*Case Report*

Emergent surgical embolectomy for middle cerebral artery occlusion related to cerebral angiography followed by neck clipping for an unruptured aneurysm in the anterior communicating artery

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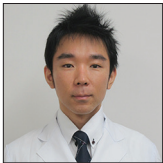
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ABSTRACT

Background: Intracranial embolism related to cerebral angiography is rare but one of the complications of the procedure. However, the standard management of acute intracranial embolism for this etiology has not been established, and there have been very few reports in the past.

Case Description: A 68-year-old male was incidentally found to have an unruptured aneurysm of anterior communicating artery (ACoA). Immediately after the cerebral angiography for the purpose of detailed examination of the aneurysm, the right partial hemiparalysis and mild aphasia developed. Magnetic resonance imaging/angiography (MRI/A) revealed an occlusion in the peripheral part of the left middle cerebral artery (MCA). Due to the existence of magnetic resonance angiography-diffusion mismatch, emergent craniotomy was immediately performed to remove intra-arterial thrombus. We also performed clipping for an unruptured ACoA aneurysm with this approach. Postoperative MRI/A showed that the occluded artery was recanalized and a slight infarction was observed in the left cerebral hemisphere. The patient was discharged on foot and followed at outpatient clinic over 4 years without no neurological deficit.

Conclusion: Emergent surgical embolectomy for distal MCA occlusion related to cerebral angiography followed by neck clipping for an unruptured aneurysm of the ACoA was successful in treating acute occlusion of the peripheral part of the MCA in a patient with an unruptured aneurysm. As there are few similar cases, there is controversy about the best management, but this surgical method can be a safe and effective treatment.

Keywords: Acute ischemic stroke, Cerebral angiography, Embolectomy, Intracranial embolism, Unruptured aneurysm

INTRODUCTION

Recently, new modalities such as three-dimensional (3D) computed tomography angiography (CTA, 3D-CTA) and magnetic resonance imaging/angiography (MRI/A) have emerged instead of digital subtraction angiography (DSA) for diagnostic studies of patients with cerebral aneurysms or intracranial vascular lesions.[12] However, when treating complicated aneurysms

or vascular malformations, confirming detailed vascular structures, including perforators or small feeders, in advance are often necessary. DSA is useful in terms of its resolution; however, it is invasive and causes neurological complications in approximately 1% of cases.[5,9] Herein, we report a case of a neurological complication related to DSA for preoperative examination of an anterior communicating artery (ACoA) aneurysm. In this case, emergent surgical embolectomy was performed to remove the embolus followed by clipping of an unruptured aneurysm of the ACoA. To the best of our knowledge, there have been no similar reports in the past; however, several aspects about the mechanism of embolisms caused by DSA and the methods for managing their complications remain unclear.

CASE DESCRIPTION

A 68-year-old man with a medical history of hypertension and hyperuricemia was incidentally found to have unruptured aneurysms of the ACoA and right internal carotid artery (ICA) – posterior communicating artery (PCoA) bifurcation. His head computed tomography (CT) and MRI/A showed no abnormal findings except for the aneurysms. The ACoA aneurysm had a maximum diameter of 7 mm [Figure 1a]. Because the aneurysm was protruding upward, located over 10 mm above the frontal base [Figure 1b and c], we planned to clip the ACoA aneurysm through an interhemispheric approach. DSA was performed for closer investigation of the aneurysm, including the perforators and bridging veins. Immediately after the procedures, slight right hemiparesis and aphasia appeared, and his National Institutes of Health Stroke Scale (NIHSS) score was 4 points. MRI/A was performed 10 min after the onset, and magnetic resonance angiography (MRA) revealed left M3 occlusion, which was patent on 3D-DSA previously [Figure 1d and e]. In addition, diffusion-weighted imaging (DWI) revealed no apparent infarction at that time [Figure 1f]. Because of the presence of MRA-diffusion mismatch, we considered recanalization therapy. The incidence of early complete recanalization in the distal middle cerebral artery (MCA) after intravenous thrombolysis was reported to be not high, at 38%.[26] Because the endovascular team was not available at this time, we decided to perform emergent surgical embolectomy for MCA occlusion as reported previously.[14] We also planned to clip the ACoA aneurysm using a pterional approach when it was possible without difficulty in addition to embolectomy.

Neuroanesthesia was induced, and the patient was placed in the supine position. The operation was started 80 min after onset. Motor evoked potentials of the right upper limb were monitored. The left frontotemporal craniotomy was performed, and the Sylvian fissure was opened widely from the distal portion under the operating microscope. The M2 superior trunk was identified, and the M2-3 bifurcation

was obstructed by an embolus [Figure 2a]. Arteriotomy was performed, and the embolus was removed [Figure 2b]. However, M3 was still occluded. There was also an embolus at the distal M3, and it was removed in the same manner [Figure 2c]. The embolus was white and slightly soft. After suturing the site of arteriotomy, recanalization of the MCA was confirmed by microvascular Doppler. Recanalization was performed 150 min after onset and 70 min after the start of surgery. Subsequently, the Sylvian fissure was widely opened to expose M1, ICA, and A1. The interhemispheric fissure was widely opened from the base, and the ACoA complex and the aneurysm were confirmed [Figure 2d]. Bilateral A1s were temporarily blocked, and the aneurysm was detached from the surrounding structures. After confirming that there were no perforators, a straight clip was applied to the aneurysm and reinforced with a bayonet clip [Figure 2e and f]. We confirmed that the blood flow on both sides of A2 was maintained by a Doppler flowmeter, and the operation was completed. No significant change in neuromonitoring was observed throughout the procedures [Video 1].

Postoperative course

The postoperative course was good. Postoperative MRA revealed recanalization of the occluded MCA and DWI demonstrated a small infarction of the left frontal lobe and insula [Figure 3]. The NIHSS score after a week was 1 point. Pathological investigation revealed that the embolus was a fresh thrombus containing a very small amount of red blood cells, and no vascular wall component was identified. The patient underwent rehabilitation for mild aphasia and was discharged home on foot with a modified Rankin scale score of 1. The unruptured aneurysm of the right ICA was treated at a later date. The patient has been followed at an outpatient clinic over 4 years, and he is doing well with no symptoms and no signs of stroke.

DISCUSSION

Etiology of cerebral infarction related to DSA

DSA is used to examine and treat many types of cerebrovascular diseases.[15] In recent years, noninvasive examinations such as CTA or MRA have shown a rise in place of this procedure. It has been reported that CTA is useful, instead of DSA, in diagnosing and determining treatment plans for patients with ruptured and unruptured cerebral aneurysms.[12] However, DSA is considered suitable for a more detailed evaluation in terms of resolution, such as for the detection of small perforators near the aneurysm.[11]

DSA may cause various complications, although infrequently. The frequency of neurological complications is about 1–3%, which is decreasing every year, and most of them are transient.[3,4,9,16,29] Factors that tend to cause neurological
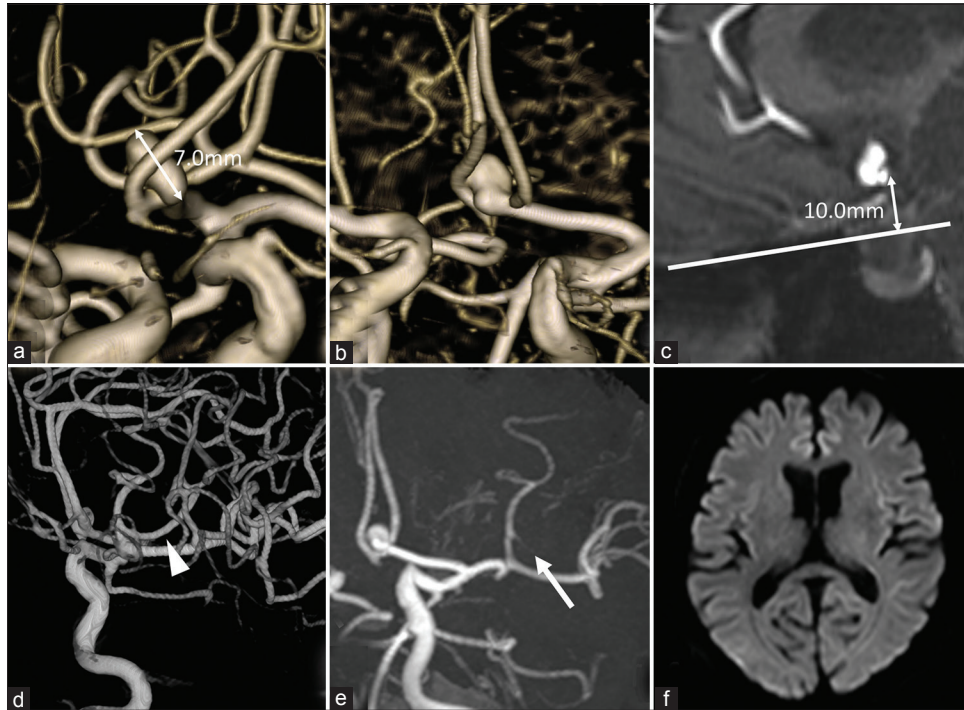
Figure 1: Preoperative imaging. (a-c) Magnetic resonance angiography (MRA) showed an unruptured aneurysm of anterior communicating artery, 7 mm in maximum diameter (a), which was protruding upward (b) and located over 10 mm above the frontal base (c). (d and e) M3 portion of middle cerebral artery was occluded in MRA (e, arrow) performed just after the three-dimensional digital subtraction angiography (3D-DSA), which was patent in 3D-DSA (d, arrowhead). (f) No cerebral infarction in diffusion-weighted imaging.
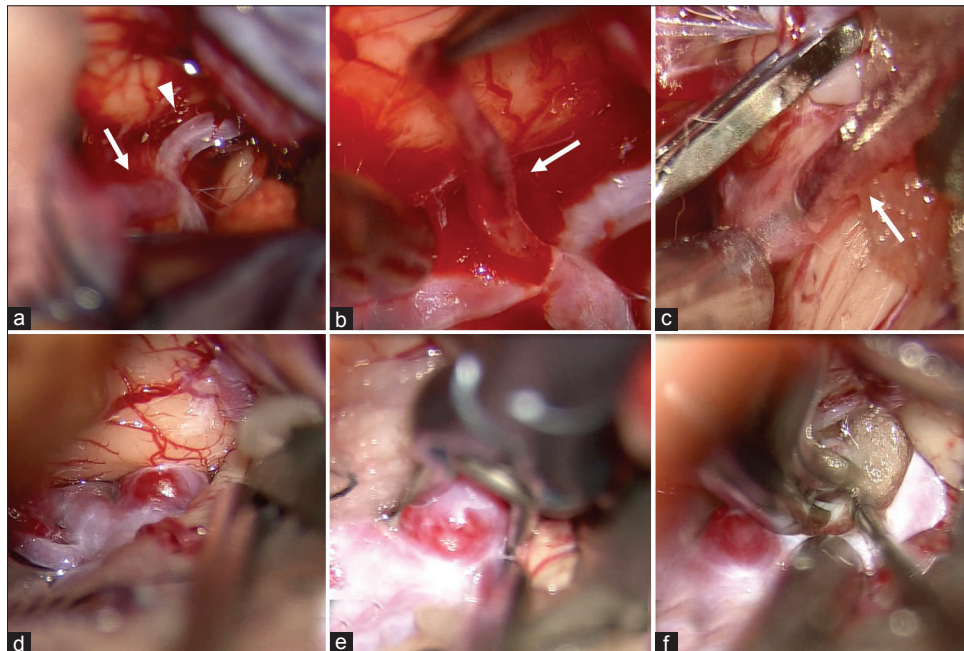
Figure 2: Intraoperative photographs. (a) Intra-arterial embolus at M2-3 bifurcation (arrow: M2, arrowhead: M3) of the middle cerebral artery. (b) White color clot (arrow) was removed from the artery and blood flow spouted due to recanalization of occluded vessel. (c) Thrombus (arrow) at the distal M3 was also removed. (d) Anterior communicating artery complex and the aneurysm. (e) Clipping the aneurysm with straight clip. (f) Final view.
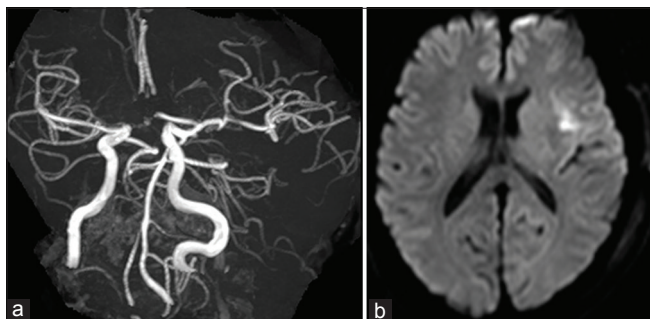
Figure 3: Postoperative imaging. (a) Magnetic resonance angiography showed recanalization of the distal part of the middle cerebral artery. (b) Diffusion-weighted imaging showed a small infarction of the left frontal lobe and insula.

complications include age over 55 years,[29] the presence of atherosclerotic cardiovascular disease,[16,29] fluoroscopy time >10 min,[29] and an indication of subarachnoid hemorrhage.[16]

Multiple mechanisms of neurological complications during DSA have been proposed, which include thrombosis from the catheter and guide wire,[6,29] disruption of an atherosclerotic plaque by the catheter or guide wire, platelet activation,[7] and effects of contrast agents on the vascular endothelium.[18]

As far as we know, there have been no previous reports on removing an embolus related to DSA. Macroscopically, the embolus was white and soft; pathologically, it was a fresh thrombus containing a very small amount of red blood cells, without any vascular wall component, and was classified as fibrin-dominant clots.[19] There was no apparent stenosis in the cervical carotid artery on the MRA. In addition, arrhythmia causing cerebral infarction, such as atrial fibrillation, was not found on detailed examination by Holter electrocardiography performed at a later date. Comprehensively, it was considered that this embolism was caused either by the plaque on the aortic arch, possibly due to scraping of the wall of the aortic arch thrombus by the catheter, or by the thrombus drawn into the catheter. We believe that this finding is useful in clarifying the mechanism of embolic events and preventing neurological complications during DSA.

Treatment of acute cerebral embolism

The rate of poor outcomes in patients with distal MCA occlusion is reported to be as high as 47.4%, and the rate tends to be higher (64.7%) for a left side occlusion.[10] The recanalization rate for therapy with recombinant tissue plasminogen activator for M2 or distal occlusion is 38%.[26] In addition, there are limited reports on the management of patients with acute cerebral infarction as a complication of arterial catheter intervention including neuroendovascular and cardiac examination

or treatment. Although the effectiveness of intra-arterial thrombolysis has been reported,[2,24] the rate of complete recanalization is 50–72%. With improvements in various devices, recanalization therapy by intravascular treatment for acute intracranial main artery occlusion has recently emerged. On the basis of the results of multiple randomized controlled trials, emergent percutaneous mechanical thrombectomy is strongly recommended if the following criteria are met: prestroke mRS score of 0–1, causative occlusion of ICA or MCA segment 1, age ≥18 years, NIHSS score ≥6, and Alberta stroke program early CT score ≥6; treatment can be initiated within 6 h of symptom onset.[23] However, the safety of mechanical thrombectomy for intracranial occlusion beyond M2, as in this case, is still debatable.[8] Thrombolysis in cerebral infarction (TICI) 2b or TICI 3 is considered a successful reperfusion, and about 85% of the obstructions beyond M2 meet the above criteria.[21] In contrast, TICI 3 recanalization was about 38–55%, which is not high.[8,21] At our institution, we have conducted surgical embolectomy for vascular occlusion of the anterior circulation because of the current unavailability of an endovascular team, which achieved favorable outcomes.[14,17] In particular, the existence of MRA-DWI mismatch is a good indication. The rate of TICI 3 recanalization for M2 occlusion was high at 86%, and the median recanalization time was 54 min.[14] In addition, another study with a larger number of cases reported a recanalization rate of 96.2% and a symptomatic hemorrhagic complication rate of 3.2%.[13] In addition, 39 patients with M2 or more distal MCA occlusion were included in the study, and they achieved a recanalization rate of 100%. Although endovascular thrombectomy is currently the main treatment for M2 occlusions,[1,8,20,25] surgical embolectomy can be a safe and effective procedure and may be an alternative treatment in some patients. The patient in the case report had a hyperacute M2 obstruction with MRA-diffusion mismatch, which was considered a good indication for surgical embolectomy in the absence of endovascular team. Moreover, the embolus was located at the M2-3 bifurcation and M3 trunk and the size of the clot was large. Thus, the treatment strategy was safe and effective in this case. As a result, postoperative TICI 3 recanalization was obtained and infarction on DWI was minimal.

Clipping for the unruptured aneurysm of ACoA

As ACoA aneurysms have a higher rate of rupture than aneurysms in other parts,[28] therapeutic intervention for the prevention of rupture is often required. As for clipping by craniotomy, pterional approach and interhemispheric approach are described. The pterional approach is the most popular except when the position of the aneurysm is significantly high from the anterior skull base.[27] When

choosing the pterional approach, the approach from the right (the nondominant hemisphere) has been recommended.[30] However, to perform safe clipping, it is necessary to select a method through which the neck of the aneurysm, A1, A2, and surrounding perforators can be visually recognized.[22] In this case, the approach from the left was suitable to secure dominant A1 before reaching the ACoA complex and confirm important structures around the ACoA complex because the left side of A1 was dominant and A2 on the left was just behind A2 on the right. However, the ACoA aneurysm had a maximum diameter of 7 mm, was protruding upward, and was located at a moderately high position, 10 mm from the anterior skull base; thus, we intended to clip it through an interhemispheric approach.

In this case, the left MCA occlusion occurred, and surgical embolectomy was performed. We opened the Sylvian fissure widely from the distal portion identify the occluded M2-3 portion. We also split the interhemispheric fissure widely from the base to identify the neck of the aneurysm, A1, and bilateral A2 without strong retraction of the frontal lobe. As a result, the ACoA complex was clearly confirmed, and clipping was performed safely through the left pterional approach, although the aneurysm was located at a relatively high position.

Limitations

The limitation of this study is that an endovascular team was not available in our hospital or region while treating this case. If an endovascular team had been available, we would have considered endovascular thrombectomy as the first option.

CONCLUSION

Emergent surgical embolectomy for MCA occlusion related to DSA followed by neck clipping for an unruptured aneurysm of the ACoA was successful in treating acute occlusion of the peripheral part of the MCA in a patient with an unruptured aneurysm. As there are few similar cases, there is controversy about the best management, but this surgical method can be a safe and effective treatment.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Conflicts of interest

There are no conflicts of interest.

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