CASE REPORT

Re-endovascular recanalization for acute middle cerebral artery reocclusion after surgical embolectomy

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SUMMARY

A 62-year-old woman with atrial fibrillation underwent burr hole trephination for a chronic subdural hematoma. Two days later the patient suddenly presented with motor dysphasia and slightly decreased motor power. Time of flight MR angiography revealed distal M1 occlusion without diffusion restriction. Stent-assisted mechanical thrombectomy was attempted but failed. Post-procedure MRI illustrated a small area of diffusion restriction within the peri-insular and parietal areas. Immediate surgical embolectomy was performed but reocclusion of M1 was documented in the postoperative angiography. Stent-assisted revascularization with a Solitaire stent was conducted and immediate restoration of blood flow was observed. The patient's motor weakness and motor dysphasia recovered fully. Re-endovascular intervention can be beneficial in selected patients for acute middle cerebral artery reocclusion after surgical embolectomy when endovascular thrombectomy fails.

BACKGROUND

Endovascular interventions are typically performed first in the treatment of acute middle cerebral artery (MCA) occlusion refractory to or unsuitable for intravenous recombinant tissue-type plasminogen activator (rtPA) since they are less invasive and time-consuming. A successful revascularization rate of approximately 90% has been reported¹; however, some patients need further treatment for incomplete recanalization. In such cases, surgical embolectomy has been considered.² Although some series have shown a good clinical outcome after embolectomy, the therapeutic strategy for reocclusion after surgery has not been well established.

We report a case of successful re-endovascular treatment for acute MCA reocclusion after microsurgical embolectomy when endovascular thrombectomy had failed.

CASE PRESENTATION

A 62-year-old woman was admitted with a chronic subdural hematoma with a midline shift to the right (figure 1A). Her medical history included hypertension and arterial fibrillation. Aspirin and warfarin were stopped 5 days prior to surgery. Burr hole trephination was conducted. Postoperative CT showed improvement of brain shift with a decrease in the hematoma.

Two days later she suddenly developed mild motor dysphasia with slightly decreased motor power on the right side. An emergency CT revealed no abnormalities. MRI was performed simultaneously to exclude acute cerebral infarction. No diffusion-restricted lesions were noted; however, time of flight MR angiography (figure 1C) revealed distal left M1 occlusion.

INVESTIGATIONS

Cerebral angiography was carried out to assess the MCA occlusion and to determine the treatment plan. Left internal carotid arterial (ICA) angiography showed distal M1 occlusion with some residual blood flow. Leptomeningeal collateral blood flow from the anterior cerebral artery (ACA) to the MCA was observed. Tirofiban (0.6 g; dosage 12.5 mg/50 ml) was infused for 15 min but the occlusion was not recanalized. Subsequent mechanical embolus removal using a Solitaire AB self-expandable stent (ev3, Plymouth, Minnesota, USA) was attempted five

Figure 1 A 62-year-old woman presented with headache. (A) Initial CT showed a chronic subdural hematoma on both sides (left>right). (B) MRI to evaluate neurological changes including motor weakness and motor dysphasia 2 days after the operation showed no remarkable findings. (C) Time of flight MR angiography showed a distal occlusion of the M1 segment of the middle cerebral artery (arrow).

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times but was not successful because navigation of the microcatheter through the embolus failed.

Post-procedure diffusion MRI conducted 3.5 h after development of the ischemic symptom revealed a small area of diffusion restriction on the peri-insular and parietal areas (figure 2D,E). Neurological examination showed grade III/V weakness of the right extremities with marked dysphasia. Surgical embolectomy was attempted because (1) there was a relatively small diffusion-restricted lesion on the MRI with collateral blood flow from ACA to MCA; (2) the occlusion time was 3.5 h; and (3) the M1 occlusion was distal so some of the lenticulostriate arteries could be saved.

TREATMENT

After a sylvian dissection, MCA suspected of having atherosclerosis was revealed. Arterial occlusion between the distal M1 and MCA bifurcation was confirmed with a microdoppler probe (Mizuho, Lowell, Massachusetts, USA). After temporary vessel occlusion, a 4 mm longitudinal arteriotomy was made in the distal M1 segment. Retrieval of a Y-shaped embolus was complete and the artery was sutured with 8/0 polypropylene after heparin irrigation of the lumen of the vessel. Restoration of antegrade blood flow was confirmed by acoustic signal with the microdoppler probe. An immediate postoperative angiogram showed reocclusion of the distal M1 (figure 3B,C). A Solitaire stent was deployed from the distal M1 to the angular branch of M2 and restoration of blood flow was observed (figure 3E,F).

OUTCOME AND FOLLOW-UP

The neurological condition of the patient recovered fully 8 weeks after onset.

DISCUSSION

Intravenous rtPA is recommended for patients within 4.5 h after the onset of stroke symptoms.³ However, the recanalization rate can vary according to the location and characteristics of the clot. In particular, large arterial occlusions including the proximal MCA or distal ICA have a lower successful recanalization rate.^{4 5} In cases that have failed or are unsuitable for administration of intravenous rtPA, an endovascular intervention can be considered. Although endovascular interventions have shown high recanalization rates up to 90.9%,^{1 6} insufficient recanalization can occur, necessitating an additional procedure. Microsurgical embolectomy can be

considered in such cases. Davalos *et al*⁷ reported that clinical-diffusion weighted imaging (DWI) mismatch, which includes an NIH Stroke Scale score of ≥ 8 and a DWI lesion volume < 25 ml, has a higher chance of infarct growth and neurological deterioration in the acute phase of stroke of < 12 h duration. Consequently, patients in such circumstances (including our patient) have been considered to be good candidates for a surgical embolectomy.² For our patient, an NIH Stroke Scale score of 8 and minimal diffusion restriction were observed after the endovascular procedure.

In general, a 6 h time window is the limit for surgical embolectomy under conditions of good collateral flow.^{8–10} With regard to location, M2 occlusion produces a more favorable outcome than M1 occlusion.⁹ An early shift to surgical embolectomy from the endovascular approach can therefore provide a good clinical outcome in patients with persistent MCA occlusion.

In our patient, initial stent-assisted mechanical recanalization and simultaneous microsurgical embolectomy were carried out within 6 h of the onset of stroke symptoms. However, immediate postoperative angiography showed distal M1 reocclusion. We attempted stent deployment, anticipating highly successful microcatheter navigation and instant restoration of blood flow. These expectations were reasonable since the surgical removal of the Y-shaped embolus located in the MCA bifurcation allowed for easy placement of the microcatheter beyond the occlusion site. Successful stent deployment and instant recanalization were evident on follow-up angiography. The estimated time from the first ischemic symptom to restoration of blood flow after reocclusion was 8 h and 24 min. Post-stenting MRI revealed no remarkable change in the diffusion-restricted lesion. This can be explained by the combination of good collateral blood flow and early reperfusion after M1 reocclusion. In addition, the location of the embolus was in the distal M1 so severe infarction of the lenticulostriate artery originating from the proximal M1 occlusion could be avoided.

Concerns remain about the reliability of evaluating the salvage of the penumbra area using diffusion MRI. Park *et al*² described three cases with favorable outcomes using a modified superciliary approach for MCA occlusion within an 8 h time window with a diffusion-perfusion (DWI-PWI) mismatch. Although rapid analysis of measured DWI-PWI mismatch can be achieved,¹¹ the method is not widely available. In addition, the indication for the initiation of endovascular therapy or surgical embolectomy based on DWI-PWI mismatch has not yet been well established.

Figure 2 (A, B) Initial digital subtraction angiography of the left internal carotid artery showed occlusion of the left distal M1 (arrow) segment of the middle cerebral artery (MCA) with some residual flow. Leptomeningeal collateral flow from the anterior cerebral artery to the MCA was observed (arrowheads). (C) Mechanical retrieval with a self-expandable stent was not successful because microcatheter navigation through the embolus failed (arrow). (D, E) Post-procedure MRI showed areas of diffusion restriction on the peri-insular and parietal areas (arrow).

Figure 3 (A) After a sylvian fissure dissection, atherosclerotic change was noted in the distal internal carotid artery (arrowhead) and middle cerebral artery (MCA). Arterial occlusion was observed on the distal M1 close to the bifurcation site (asterisks) with a microdoppler probe. (B, C) Postoperative digital subtraction angiography (DSA) after embolectomy revealed reocclusion of the distal M1 (arrow). (D) Successful placement of the microcatheter beyond the occlusion area (arrow) revealed a patent distal MCA vascular bed. (E, F) DSA after deployment of a self-expandable stent confirmed the restoration of blood flow. (G, H) Diffusion MRI after stent deployment illustrated a restricted lesion (arrow) without any remarkable change compared with that of the pre-embolectomy state. (I) DSA at 6 months showed good blood flow through the stent. Radiopaque markers (arrows) of the stent were well visualized.

Our patient had a small diffusion-restricted lesion with good collateral blood flow. We therefore treated the patient aggressively using endovascular and microsurgical approaches to salvage the penumbra area. Although some physicians prefer antiplatelet medication for reocclusion after embolectomy, it cannot offer instant recanalization. Furthermore, we cannot exclude the possibility of an underlying atherosclerotic plaque when considering an atherosclerotic change of the MCA. In addition, the patient was medicated with aspirin and warfarin before surgery. Therefore, stent deployment could be a more appropriate procedure for our patient.

In conclusion, re-endovascular interventions in selected patients can be beneficial for MCA reocclusion following surgical embolectomy after endovascular thrombectomy fails.

Learning points

- Re-endovascular intervention can be beneficial for middle cerebral artery reocclusion following surgical embolectomy after failed endovascular thrombectomy in selected patients.

Contributors JSJ wrote the manuscript and reviewed the medical records. SHS and HCK revised the manuscript.

Competing interests None.

Patient consent Obtained.

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