

Case Report

Surgical embolectomy for middle cerebral artery occlusion after thrombolytic therapy: A report of two cases

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Received: 20 February 14 Accepted: 22 April 14 Published: 13 June 14

This article may be cited as:Katsuno M, Kawasaki K, Izumi N, Hashimoto M. Surgical embolectomy for middle cerebral artery occlusion after thrombolytic therapy: A report of two cases. *Surg Neurol Int* 2014;5:93.Available FREE in open access from: <http://www.surgicalneurologyint.com/text.asp?2014/5/1/93/134520>

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Abstract

Background: Occlusion of the intracranial main trunk results in a poor functional outcome and a high mortality rate. Accordingly, some revascularization procedures such as intravenous administration of recombinant tissue plasminogen activator (rt-PA), endovascular surgery, or surgical embolectomy in the very acute stage have been attempted.

Case Description: We describe two patients with middle cerebral artery occlusion due to cardiogenic embolism. One patient was subjected to surgical embolectomy shortly after intravenous rt-PA and the other was subjected to same after intra-arterial urokinase. Complete recanalization without new cerebral infarction territory was achieved in both patients.

Conclusion: Based on our experience, we think that surgical embolectomy is an effective and safe procedure and should be attempted when no response to early thrombolytic therapy is obtained.

Key Words: Cerebral infarction, middle cerebral artery, surgical embolectomy

**Access this article
online****Website:**www.surgicalneurologyint.com**DOI:**

10.4103/2152-7806.134520

Quick Response Code:

INTRODUCTION

Early recanalization of an occluded artery leads to better clinical outcomes in patients with acute ischemic stroke through protection of the time-sensitive penumbra. Administration of intravenous recombinant tissue plasminogen activator (IV-rt-PA) within 4.5 h from onset has been the standard treatment for acute ischemic stroke; however, the rate of IV-rt-PA induced revascularization is less than 25%.^[13] On the other hand, intra-arterial administration of urokinase (UK) within 6 h from onset to patients who do not respond to rt-PA has been reported to achieve recanalization in 66% of those patients.^[12] Therefore, endovascular techniques such as mechanical embolus removal

in cerebral ischemia (MERCİ) and endovascular thromboaspiration [the penumbra thromboaspiration system (PS)] have been developed to improve the rate of revascularization to 100%.^[2] Yet, the recanalization rate of surgical embolectomy has also been reported to be more than 90%.^[5,6] Although MERCİ and PS should be performed by endovascular surgeons, in our institute, surgical embolectomy has been adopted instead of endovascular surgery because there is only one neurosurgeon. We describe here two patients with middle cerebral artery (MCA) occlusion who were subjected to surgical embolectomy shortly after thrombolytic therapy and in whom complete recanalization was achieved without new cerebral infarction territory.

CASE REPORT

Case 1

A 70-year-old man presented with left hemiparesis of sudden onset. He was admitted to our hospital after 1.5 h from onset and his National Institute of Health Stroke Scale (NIHSS) score on admission was 17. Magnetic resonance (MR) angiography demonstrated occlusion of the right horizontal segment of MCA (M1) [Figure 1a], but the ischemic lesion was found to affect only part of precentral and central artery territories on diffusion-weighted imaging (DWI) [Figure 1b]. He was diagnosed with cardiogenic embolism because his electrocardiogram showed atrial fibrillation. Although IV-rt-PA (0.6 mg/kg) was started at 2.5 h from onset, NIHSS and recanalization assessed by MR angiography did not improve and the DWI did not change after IV-rt-PA. We speculated the embolus was located from the distal M1 to the proximal M2 because the T2*-weighed gradient echo imagin (GRE) did not show susceptibility vessel sign (SVS) at the insula segment of MCA (M2). Single-photon emission computed tomography (SPECT) demonstrated reduction of the cerebral blood flow in the whole MCA territory [Figure 1c]. There is some possibility that infarction lesions might change to hemorrhagic by recanalization. However, we thought the rapid recanalization may be beneficial for improving the condition of the patient. Consequently, surgical embolectomy was started at 6 h from onset. Under general anesthesia, frontotemporal craniotomy and dissection of the Sylvian fissure were performed. The whole M2 was exposed to confirm the end of the embolus.

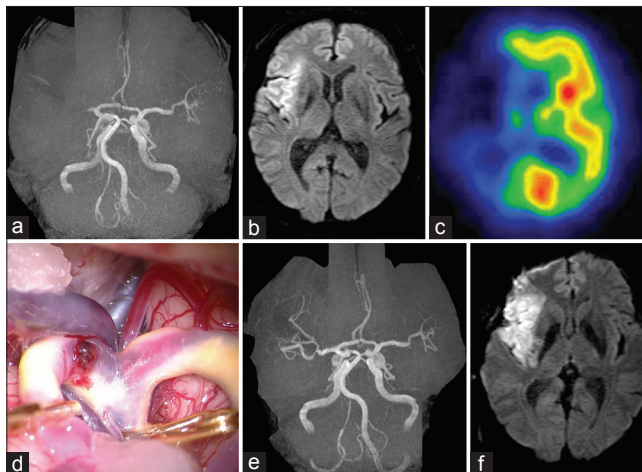


Figure 1: Case 1. (a, b) Preoperative MR angiography and DWI demonstrating right M1 occlusion and cerebral infarction affecting only part of precentral and central artery territories. (c) Preoperative SPECT showing reduction of the cerebral blood flow in the whole MCA territory. (d) Intraoperative photograph showing an embolus being extracted; (arrowhead) the arteriotomy site and embolus. (e, f) Postoperative MR angiography and DWI demonstrating complete recanalization and no additional cerebral infarction

The embolus existed from the distal M1 to the proximal M2 as previously assumed. Transverse arteriotomy of the proximal M2 was performed just distal to the MCA bifurcation and the embolus was removed [Figure 1d]. The artery was repaired with intermittent sutures after confirming anterograde and retrograde flow. Complete recanalization was achieved at 7 h after onset and at 58 min after the start of surgery. Recanalization was confirmed by MR angiography [Figure 1e], and DWI did not show any new ischemic lesion [Figure 1f] and hemorrhagic lesions. Revaxaban was started on postoperative day 1. His left hemiparesis improved, and 2 months after onset, his NIHSS score and modified Rankin Scale (mRS) score were 6 and 2, respectively.

Case 2

A 74-year-old woman with left hemiparesis was transferred to our hospital at 4 h from onset. Her NIHSS score on admission was 11 and electrocardiogram showed atrial fibrillation. MR angiography demonstrated right distal M1 occlusion [Figure 2a]. DWI showed an acute ischemic lesion that extended from the basal ganglia to the corona radiata [Figure 2b] and cerebral perfusion was decreased in the whole MCA territory [Figure 2c]. She was diagnosed with cardiogenic embolism at 5 h from onset. Although intra-arterial urokinase therapy was started at 5.5 h from onset, the embolus that existed from the distal M1 to the proximal M2 on catheter angiography (DSA) did not dissolve. Surgical embolectomy was performed because subsequent studies such as MR imaging and NIHSS did not show any improvement. The surgical procedure was the same as in Case 1 [Figure 2d]. Complete recanalization was achieved at 8 h after onset

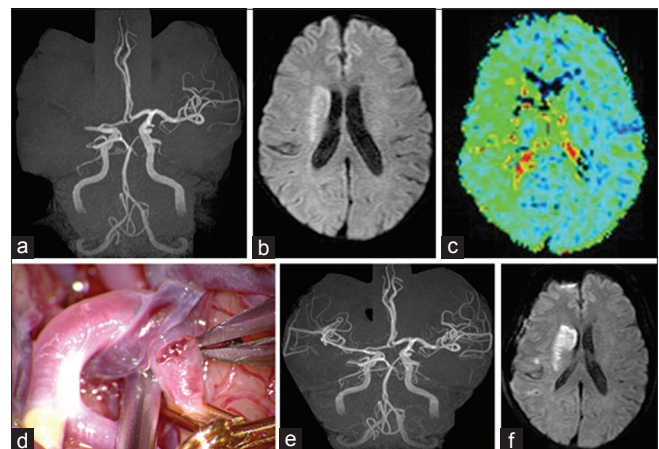


Figure 2: Case 2. (a, b) Preoperative MR angiography and DWI demonstrating right M1 occlusion and cerebral infarction that extended from the basal ganglia to the corona radiata. (c) Preoperative MR perfusion image showing reduction of the cerebral blood flow in the whole MCA territory. (d) Intraoperative photograph showing an embolus being extracted; (arrowhead) the arteriotomy site and embolus. (e, f) Postoperative MR angiography and DWI demonstrating complete recanalization and no additional cerebral infarction

and at 50 min after the start of surgery. Recanalization was confirmed by MR angiography [Figure 2e] and there were no additional ischemic lesions on DWI [Figure 2f] and hemorrhagic lesions. Revaroxaban was started on postoperative day 1. One month after onset, her NIHSS score was 4 and mRS score was 1.

DISCUSSION

Although the efficacy of surgical embolectomy for large vessel occlusion has already been reported by studies involving a small number of patients,^[5,6,7,11] the development of endovascular techniques blocked the spread of surgical embolectomy as a standard technique. However, the rate of complete MCA recanalization after surgical embolectomy was reported to be higher than that after PS combined with intra-arterial thrombolysis or internal carotid artery stenting.^[1,5,6,8] Previous studies indicated that the rate of complete MCA recanalization after surgical embolectomy was 90-100%,^[5,6] while that after endovascular techniques was approximately 50%.^[1,8]

The median time to achieve partial recanalization by PS was reported to be 97 ± 37 min from initial parenchymography.^[8] On the other hand, the median time to achieve complete MCA recanalization by surgical embolectomy was 54-70 min from the start of surgery.^[6] Recent advances in surgical techniques have also made it possible to perform surgical embolectomy promptly and in a short time. Although we performed a usual skin incision and craniotomy as well as a conventional operation, we could reduce the revascularization time by performing accurate manipulations and small transverse arteriotomy without special techniques.

Accordingly, surgical embolectomy might be a more effective procedure than PS from the viewpoint of complete recanalization rate and time. In the present cases, complete recanalization was achieved within 1 h by surgical embolectomy and the outcomes were good, as indicated by the low mRS score.

Nevertheless, the surgeon must pay attention to prevent the occurrence of surgical complications at the arteriotomy site after suturing it and hemorrhagic complications. First, anastomotic leakage or dissection can be prevented by correct intima-to-intima suturing of the vessel wall under high magnification. Second, stenosis can be prevented by transverse arteriotomy and intermittent suture with fine bites. Although some reports of surgical embolectomy have described the usefulness of longitudinal arteriotomy,^[5,11] one report mentioned that longitudinal arteriotomy caused greater stenosis compared with transverse arteriotomy.^[4] In fact, follow-up studies of the present cases did not demonstrate significant stenosis at the arteriotomy site. Third, it is possible to administer a lower dose of IV-rt-PA

before surgical embolectomy. The Japan Alteplase Clinical Trial revealed that in Japanese patients, a lower dose of IV-rt-PA (0.6 mg/kg) for acute ischemic stroke produced outcomes comparable to those obtained with a 0.9 mg/kg dose and that a lower dose of IV-rt-PA could contribute to prevent hemorrhagic complications.^[14] Actually, in Case 1, a lower dose of IV-rt-PA was used and the patient did not present hemorrhagic complications. Recanalization rate and time depend on several factors. Embolus length is an important factor for all revascularization procedures. In the case of surgical embolectomy, it is necessary to use multiple tandem arteriotomies for a long embolus. However, in case of a long embolus that exceeds the operation fields, there is no certainty that it has been completely removed even after multiple tandem arteriotomies. Therefore, the surgeon must evaluate whether its length is within the limits of the operative field through preoperative studies.

The embolus can be directly and rapidly detected on computed tomography scan by the presence of a hyperdense MCA and on T2*-GRE by a hypointense signal. The deoxygenated hemoglobin in red thrombi result in hypointense signals on T2*-GRE. The radiological finding that red thrombi in occluded vessels result in hypointense signals on T2*-GRE is known as GRE SVS.^[3] The SVS on T2*-GRE was recently reported to indicate embolus location and length accurately, similar to DSA findings.^[10] Thus, it is important to detect the embolus length on T2*-GRE before surgical embolectomy.

CONCLUSION

We think surgical embolectomy can be a very effective and safe revascularization procedure when the embolus is not long and when no response to thrombolytic therapy is obtained in the very early stage after onset.

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