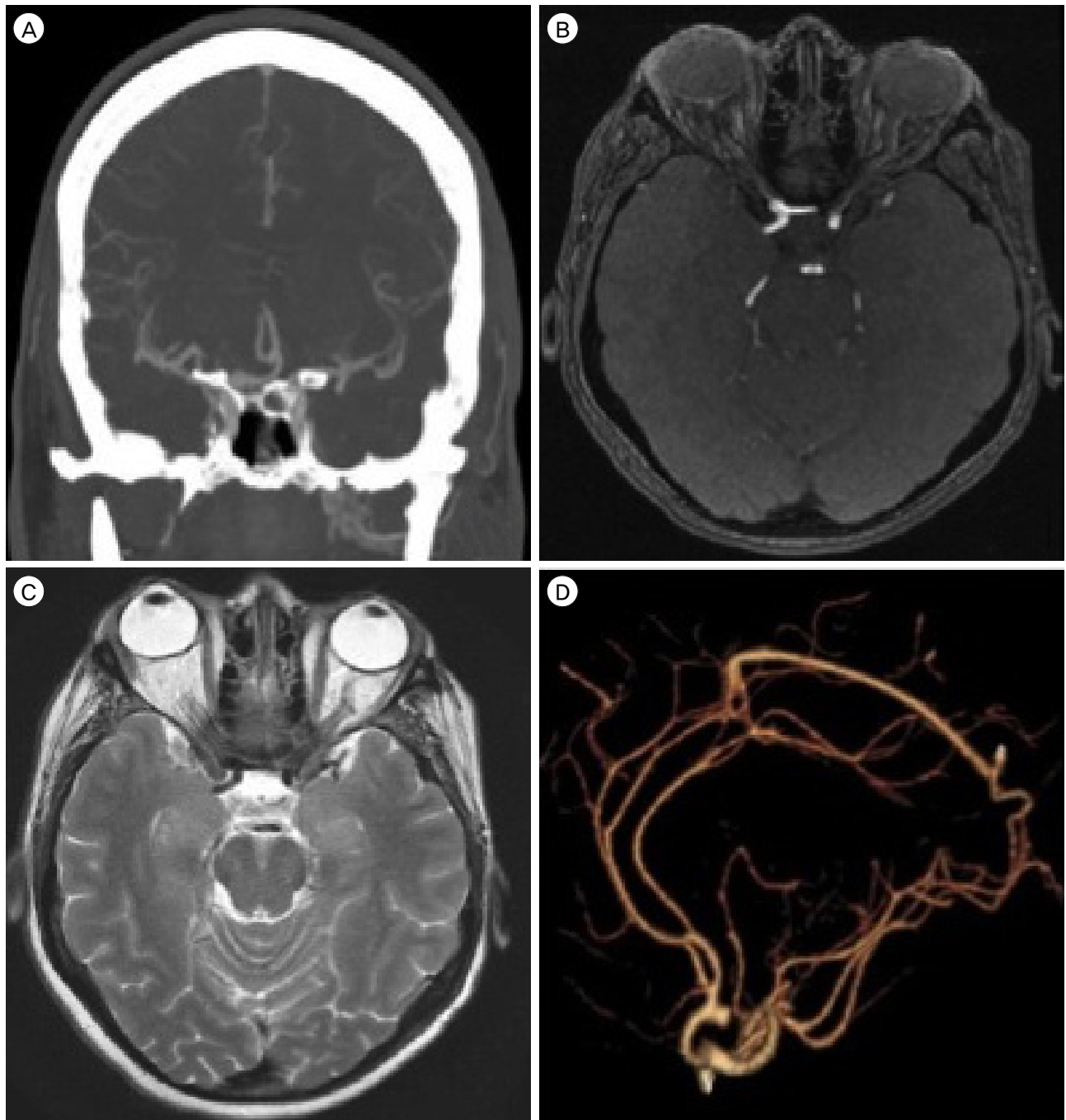


Fig. 1. Preoperative computed tomography angiogram demonstrates the ACoA aneurysm (A) and low bifurcation of the internal carotid artery (B, C). Reconstructed images show the aneurysm, which projects posteriorly (D).

ipsilateral A1 became visible. The contralateral A1 was then exposed and showed the same course across the skull base (Fig. 3). Once proximal control was defined, the ACoA was exposed along with the bilateral A2 segments. As predicted by the preoperative CTA,

the aneurysm projected posteriorly. Both A2 segments projected anteriorly and swept around the base of the lesion. Each of the recurrent arteries of Huebner arose from its typical location in the proximal A2 segment. Proximal control with bilateral A1 temporary clipping

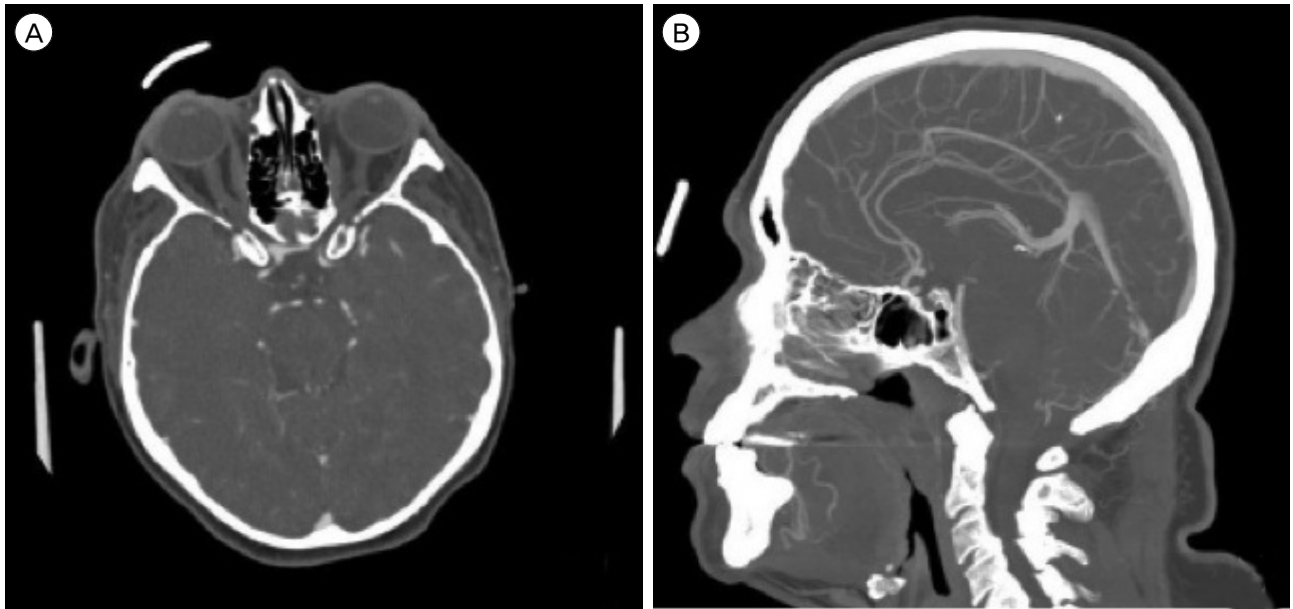


Fig. 2. Axial (A) and sagittal (B) imaging demonstrate the aneurysm, which projects posteriorly.

was performed and final aneurysm dissection with neck preparation was achieved. The aneurysm was clipped uneventfully, the temporary A1 clips were removed, and ICG video angiography was used to identify aneurysm obliteration and preservation of the parent vessels. The patient was discharged home on

post-operative day 2. Overall post-operative course was uneventful.

DISCUSSION

An infraoptic ACA is associated with a low bifurca-

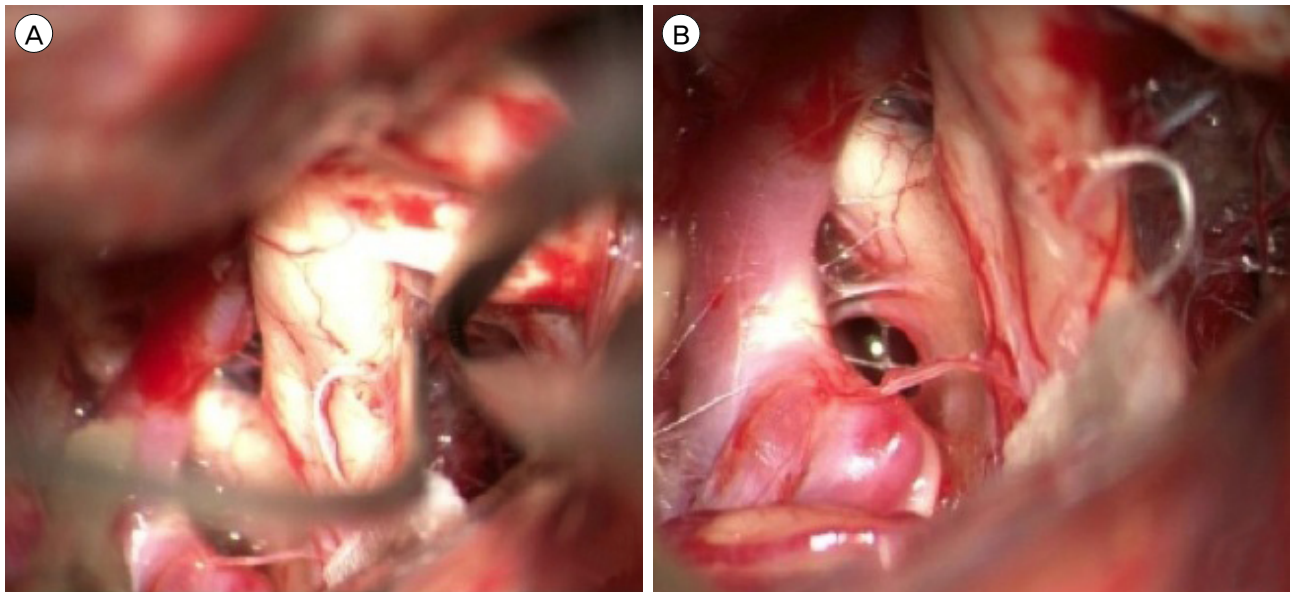


Fig. 3. View from right pterional craniotomy shows an infraoptic A1 segment. The ACA projects medially underneath the optic nerve and arises anterior to the optic chiasm (A) in the pre-chiasmatic space (B).

tion of the ICA and suggests abnormal development of the circle of Willis.¹³⁾ This has been associated with other coexisting vascular anomalies including normal ACoA complex with an additional infraoptic vessel that forms an anastomosis between the ICA and ACA; absent ipsilateral or contralateral A1; early bifurcation of the ICA at the level of the ophthalmic artery; and termination of an accessory infraoptic ACA in normal frontal brain parenchyma in the presence of a normal ACoA complex.

Bilateral infraoptic ACAs are less common than unilateral anomalies.⁸⁾ One report describes an associated gyral abnormality.¹¹⁾ The anomalous ACA usually arises from the intra-dural ICA near the level of the ophthalmic artery, as it did in the presented case, or rarely from the extra-dural ICA.⁹⁾

The most important clinical association of such an anomaly is the high incidence of intracranial aneurysms of the ACA-ACoA complex.^{5,8,14)} Recognition of this anomaly is important in planning surgery for ACA-ACoA complex aneurysms in order to identify

proximal arterial control of the aneurysm. Failure to account for this anomaly might result in unnecessary dissection along and possible damage to the optic apparatus or inferior frontal lobe during aneurysm repair. In the case of this anomaly, surgical treatment of the aneurysm at the ACoA may be difficult because the proximal ACA may be obscured by the optic nerve. In addition, the altered course of the A1 may change the orientation of the ACoA complex (and thus its important perforators which normally project posteriorly) or the Artery of Heubner as it arises from the proximal A2 or distal A1. Careful radiographic evaluation and understanding of variations of the ACA are essential for surgery. In this case, pre-operative knowledge of these anatomic variants enabled early identification of the ICA bifurcation under the optic nerve and unnecessary dissection along the inferior frontal lobe or optic apparatus was avoided. In this case, given the early medial infraoptic course of the A1 arteries, establishment of proximal control was comparatively easy.

Table 1. Infraoptic anterior cerebral arteries reported in the literature

Author	Year	Neurological disease and treatment	Patient age and gender	Bilateral or unilateral infraoptic A1	Direction of aneurysm
Present case	2014	ACoA aneurysm clip	52 female	Bilateral	Posterior
Kang et al ⁹⁾	2012	ACA aneurysm coil	59 female	Bilateral	Posterior
Kan, P	2012	ACoA aneurysm coil+clip	40 female	Unilateral right	Superior
Ji & Ahn ⁸⁾	2010	Left MCA aneurysm clip	28 female	Bilateral	
Akiyama et al ¹¹⁾	2010	MCA+BA aneurysms clip+coil	63 female	Unilateral right	
Gupta et al ⁶⁾	2008	Cortical branch of ACA aneurysm clip	22 male	Unilateral right	Superior
Wong et al ¹⁴⁾	2008	Arteriovenous malformation		Unilateral right	
Wong et al ¹⁴⁾	2008	ICA aneurysm		Bilateral	
Yurt et al ¹⁵⁾	2008	ACoA aneurysm clip	35 male	Unilateral right	Posterior
McLaughlin et al ¹¹⁾	2007	ACoA aneurysm clip	34 female	Bilateral	Superior
Chakraborty et al ³⁾	2006	ACoA aneurysm	34 male	Bilateral	Superior
Kilic et al ¹⁰⁾	2005	ACoA aneurysm clip	38 male	Bilateral	Superior
Al-Qahtani et al ²⁾	2003	ACA aneurysm coil	11 male	Unilateral right	Superior
Hillard et al ⁷⁾	2002	ACoA aneurysm coil	30 female	Unilateral right	Superior
Given & Morris ⁵⁾	2002	Left MCA+BA aneurysms	63 female	Unilateral right	
Spinnato et al ¹³⁾	1999	Right MCA+ACoA aneurysms	30 male	Unilateral right	Superior

ACoA = anterior communicating artery; ACA = anterior cerebral artery; MCA = middle cerebral artery; ICA = internal carotid artery; BA = basilar artery

Pre-operative evaluation of the ACoA complex anatomy is critical in the clipping of an ACoA aneurysm (as it is for any aneurysm location). Exposure of aneurysms located more than 1 cm above the skull base will be more difficult due to increased need for frontal lobe retraction as well as possibly interhemispheric dissection and gyrus rectus resection just to visualize the aneurysm. In addition, clipping of posteriorly projecting ACoA aneurysms is typically more difficult as the aneurysm projects in the same direction as the important perforator arteries. A posterior projecting aneurysm is often found in cases of an infraoptic A1 given the course of the ACA from inferior to superior as it turns under the optic nerve towards the ACoA complex (Table 1). However, in the reported case, the unusually anterior location of the ACoA complex actually made aneurysm exposure easier. In addition, the perforating vessels from the ACoA were pushed above the lesion, making safe surgical clipping without compromise of the associated perforating arteries more likely.

CONCLUSION

Safety in surgical clipping of intracranial aneurysms is achieved through many steps. Thorough pre-operative evaluation of the aneurysm as well as its parent vasculature is critical to achieving good surgical results. An infraoptic course of A1 from an early ICA bifurcation is rare; bilateral infraoptic A1 courses are even rarer. A pre-disposition to ACoA aneurysms appears possible with an infraoptic A1 course given the previous reports of association as well as this case. Identification of this anomaly pre-operatively can enhance surgical safety in aneurysm clipping and unnecessary and potentially dangerous dissection can be avoided.

STATEMENT OF CONTRIBUTORSHIP

MHC and MRF drafted the manuscript. AJT and CSO revised the draft manuscript.

Disclosure

This authors have no personal financial or institutional interest in any of the materials or devices described in this article.

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