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Case Report

Microsurgical clipping of a ruptured lobulated anterior communicating artery aneurysm arising from a fenestrated complex: a case report

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ABSTRACT

Fenestrations of the anterior communicating artery (ACOM) are uncommon vascular variants that predispose to aneurysm formation due to structural defects and altered hemodynamics. Their association with lobulated, broad-neck aneurysms creates significant diagnostic and surgical challenges. Herein this case reports a case of a 60-year-old woman with hypertension and diabetes presented with World Federation of Neurosurgical Societies grade IV subarachnoid hemorrhage. Digital subtraction angiography revealed a lobulated aneurysm with a broad neck (4.8 mm) arising from the superior limb of a fenestrated ACOM complex. Emergency left pterional craniotomy was performed. Sequential clipping was employed: a 9 mm straight clip remodeled the aneurysmal neck and secured a perforator, followed by a 4-mm fenestrated clip across the neck for complete obliteration. Indocyanine green angiography confirmed aneurysm exclusion with preservation of parent vessels and perforators. Postoperatively, the patient showed modest neurological improvement but succumbed on day 19 due to ventilator-associated pneumonia and comorbidities. Fenestrated, lobulated ACOM aneurysms are technically demanding. Tailored clip strategies, careful preservation of perforators, and intraoperative angiography are crucial for safe and effective microsurgical management.

Keywords: Fenestrations of the anterior communicating artery, Digital subtraction angiography, Aneurysm

INTRODUCTION

Aneurysms of the anterior communicating artery (ACOM) complex represent the most common site among intracranial aneurysms and account for almost one third of all cases.[1] The embryologic origin and complex hemodynamics of this region predispose these aneurysms to rupture and challenging morphology. One notable anatomical variant within this territory is the fenestration of the ACOM complex. Fenestrations—defined as duplicated channels of the artery that diverge and reunite—have been reported in up to 3–7% in angiographic series and as high as 21–40% in cadaveric autopsy studies, depending on methodology.[2-4] The presence of fenestration is clinically relevant because it may increase the risk of aneurysm formation, due to inherent structural defects in the tunica media at the entry and exit of the fenestrated channels, and altered hemodynamic shear stress at the branching/fenestration site.[5-7]

In contemporary neurovascular practice, endovascular treatment (coiling, stent assisted techniques, flow diversion) has become standard for many intracranial aneurysms. However, when confronted with broad necked, lobulated aneurysms with complex orientation—particularly in the setting of anomalous vascular anatomy—microsurgical clipping retains a key role. Microsurgical approaches provide direct visualization of critical perforating arteries, fenestrated limbs, and real time angiographic confirmation of parent vessel and branch patency.[8]

The present report describes a rare and technically demanding case of a ruptured lobulated aneurysm arising from a fenestrated ACOM complex managed with staged

microsurgical clipping, underscoring the importance of detailed anatomical planning and intraoperative adjuncts in such scenarios.

CASE REPORT

A 60-year-old woman with a history of hypertension and type 2 diabetes mellitus presented to the emergency department with sudden onset of a severe headache, associated with vomiting and giddiness, followed by collapse. On arrival she was drowsy, with a Glasgow coma scale (GCS) score of E2V3M4. Shortly thereafter she experienced a devastating rebleed, and her condition deteriorated to E1VtM1 requiring intubation and ventilatory support.

Non contrast computed tomography (CT) of the brain revealed diffuse subarachnoid hemorrhage (SAH) (Figure 1), with blood predominating in the interhemispheric fissure and suprasellar cisterns consistent with a high-grade rupture pattern.

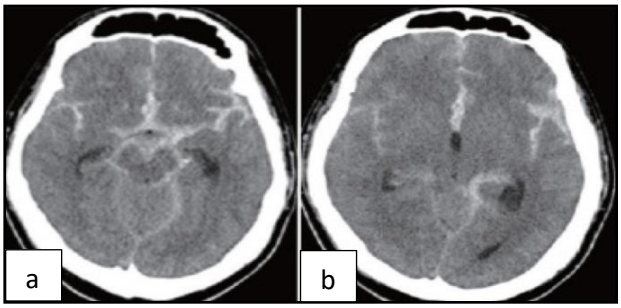

Figure 1 (a and b): Non-contrast CT brain revealed SAH.

Digital subtraction angiography (DSA) was performed emergently. Angiographic study revealed a fenestrated ACOM complex: two discrete parallel limbs of the ACOM reunited distally, forming the classic "fenestration" morphology. From the superior limb of the fenestrated complex arose a lobulated aneurysm with a broad neck measuring approximately 4.8 mm, its dome projecting superiorly and somewhat posteriorly in close proximity to hypothalamic perforating vessels. The inferior limb of the fenestration exhibited atherosclerotic plaque near its junction with the contralateral A2 segment, raising concerns about vessel fragility and branching anatomy (Figure 2).

Given the patient's poor clinical grade, the risk of re hemorrhage, and the complex morphology of the aneurysm—with broad neck, lobulation, fenestration, and associated plaque—the decision was made for an urgent left pterional craniotomy and microsurgical clipping of the aneurysm.

Intraoperatively, following standard left pterional exposure, the frontal lobe was gently retracted and the rectus gyrus partially mobilized. The fenestrated ACOM limbs were clearly identified; the superior limb giving rise to the aneurysm dome and the inferior limb bearing the atherosclerotic plaque. Multiple perforating arteries to the hypothalamus and subcallosal region were seen emanating adjacent to the aneurysm neck.

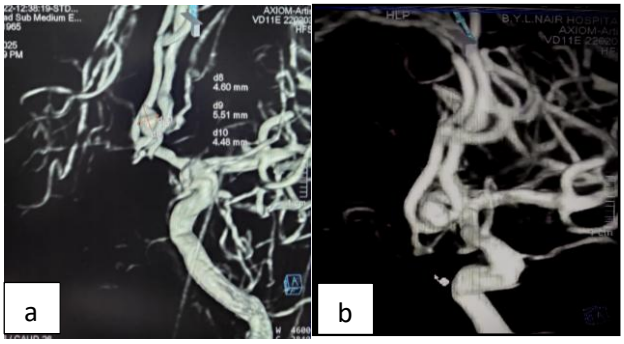

Figure 2 (a and b): DSA.

The aneurysm itself appeared flame shaped, with a fragile, thin dome and a small bleeding nipple. Because of the fragility and complexity of the anatomy, a staged clipping technique was used: first, a straight 9 mm clip was applied across the neck to remodel the broad neck and safeguard a key perforator. After confirming flow and vessel patency, a second 4 mm fenestrated clip was applied across the remodeled neck to achieve definitive exclusion. Intraoperative indocyanine green (ICG) angiography was used to confirm complete aneurysm obliteration and preservation of both A2 segments and all perforators (Figure 3).

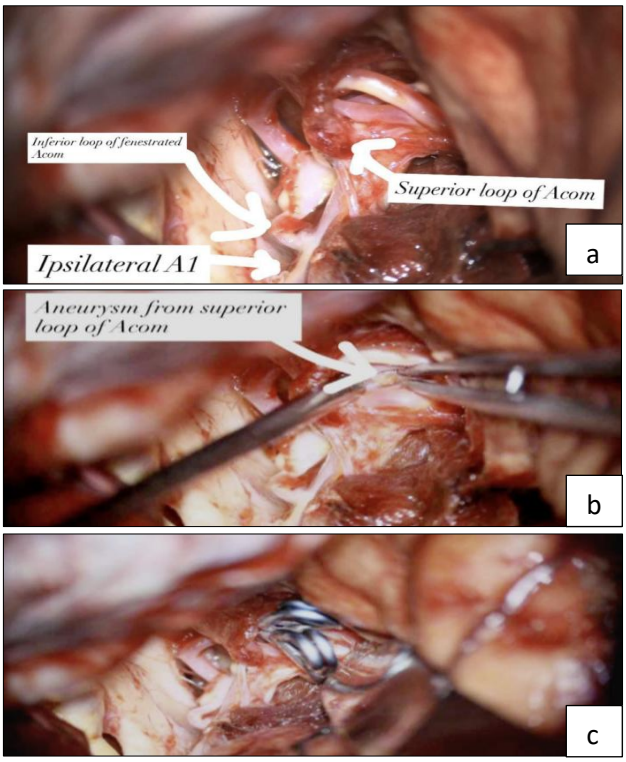

Figure 3 (a-c): Intraoperative images.

Post operatively, the patient remained in the intensive care unit on ventilatory support (Figure 4). In the early phase she showed some neurological improvement: she opened her eyes to pain and localized to pain (GCS E2M5Vt). Unfortunately, her postoperative course was complicated by ventilator associated pneumonia, systemic comorbidities, and persistent poor neurological status.

She ultimately passed away on postoperative day 19 due to multisystem complications related to her poor initial grade and comorbidities.

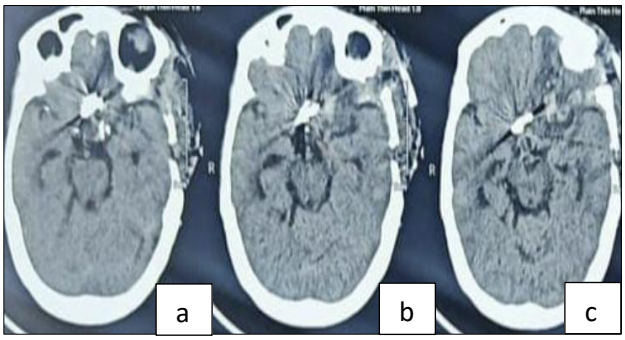

Figure 4 (a-c): Post-operative radiographic images.

DISCUSSION

The presence of fenestration in the ACOM complex introduces additional challenges in the pathogenesis and management of aneurysms. As reported by fenestrations of the anterior communicating artery: incidence on 3D angiography and relationship to aneurysms, fenestrations of the ACOM were identified on 3D rotational angiography in about 5.3% of datasets in patients with anterior circulation aneurysms, and within that subset, 83% of the fenestrations were associated with one or more ACOM aneurysms.[9]

The significantly higher association of fenestration with aneurysms as compared to other locations supports the concept of fenestration as a morphological risk factor. Another study investigating morphological risk factors for ACOM aneurysm rupture found that fenestration of the ACOM had an odds ratio of 4.135 for rupture (p=0.026) among 255 treated patients, along with factors such as dome orientation, blebs, high aspect ratio and size >7 mm.[10]

The mechanistic basis for aneurysm formation in fenestrated vessels likely involves multiple factors: the arterial duplication results in two channels sharing a common advential sheath but often divergent tunica media and elastic layers; the proximal and distal end points of the fenestration may carry structural weaknesses in the vessel wall; altered flow turbulence and shear stress at the fenestration interface may promote wall degeneration and aneurysm initiation.[5,7] Additionally, the presence of atherosclerotic plaque (as in the inferior limb in our case) may further compromise vessel integrity adjacent to the fenestrated anatomy.

From a therapeutic standpoint, aneurysms arising in fenestrated ACOM complexes demand heightened surgical awareness. First, accurate preoperative imaging and three-dimensional angiographic reconstructions are essential to identify the fenestration, limbs, perforators and associated plaques. Missed recognition of fenestration may lead to incomplete clipping or inadvertent occlusion of a limb, potentially compromising perforators supplying deep hypothalamic and frontal lobe structures. For example, the report by microsurgically critical anomaly of the anterior communicating artery complex during the pterional approach to a ruptured aneurysm: double fenestration, described a double fenestration of the proximal A2 segments, where the bridging artery was mistaken for an aneurysm neck.[11]

Second, morphological features such as broad neck, lobulated dome, plaque involvement and complex orientation (as in our patient) may render endovascular management less reliable. Indeed, a recent matched comparative study between microsurgical clipping and endovascular treatment for ACOM aneurysms showed that while clipping offered higher rates of complete occlusion (p=0.007), it also carried a higher rate of ischemic complications; nevertheless, clinical outcomes at follow up were comparable between the two modalities.[12]

In the context of fenestrated ACOM anatomy, the ability to directly visualize and preserve fenestrated limbs and perforators makes microsurgical clipping a preferred strategy, especially in ruptured settings with complex anatomy.

Our case required staged clipping—a methodical two step approach—to ensure neck remodeling and perforator protection. The utilization of intraoperative ICG angiography provided real time confirmation of aneurysm obliteration and preservation of critical vessels, which is particularly valuable in complex vascular anatomy.

Despite optimal surgical technique, the patient's poor neurologic grade at presentation (rebleed, GCS E1VtM1), systemic comorbidities and postoperative complications unfortunately resulted in an unfavourable outcome. This underscores a critical clinical lesson: even in expertly managed surgical cases, patient factors (grade, comorbidity, timing) heavily influence prognosis. Early detection of aneurysms in patients with fenestrated ACOM anatomy may offer better opportunities for elective treatment before rupture.

CONCLUSION

In conclusion, the combination of ACOM fenestration, broad necked lobulated aneurysm, and atherosclerotic plaque presented a rare and formidable surgical scenario. The meticulous microsurgical strategy outlined here—

comprehensive anatomical evaluation, staged clipping, intraoperative angiographic confirmation may serve as a blueprint for similar challenging cases.

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