

## Surgical Significance of Infra-Optic Course of A1 Segment of Anterior Cerebral Artery: Report of Two Cases

### Abstract

Anatomic variations of the anterior cerebral artery-anterior communicating artery complex (ACA-AComA) are common. An infra-optic course of the A1-ACA is extremely rare, and recognition of this variant is very important in planning surgery for ACA-AComA complex aneurysms. We present two cases of spontaneous subarachnoid hemorrhage due to ruptured AComA aneurysms with unilateral infra-optic course of the A1-ACA. In both the cases, the preoperative catheter angiography revealed low bifurcation with a horizontal course of internal carotid artery. In our first case, the finding was rather unexpected; however, in our second case, we could anticipate an infra-optic course of A1-ACA. Preoperative recognition of this anomaly helps in achieving proximal vascular control with ease and confidence. It also enhances surgical safety of aneurysm clipping, by avoiding unnecessary dissection elsewhere. This emphasizes the importance of careful preoperative angiographic evaluation. In the presence of this anomaly, one should always search for other associated vascular anomalies.

**Keywords:** Aneurysm clipping, anterior communicating artery aneurysm, infra-optic A1 segment of anterior cerebral artery, precommunicating segment of anterior cerebral artery

### Introduction

Internal carotid artery (ICA) bifurcates into its terminal branches; anterior and middle cerebral arteries below the anterior perforated substance. A1 segment of the anterior cerebral artery (ACA) then courses anteromedially above the optic chiasm in 70% or optic nerve in 30% of populations, ultimately to join the anterior communicating artery (AComA).<sup>[1]</sup> Anatomic variations of the ACA-AComA are commonly identified in aneurysm surgery with the most common variant being hypoplastic A1 segment of ACA.<sup>[1]</sup> An infraoptic course of A1-ACA is extremely rare. We present two cases of ruptured aneurysm at the AComA with unilateral infraoptic course of A1-ACA.

### Case Reports

#### Case 1

A 42-year-old male, known hypertensive presented with a history of sudden onset of severe headache followed by an episode of seizure with loss of consciousness. He was brought intubated

to emergency, and his GCS was 9T/15. Computed tomography of the brain showed diffuse basal cistern subarachnoid hemorrhage (SAH) with intra-ventricular extension (IVH). Four-vessel digital subtraction angiography (DSA) showed early and low bifurcation of the right ICA at the level of anterior clinoid process with a single, small, lobulated aneurysm arising from the AComA with hypoplastic/aplastic left A1 ACA [Figure 1].

#### Case 2

A 60-year-old female, a known diabetic and hypothyroid presented with sudden onset of severe holocranial headache with associated giddiness and multiple episodes of vomiting. At the time of presentation, her GCS was 15/15 and had no neurological deficits. Computed tomography of the brain showed diffuse basal cistern SAH with no IVH. Transfemoral four vessels DSA showed evidence of saccular aneurysm measuring 5 mm × 4 mm in size arising from AComA with fundus directed superiorly with severely hypoplastic left A1-ACA and early bifurcation of the right ICA with a horizontal medial course of A1-ACA [Figure 2].

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Both patients underwent clipping of the aneurysm. A right-sided standard pterional craniotomy was performed in both patients. After the chiasmatic and optico-carotid cisterns were opened, the right ICA bifurcation was noted well below the right optic nerve. The right A1 segment was identified to have a horizontal medial course below the right optic nerve and arose vertically at almost right angle between the right and left optic nerve, almost abutting the anterior chiasm. Thus an infra-optic course of right A1-ACA was confirmed intraoperatively [Case 1: Figure 1 and Case 2: Figure 2]. Proximal control was achieved using elective, intermittent, temporary clipping on the right A1 segment. The neck of the aneurysm was dissected along with exposure of A2-ACA segments bilaterally. The aneurysm was clipped uneventfully.

### Discussion

Infra-optic course of A1 segment of ACA is a rare but well-known anomaly. In 1959, Robison first described this anomaly from an anatomic dissection.<sup>[2]</sup> Following the first description in 1959, approximately 54 cases have been reported in the literature. However, Isherwood and Dutton were the first to demonstrate this anomaly on angiography.<sup>[3]</sup> The presence of infra-optic course of A1-ACA indicates abnormal embryologic development of the circle of Willis.<sup>[4]</sup> The bilateral infra-optic course of A1-ACAs is very much rare as compared to unilateral anomalies.<sup>[5]</sup> In ours and other reported cases, the infra-optic course of A1-ACA has typical appearances on angiography, like low bifurcation of the ICA at the level of the anterior clinoid

process, and a horizontal medial course of A1-ACA as it passes beneath the optic nerve and turns almost at right angle to emerge between the right and left optic nerves to join the normally located AComA.

Infra-optic course is associated with increased risk of berry aneurysms and other intracranial vascular anomalies.<sup>[6]</sup> Aplasia or hypoplasia of contralateral ACA being the most commonly associated anomaly.<sup>[7]</sup> Other less commonly associated anomalies include variant of carotid-basilar artery anastomosis, fused pericallosal artery, and plexiform AComA.<sup>[7]</sup> The most common site of aneurysm associated with infra-optic course of ACA is at the ACA-AComA complex.<sup>[7]</sup> The embryogenesis of this variant is still controversial, and possible explanations available in the literature are hypothetical. One of the hypotheses is that this variant may represent persistence and enlargement of an anastomotic vessel between the primitive dorsal and ventral ophthalmic arteries originating from the embryological development of the definitive ophthalmic artery.<sup>[8,9]</sup> Other alternate hypothesis is that this variant may be due to the enlargement of prechiasmatal anastomosis consisting of prechiasmatal branch of ophthalmic artery, superior hypophyseal branch of ophthalmic artery and chiasmatal branches of the ACA.<sup>[2,3]</sup> The persistence of the embryonic anastomosis between the primitive maxillary artery and the primitive olfactory artery, which later gives rise to ACA, could also account for this variant.<sup>[10]</sup> The surgical management of AComA

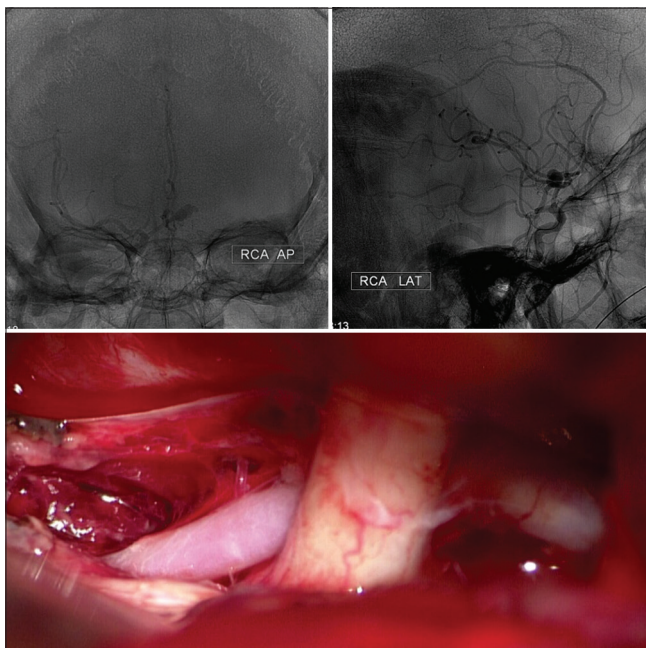


Figure 1: Digital subtraction cerebral angiography, anteroposterior, and lateral views showing low and early bifurcation of the right internal carotid artery at the level of anterior clinoid process and a small lobulated AcomA aneurysm with hypoplastic left A1-anterior cerebral artery (above). Intraoperative view showing infra-optic horizontal course of the right A1-anterior cerebral artery segment (below)

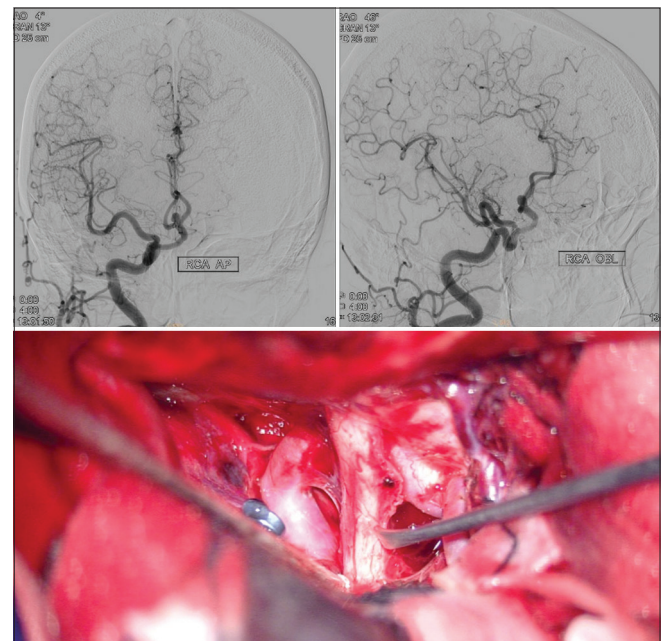


Figure 2: Digital subtraction cerebral angiography, anteroposterior, and oblique view showing low and early bifurcation of right internal carotid artery and a typical horizontal medial course of anomalous right A1-anterior cerebral artery, which turns superiorly almost at right angle to supply both A2-anterior cerebral artery with a single saccular AcomA aneurysm (above). Intraoperative view of the right pterional craniotomy showing infra-optic horizontal course of right A1-anterior cerebral artery segment (below)

aneurysm with associated infra-optic course of A1 ACA can be difficult because the proximal ACA is obscured by the optic nerve and also altered the course of A1-ACA may change the orientation of the AComA complex. The recognition of this anomaly preoperatively is very important in planning surgery for ACA-AComA complex aneurysms. Failure to identify this variant preoperatively could result in unnecessary dissection elsewhere with possible damage to optic nerve, chiasm, and basal frontal lobe during aneurysm surgery. Hence, careful preoperative angiographic evaluation and perfect understanding of variations of the ACA are very essential and important for surgery.

In our cases, with preoperative angiography revealing low bifurcation of ICA, we expected infra-optic course of A1-ACA and was confirmed intraoperatively in both cases.

### Conclusion

Preoperative recognition of this anomaly helps in achieving proximal vascular control with ease, increases the surgeon's confidence and also enhances surgical safety of aneurysm clipping avoiding unnecessary and potentially dangerous dissection elsewhere. In the presence of this anomaly, one should always search for other possible associated intracranial vascular anomalies. Since this variant is commonly associated with intracranial aneurysms and other intracranial vascular anomalies, careful and continued to follow-up of patients with this variant is essential for detection of de novo aneurysms. This also emphasizes the importance of careful preoperative evaluation of DSA before planning for aneurysm surgery.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not

be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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### Conflicts of interest

There are no conflicts of interest.

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