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Case Report

# Discrepancy between Angiography and Operative Findings of Small Side Wall Aneurysms in Atherosclerotic Parent Arteries

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Preoperative evaluation of precise aneurysmal geometry is important for the treatment of intracranial aneurysms. We present two cases of unclippable side wall aneurysms due to their extremely low dome height, which appeared as saccular in the preoperative image because of a comparatively narrow atherosclerotic parent arterial lumen. In both cases, a calcified vessel wall was noted preoperatively. Lack of a definitive neck and abrupt discrepancy between the fragile aneurysmal wall and the atherosclerotic parent arterial wall was confirmed intraoperatively in both cases. This study describes an illustrative mechanism for the finding with emphasis on the importance of its preoperative diagnosis. Intracranial atherosclerosis associated with small side walled aneurysms may lead to overestimation of aneurysm height on preoperative imaging of the intravascular compartment.

**Keywords** Aneurysm, Angiography, Atherosclerosis, Diagnosis

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## INTRODUCTION

Atherosclerotic change in aneurysm and parent artery has been reported as in 10-26.7% of cerebral aneurysm.[4)9)] and is one of the risk factors encountering in aneurysmal surgery. Atherosclerosis in the intracranial artery and in part of the aneurysm result in diminished flexibility of the vessel itself, which not only makes the surgery difficult to perform but can also result in unexpected ischemic complications such as thromboembolism and vessel occlusion.[10)] Clip attempt of severely atherosclerotic lesions often resulted in remnant neck and clip slippage.[10)] Therefore, preoperative identification of the geometry of an aneurysm is important for making adequate surgical planning.

We encountered two cases of unruptured side wall aneurysms, which appeared as saccular aneurysms on angiography but were confirmed following microscopic exploration as very shallow aneurysmal bulge of adventitia with underlying parent artery atherosclerosis. These case presentations describe the cause and predictable factor in discrepancy between angiographic and operative findings of these patients.

## CASE REPORT

### Case 1

A 64-year-old male presented with sudden onset severe headache. Brain computed tomography (CT) showed

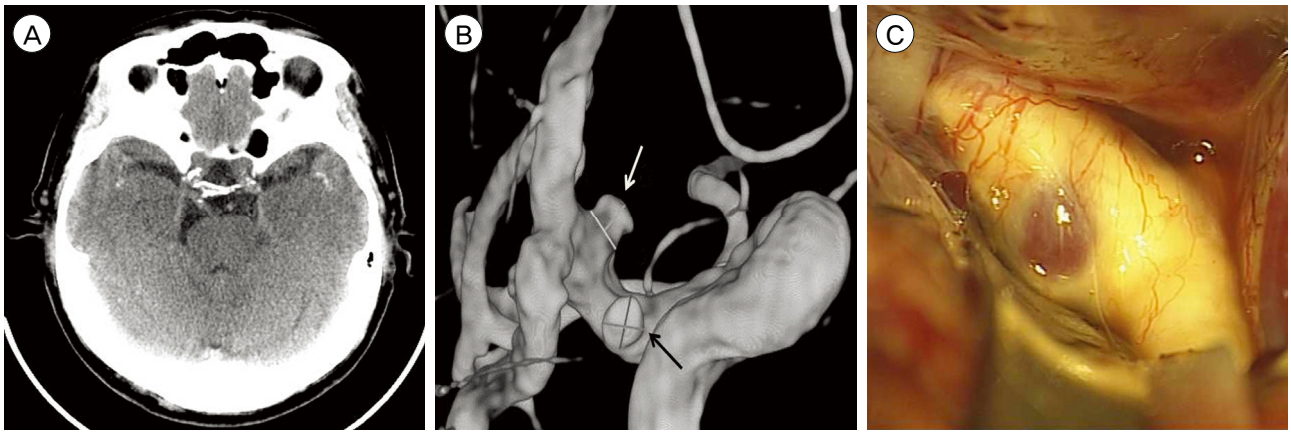


**Fig. 1.** (A) Brain computed tomography of a 64-year-old male presenting with severe headache, shows multiple calcification on the bilateral cavernous internal carotid artery and middle cerebral artery. (B) Three-dimensional angiography reveals 3.5 mm sized saccular aneurysm at the internal carotid artery dorsal side (white arrow) and a 3 mm sized aneurysm at the lateral side (black arrow). (C) In microscopic view, an unruptured aneurysm with very shallow dome height is noticed in the atherosclerotic parent artery.

no hemorrhage (Fig. 1A). Multiple arterial wall calcifications were present on the bilateral cavernous internal carotid artery (ICA) and bilateral middle cerebral artery (MCA). CT angiography and catheter angiography revealed a 3.5 mm sized saccular aneurysm at the ICA dorsal side and a 3 mm sized aneurysm at the lateral side (Fig. 1B). Diffuse atherosclerotic arterial narrowing was also evident in multiple cerebral vessels. Cerebrospinal fluid (CSF) tapping was conducted but contaminated by traumatic lumbar puncture, as CSF red blood cell count > 1000/mm$^3$. Although subarachnoid hemorrhage was not detected on CT, sentinel leak could not be ruled out for his sudden and severe nature of headache. After a discussion with the patient, surgical treatment was attempted for the dorsal ICA aneurysm. Under the general anesthesia, the aneurysm was exposed with a routine pterional approach. Microscopically, the ICA was hard in consistency and yellowish in color with atherosclerosis (Fig. 1C). Neovascularization was noticed along the entire arterial wall. The aneurysm was a small hemispheric bulge with a thin and fragile arterial window in the atherosclerotic ICA, without a saccular component. Direct clipping was impossible due to the lack of a definitive neck and an abrupt discrepancy between the fragile aneurysmal wall and the atherosclerotic parent artery. The aneurysm was treated by wrapping and coating with a muslin gauze and fibrin glue. The patient recovered without any complications.

**Case 2**

A 46-year-old male presented with headache. A brain CT showed no hemorrhage and 3 dimensional angiography showed a saccular aneurysm 5 mm in maximal diameter and 4 mm in height at the M1 segment of the right MCA (Fig. 2A). Considering his young age, surgical clipping was planned with a conventional pterional approach under general anesthesia. Intraoperatively, the aneurysm had a very shallow aneurysmal height and showed a hemispheric appearance without any definitive neck (Fig. 2B). The parent artery was severely atherosclerotic along its entire length. Several other bleb-like thin and reddish arterial windows were evident on the ipsilateral MCA. Direct clipping was not attempted due to the high risk of parent artery compromise. Instead, the lesions were wrapped with muslin gauze and coated with fibrin glue. Postoperative CT showed an asymptomatic minimal subdural hematoma on the contralateral side. Diffuse calcification was observed along the right MCA and anterior cerebral artery (Fig. 2C). The patient made an excellent recovery and remains intact postoperatively.

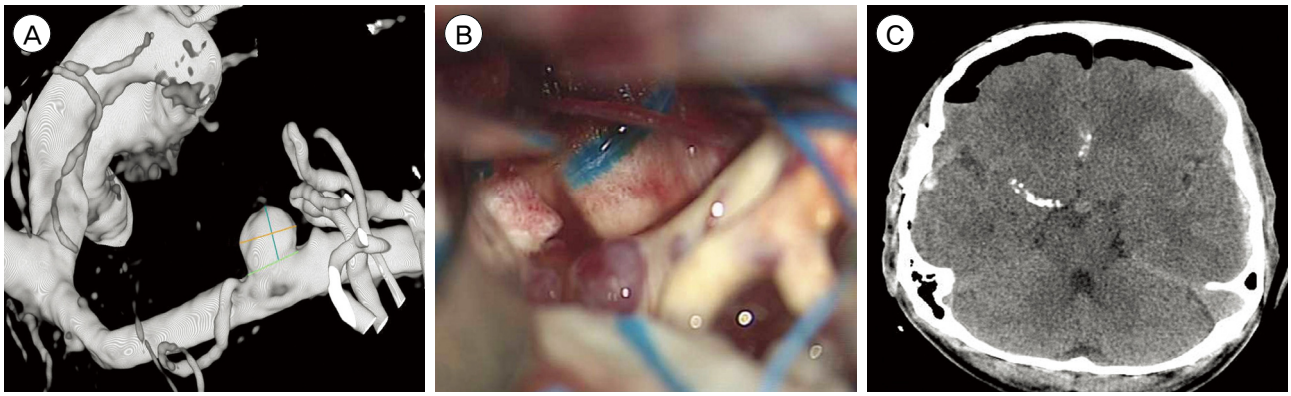


**Fig. 2.** (A) Three-dimensional angiography shows a saccular aneurysm with a 5 mm maximal diameter and 4 mm height at the M1 segment of the right middle cerebral artery (MCA) in a patient with headache. (B) Intraoperatively, the aneurysm has a very shallow aneurysmal height and shows a hemispheric appearance without any definitive neck, in contrast to its initial saccular angiographic finding. The parent artery is severely atherosclerotic along its entire length. Several other hemispheric bulges with thin aneurysmal wall are noted on the ipsilateral MCA. (C) Postoperative computed tomography shows asymptomatic a minimal subdural hematoma on the contralateral side. Diffuse calcification is present along the right middle cerebral and anterior cerebral artery.

## DISCUSSION

In modern era of vascular surgery, advent of diagnostic imaging tool has been attributing to accurate diagnosis and rapid preoperative planning. The diagnostic accuracy of CT angiography has been much improving and sensitivity and specificity of multi-detector CT angiography reported as reaching 95% and 96.2%, respectively, on a per-aneurysm basis.[7] Digital subtraction angiography (DSA) is still remained as gold standard modality for diagnosis of intracranial aneurysm even though some authors suggest that CT angiography selectively replace DSA in patients suspected of having a cerebral aneurysm. However, misdiagnosis of vascular lesions has been reported in CT angiography,[6] magnetic resonance imaging (MRI),[2] and 3-dementional rotational DSA[5] in which surgical explorations revealed true diagnosis. Treatment plan had to be changed intraoperatively in all of these series and even an unnecessary operation was performed in one of those reports.[6] Therefore, meticulous and thorough evaluation of preoperative imaging information seems to be critical.

The reason why the aneurysms with hemispheric appearance in the present case reports looked like saccular aneurysms on preoperative angiography might be due to the parent arterial atherosclerosis at the aneurysmal neck. The atherosclerotic thick arterial wall created the appearance of an angiographic neck of the aneurysm, which actually lacked a definitive neck (Fig. 3). As a consequence, the decreased luminal diameter of the parent artery was attributed to the overestimated dome to neck ratio in angiography compared to the real anatomy. Most of the neuroimaging studies on cerebrovascular structures, including CT angiography, enhanced magnetic resonance angiography and DSA, show an intraluminal anatom-

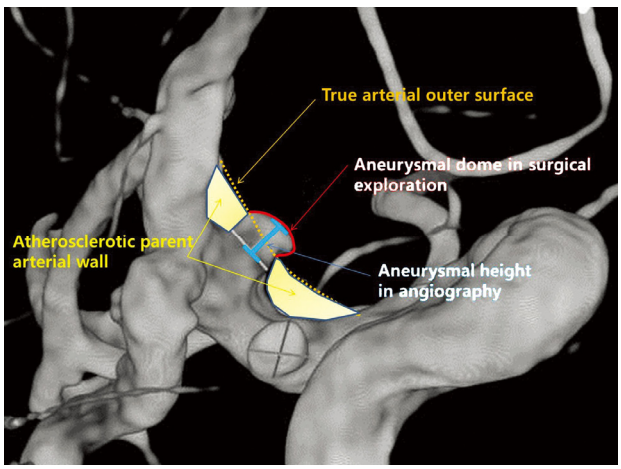


**Fig. 3.** An angiographic saccular aneurysm is confirmed as a blister-like small aneurysm with hemispheric dome on surgical exploration. The discrepancy in the outer and inner walls of the parent artery is due to atherosclerotic plaque, which gave it a higher neck to dome ratio on angiography than its real size.

ic appearance that represents contrast filling. If atherosclerotic arterial narrowing and aneurysmal dilatation are occurring in same anatomic location, the angiographic finding might appear to be different from its original shape, as in the two cases in this report. Therefore, one must remember that vascular images representing intravascular contrast filling do not fully elucidate the vascular anatomy, especially in atherosclerotic vessels. Recently, various techniques for vessel wall imaging including high-resolution MRI have been developed and introduced to depict the morphologies of atherosclerotic plaques and arterial walls beyond the simple luminal changes that can be observed with traditional luminal evaluation.[1)] Although there are limitations in imaging of the intracranial arterial wall because of anatomic variability, tortuous geometry, and much smaller vessel diameters and wall thicknesses compared to extracranial vessel,[1)3)] improved blood suppression with motion-sensitized driven-equilibrium in combination with a contrast-enhanced 3-dimensional fast spin echo sequence enabled visualization of wall enhancement in intracranial aneurysms.[8)] If atherosclerotic change in parent artery or aneurysm were suspected, these advanced vessel wall imaging might be helpful to clarify and understand of regional anatomy in vicinity of aneurysmal wall and may offer insight into the clinical diagnosis and treatment decisions. In our two cases, arterial wall calcifications were evident on parenchymal images on CT. Wall calcification represents advanced atherosclerosis in the involved artery, so this finding might be an important clue for ruling out the discrepancy of intraluminal and extraluminal surgical arterial anatomy in simple and fast way.

## CONCLUSION

Vascular images representing intravascular contrast filling do not fully elucidate the vascular anatomy, especially in atherosclerotic vessels. Aneurysms with a relatively small dome to neck ratio arising from a calcified atherosclerotic parent artery should be cautiously approached due to the possibility of unclippable shallow aneurysm.

**Disclosure**

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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