

Endovascular Repair of a Middle Meningeal Artery Aneurysm after Cranial Surgery

Masanori Suzuki,¹ Shushi Kominami,¹ Kenta Koketsu,¹ Takayuki Mizunari,¹ Shiro Kobayashi,¹ and Akio Morita²

This report describes a case of middle meningeal artery aneurysm caused after cranial surgery. A 55-year-old woman who experienced a ruptured internal carotid artery anterior wall aneurysm was treated by internal carotid artery trapping and high-flow bypass using a radial artery graft. Eight days after surgery, we performed cerebral angiography to confirm patency of the radial artery graft and discovered a middle meningeal artery aneurysm, which was not identified in preoperative angiography. The aneurysm was treated by endovascular embolization using n-butyl cyanoacrylate and complete obliteration was confirmed by angiography. This middle meningeal artery aneurysm was associated with prior surgical procedures, particularly craniotomy or dural tenting sutures. Our study suggests that middle meningeal artery aneurysms can be a rare complication associated with brain surgery. Endovascular embolization using a liquid material may provide an effective and safe treatment for such cases.

Keywords: middle meningeal artery aneurysm, endovascular embolization

Introduction

Middle meningeal artery aneurysms are uncommon. The irrupture can cause various intracranial hemorrhages including epidural hematomas,¹ subdural hematomas,² and intracerebral hemorrhages.^{3,4} For the most part, their etiology is associated with head trauma with skull fracture, while in non-traumatic cases, previous reports have demonstrated etiologies closely associated with primary diseases such as moyamoya disease,⁵ neurofibromatosis,⁶ meningioma,⁷ cavernous hemangioma,⁸ and ipsilateral cerebral vessel occlusion.⁹ Postoperative middle meningeal artery aneurysms have not been reported with a clear angiographic appearance. We present the case of a 55-year-old woman with a middle meningeal artery aneurysm, identified after internal carotid artery trapping with high-flow bypass using a radial artery graft, which was successfully treated by endovascular embolization using n-butyl-cyanoacrylate (NBCA).

¹Department of Neurosurgery, Nippon Medical School Chiba Hokusoh Hospital, Inzai, Chiba

²Department of Neurosurgery, Nippon Medical School Hospital, Tokyo

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Case Report

A 55-year-old woman was admitted to the hospital following the sudden onset of a severe headache and disturbance of consciousness. Brain computed tomography (CT) revealed a diffuse subarachnoid hemorrhage. She was subsequently transferred to our department for surgical treatment. A left internal cerebral angiogram showed an irregularly shaped blood blister-like aneurysm located on the anterior wall of the supraclinoid internal carotid artery at a non-branching site. Based on a diagnosis of ruptured blister-like internal carotid anterior wall aneurysm, we performed internal carotid artery trapping with a superficial temporal artery-middle cerebral artery anastomosis and high-flow bypass using a radial artery graft. Intraoperative findings did not reveal visible dural lacerations or obvious hemorrhage from the middle meningeal artery. After surgery, the patient recovered consciousness without neurological deficits and next day brain CT showed no cerebral infarction or obvious epidural and subdural hematomas. Eight days after surgery, cerebral angiography was performed to ascertain bypass graft patency. At this time, we discovered a middle meningeal artery aneurysm, which was not present during the initial cerebral angiography. We considered this middle meningeal artery aneurysm as a pseudoaneurysm because the left common carotid angiogram revealed late filling of the aneurysmal sac during the arterial phase and stagnation of contrast medium (Fig. 1). Fusion images of three dimensional digital subtraction angiography (3D DSA) of external carotid angiograms with skull demonstrated an aneurysm located near the craniotomy cut edge of the skull and just under a hole drilled for tenting sutures (Fig. 2). We

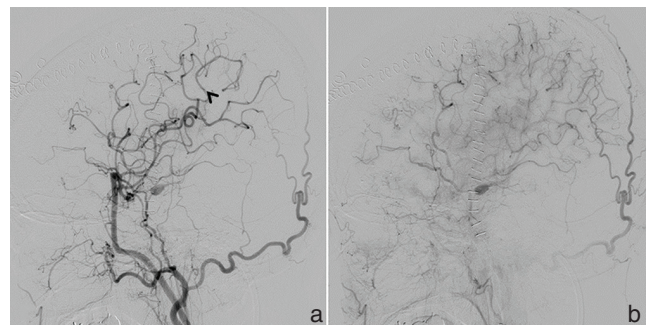


Fig. 1 Postoperative left common carotid angiograms showing late filling of a middle meningeal artery aneurysm (a) and stagnation of contrast medium (b).

performed endovascular embolization using a NBCA-lipiodol mixture 14 days after the second cerebral angiography, because inflammatory condition due to pneumonia was improved. Under local anesthesia, 5 Fr Guider™ guiding catheter (Stryker, Fremont, California, USA) was inserted in the right external carotid artery distal to the bypass vessel connection. Exelsior™ SL-10 micro catheter (Stryker, Fremont, California, USA) was positioned at the distal portion of the squamous branch of the left middle meningeal artery, just proximal to the aneurysm. A 20% NBCA-lipiodol mixture was carefully injected into the aneurysm and the distal and proximal portion of the middle meningeal artery. After the NBCA injection, the middle meningeal artery aneurysm completely disappeared (Fig. 3). The patient was ambulatory and discharged three days after the embolization without complications.

Discussion

In our case, the etiology of the middle meningeal artery aneurysm was closely associated with surgical procedures because it was not identified during preoperative cerebral angiogram. Based on the 3D DSA fusion image of external carotid angiograms with skull, we assumed that dural tenting sutures or craniotomy may have caused this middle meningeal aneurysm. No visible bleeding from the middle meningeal

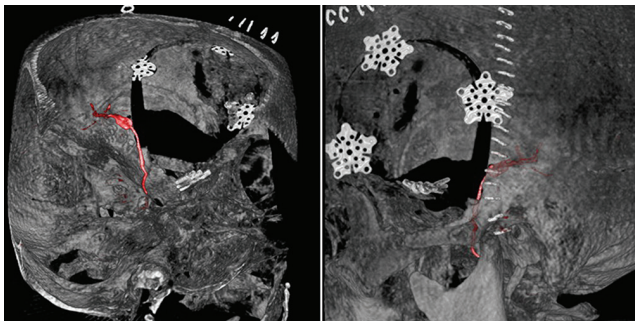


Fig. 2 Fusion image of three dimensional digital subtraction angiography with skull demonstrating an aneurysm (arrow) located near the craniotomy cut edge of the skull and just under a hole drilled for tenting suture.

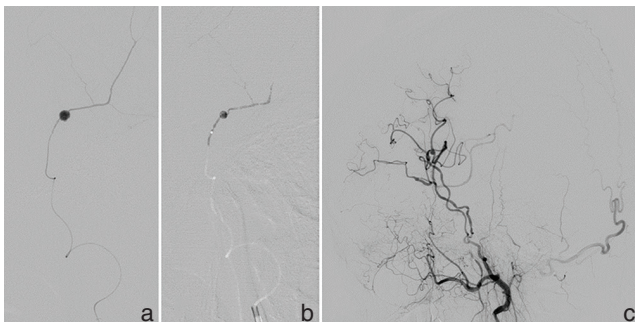


Fig. 3 Supraselective angiograms from a microcatheter in the left middle meningeal artery. a: Lateral view. b: NBCA injection into the aneurysm and the distal and proximal part of the middle meningeal artery. c: Complete disappearance of the middle meningeal artery aneurysm.

artery at the aneurysm site was identified intraoperatively. The next day postoperative brain CT demonstrated no obvious subdural hematoma or epidural hematoma; therefore, we did not consider that the middle meningeal artery had suffered major damage due to the surgical procedures and speculate that a small wall injury of the middle meningeal artery worsened over the week.

Surgical resection by open surgery and endovascular embolization has been reported as appropriate treatment for middle meningeal artery aneurysms.³⁻⁷⁾ In our case, we opted to perform endovascular embolization because repeat surgery after bypass using the superficial temporal artery feeding the scalp may result in poor wound healing. Endovascular treatment carries a risk of vessel injury at the connection of the bypass vessel in the subacute stage after surgery, which can be avoided by careful catheterization. Spontaneous resolution of traumatic middle meningeal artery aneurysms has been reported in a few reports.^{10,11)} Superselective angiography just before NBCA injection showed shrinkage of aneurysm size compared to the postoperative common carotid angiogram; therefore, it might have resolved without intervention. However, patients might be seriously damaged by not only intracranial hemorrhage but also by ischemic events due to low bypass patency caused by a massive hematoma if the aneurysm was to rupture. Therefore, we emphasized the need for endovascular treatment of middle meningeal artery pseudoaneurysms in this case.

We suggest that brain surgery caused these aneurysms even if no visible bleeding was observed from the middle meningeal intraoperatively; therefore, we should carefully evaluate the presence of these aneurysms in postoperative angiography or three-dimensional computed tomographic angiography.

Conclusion

We encountered a middle meningeal artery aneurysm following internal carotid artery trapping using a radial artery graft bypass for a ruptured internal carotid artery anterior wall aneurysm. The middle meningeal artery aneurysm was treated solely by endovascular embolization using NBCA. We propose that endovascular embolization using NBCA for middle meningeal artery aneurysms may provide a safe and effective treatment for patients following surgical procedures. We suggested that patients undergoing intracranial surgical procedures run the potential risk of developing a middle meningeal aneurysm even if there is no obvious dural laceration or active bleeding from the vessel.

Conflicts of Interest Disclosure

The authors declare no conflicts of interest. This report did not receive any funding from the public or from any commercial agencies.

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