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Case Report

Thrombectomy with Soutenir for acute ischemic stroke patients unresponsive to intravenous recombinant tissue plasminogen activator

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●Abstract●

Purpose: We report two cases of acute ischemic stroke patients treated by additional thrombectomy using a basket-shaped microsnare (Soutenir) after infusion of intravenous recombinant tissue plasminogen activator (rtPA). Successful recanalization and good prognosis were achieved in both cases.

Case 1: A 67-year-old man presented with left hemiplegia and agnosia. After completion of the intravenous rtPA infusion, he continued to show severe neurological deficit. Angiography revealed occlusion of the posterior trunk and a branch of the anterior trunk of the right middle cerebral artery (MCA). The two occluded arteries were successfully recanalized by removing the clot with Soutenir, resulting in neurological improvement.

Case 2: A 49-year-old man presented with right hemiplegia and aphasia. After completion of the intravenous rtPA infusion, he continued to show severe neurological deficit. Angiography revealed occlusion of the left MCA at the proximal M1 segment. The occluded artery was successfully recanalized by removing the clot in the manner described above, resulting in neurological improvement.

Conclusion: To our knowledge, this is the first report describing patients treated by additional thrombectomy using a Soutenir after failed intravenous infusion of rtPA. This procedure is a therapeutic option for selected acute ischemic stroke patients who are unresponsive to intravenous rtPA.

●Key Words●

acute ischemic stroke, endovascular treatment, recombinant tissue plasminogen activator, Soutenir, thrombectomy

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Introduction

Intravenous (IV) administration of recombinant tissue plasminogen activator (rtPA) within 3 hours of symptom onset in patients with acute ischemic stroke has been proven to be an effective treatment[10]. However, IV rtPA alone is occasionally insufficient to treat severe neurological deficit due to persistent major vascular occlusion[1,6,8,14]. Since early recanalization is directly correlated with functional recovery and the rate of recanalization of major arterial occlusion with IV rtPA is low[7,8,13], an additional neuroendovascular approach would be a reasonable alternative for patients unresponsive to IV rtPA. In our hospital, three-dimensional computed tomography (CT) angiography is obtained before or during IV rtPA. For patients with major arterial occlusion who show no remarkable improvement of the neurological deficits after IV rtPA, we aggressively perform additional neuroendovascular treatment. Soutenir (Solution, Yokohama) is a basket-shaped microsnare which can be used to retrieve a thrombus (**Fig. 1**). Here, we report two cases of acute ischemic stroke patients who were unresponsive to rtPA and were successfully treated by thrombectomy using Soutenir.

Case 1

A 67-year-old man presented with left hemiplegia and agnosia. Since CT did not reveal any definite abnormality corresponding to the symptoms (**Fig. 2A**), IV rtPA was initiated at 110 minutes after symptom onset. The National Institutes of Health Stroke Scale (NIHSS) score at the time of infusion was 22. Although the neurological deficit slightly improved after the completion of rtPA infusion, severe hemiplegia persisted (NIHSS score; 11). Informed consent for thrombectomy was obtained from the patient's family members. The femoral artery was punctured using the

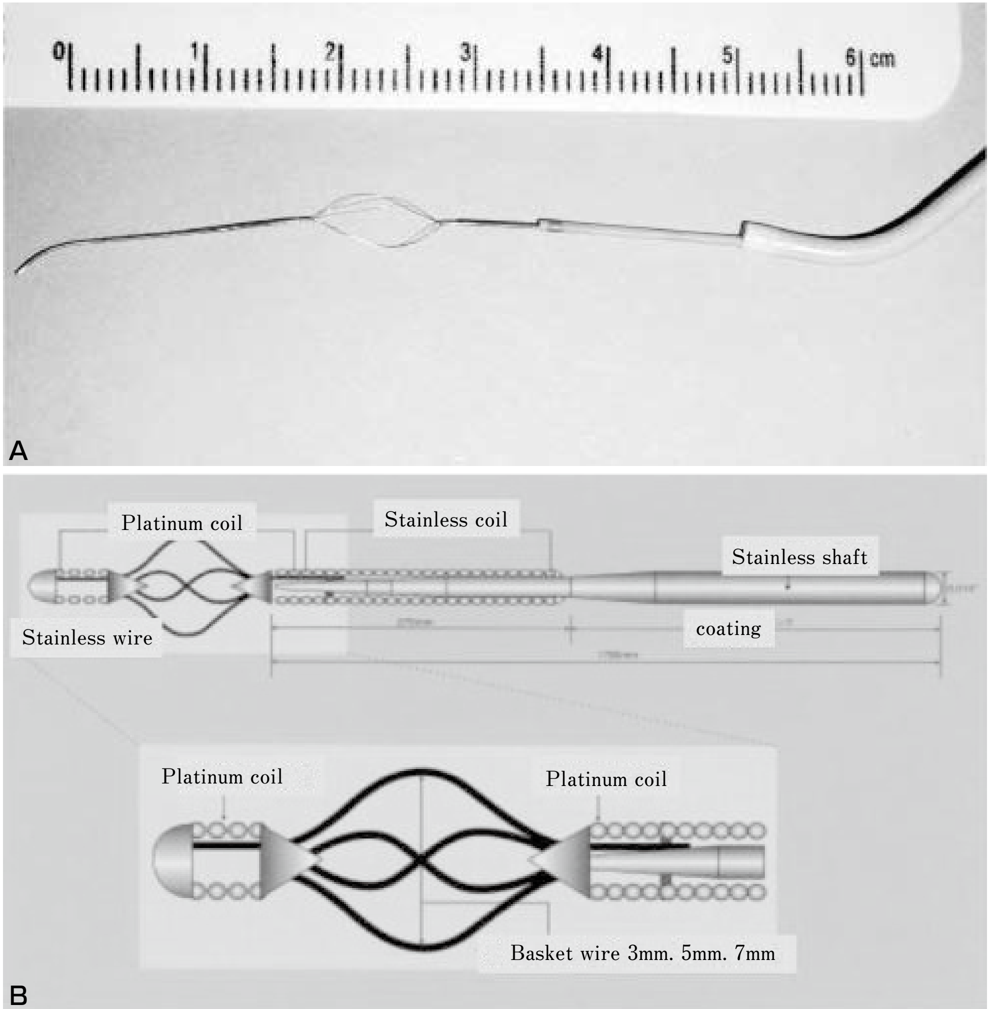

Fig. 1 Macroscopic appearance and schema of Soutenir
A: Soutenir is deployed through a microcatheter.
B: Schematic drawing of Soutenir. The basket consists of 4 microwires.

Seldinger single-wall puncture technique at 190 minutes after symptom onset, and a 6 Fr sheath was set in place. A 6 Fr guiding catheter (Envoy; Cordis, Miami, FL, USA) was placed in the right internal carotid artery (ICA). Right internal carotid angiogram disclosed occlusion of the posterior trunk and a branch of the anterior trunk of the right middle cerebral artery (MCA) (**Fig. 2B**). A microcatheter (Excelsior, Boston Scientific, Natick, MA, USA) and 0.016-inch microguidewire (GT wire, Terumo, Tokyo) were gently navigated through the MCA until they were distal to the occlusion of the posterior trunk. The microguidewire was then replaced with a Soutenir (diameter, 3 mm) and the microcatheter was pulled back just proximal to the clot to open the Soutenir basket. Then, mechanical clot disruption and removal were applied as shown in **Fig. 3**. When the operator felt any resistance while pulling back the Soutenir, the whole assembly of the microsnare and microcatheter was withdrawn as a unit through the guiding catheter (**Fig. 3F**), assuming that the clot was sandwiched between the Soutenir and microcatheter. The occluded posterior trunk was successfully recanalized, and the occluded branch of the anterior trunk was recanalized in the same manner (**Fig. 2C**). Although the flow of the central artery was stagnated there was good collateral circulation via other cortical arteries and the stagnated vessel was too small and too distal for thrombectomy. We finished the procedure 241 minutes after the symptom onset, and finally achieved a Thrombolysis in Myocardial Infarction (TIMI) grade Ⅲ flow (**Fig. 2D**). The retrieved clot was found at the Soutenir basket (**Fig. 2E**). The procedure required 59 minutes. The patient recovered

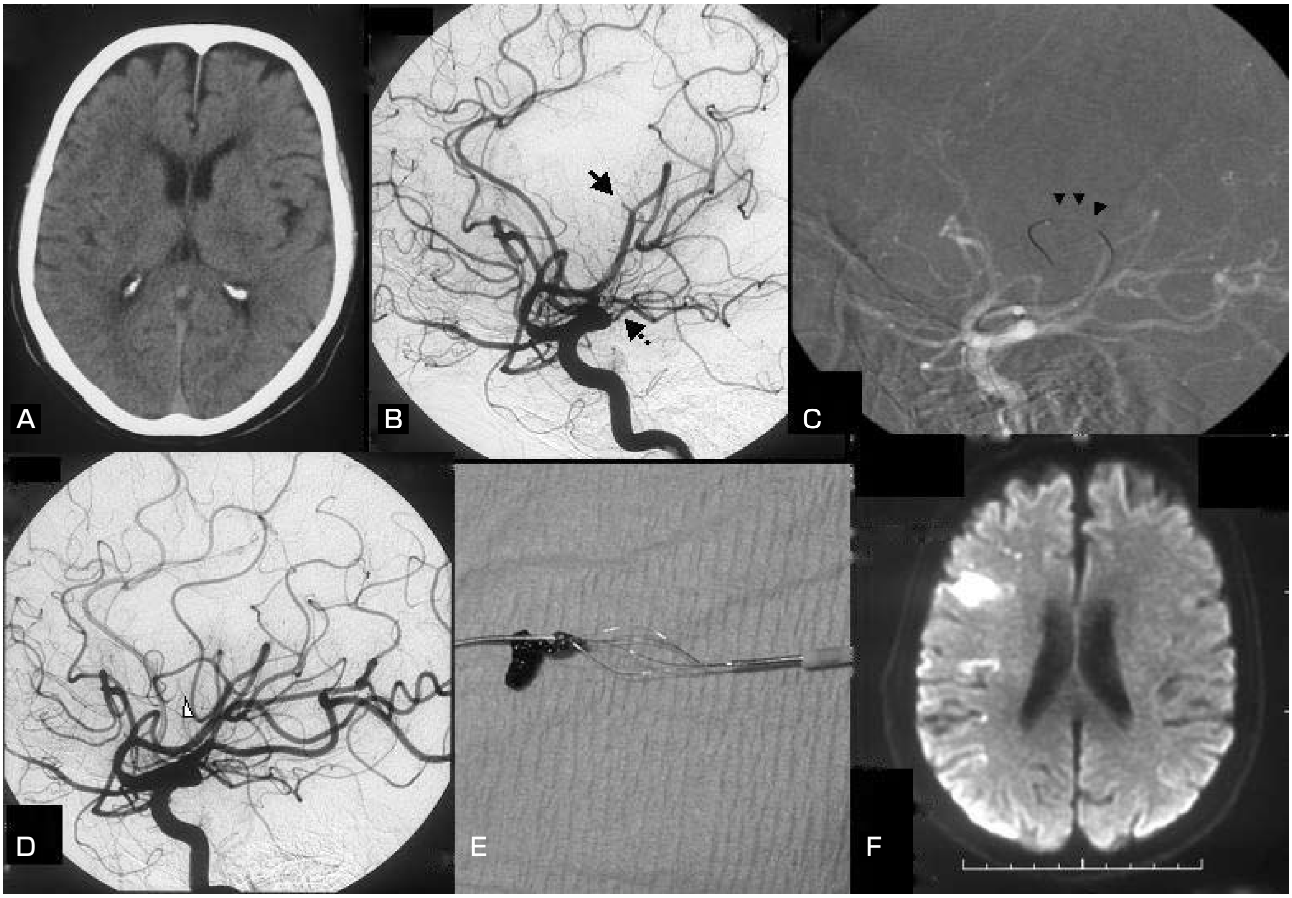

Fig. 2 Case 1
A: Axial CT image before rtPA infusion showing no abnormal findings.
B: Right internal carotid angiogram (lateral view) demonstrating occlusion of the anterior trunk (arrow) and of posterior trunk (dotted arrow) of the right middle cerebral artery.
C: Intraoperative image of Soutenir entrapping a clot. The radiolucent basket (arrowheads) was between the two radiopaque markers.
D: Postprocedural angiography showing recanalization. Only the flow of the central artery is still stagnated (arrowhead).
E: Retrieved thrombi are tangled around the Soutenir.
F: Axial MR diffusion-weighted image one day after the procedure. Small spotted acute infracted areas are shown in the territory of the right middle cerebral artery.

from hemiplegia immediately after the procedure, and no cerebral hemorrhage developed. Magnetic resonance (MR) diffusion-weighted imaging performed one day after the procedure showed only small spotted ischemic lesions in the territory of the right MCA (**Fig. 2F**). The patient was discharged without any neurological deficit (modified Rankin Scale [mRS], 0).

Case 2

A 49-year-old man presented with right hemiplegia and aphasia. IV rtPA was administered 140 minutes after symptom onset; however, no remarkable improvement in neurological deficit was observed. The NIHSS score improved only minimally from 33 to 27. Informed consent for thrombectomy was obtained from the patient's family members. The femoral artery was punctured using the Seldinger single-wall puncture technique at 200 minutes after the symptom onset and a 7 Fr sheath was set in place. A 7 Fr guiding catheter with a balloon (Patlive; Clinical Supply, Gifu) was placed in the left ICA. Left internal carotid angiogram disclosed occlusion of the left MCA at the proximal M1 segment (**Fig. 4B**). An Excelsior and a 0.016-inch GT wire were gently navigated through the MCA until they were distal to the occluded M1 segment. Thrombectomy was performed in the same manner as described in Case 1 (**Fig. 4C**). In this case, however, when

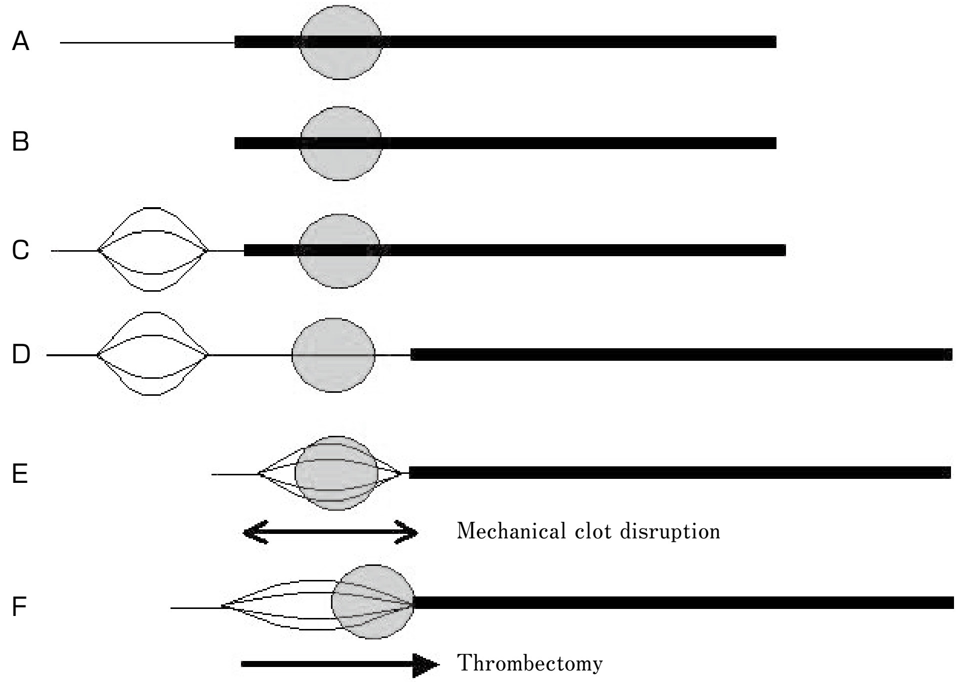

Fig. 3 Techniques of mechanical clot disruption and embolectomy with Soutenir
A : Microcatheter tip is placed distal to the clot.
B, C : Microguidewire is removed and replaced with Soutenir.
D : Microcatheter is pulled back just proximal to the clot.
E : Soutenir is passed back and forth like a linear reciprocating motion through the thrombus (clot disruption).
F : When an operator feels some resistance while pulling back the Soutenir, the whole assembly of the Soutenir and microcatheter is withdrawn as a unit through the guiding catheter (embolectomy).

the whole assembly of the microsnare and microcatheter was retrieved, the Patlive balloon was inflated to block the proximal blood flow, and the blood was aspirated through the guiding catheter to facilitate clot removal. The thrombus was partially retrieved, and the remaining thrombus moved distally and occluded the posterior trunk (**Fig. 4D**). This remaining clot was eventually removed in the same manner, and successful recanalization was finally achieved with a TIMI grade Ⅲ flow (**Fig. 4E**). The patient recovered from the hemiplegia and aphasia immediately after the procedure. The procedure required 51 minutes. Although postprocedural CT disclosed a thin subarachnoid hemorrhage (SAH) in the left cerebral hemisphere (**Fig. 4F**), it disappeared by the next day, and no intracerebral hemorrhage occurred. MR fluid-attenuated inversion recovery image obtained on day 10 showed an area of acute infarction in the left basal ganglia and temporal lobe (**Fig. 4G**). The patient was discharged with mild sensory aphasia (mRS, 2).

Discussion

Although IV rtPA within 3 hours of symptom onset has been proven to be effective[10)], it is insufficient to treat patients with severe neurological deficit due to major arterial occlusion[1,6,7,8,14)]. Some previous studies of intra-arterial thrombolysis for major arterial occlusion showed that clinical outcome is highly correlated with the degree of recanalization[6,8)]. Considering that the rate of recanalization of major arterial occlusion with IV rtPA is low[6,7,14)], additional endovascular management in selected patients unresponsive to IV rtPA would be challenging.

The endovascular management of acute ischemic stroke includes thrombolysis, mechanical clot disruption, thrombectomy, angioplasty, and stent placement. Compared with thrombolysis, the mechanical endovascular approach is expected to obtain more rapid recanalization. So far, various methods of mechanical clot disruption and thrombectomy have been reported; clot embolectomy and/or disruption using

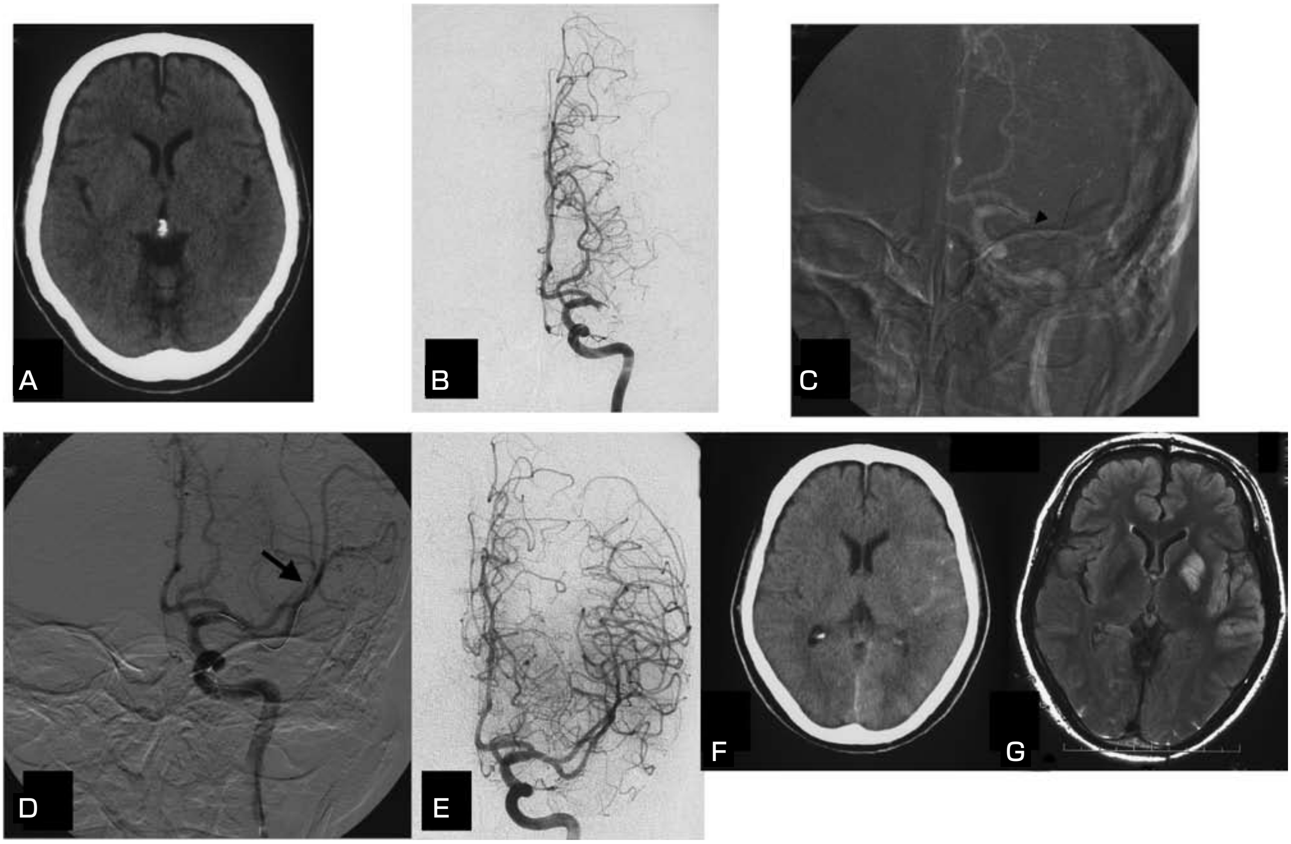

Fig. 4　Case 2
A：Axial CT image before rtPA infusion showing no abnormal findings.
B：Left internal carotid artery angiogram (frontal view) demonstrating occlusion of the left middle cerebral artery at M1 segment.
C：Intraoperative image of Soutenir entrapping a clot (arrowhead).
D：After partial removal of the clot lodged in M1 segment, the remaining embolus moved distally, resulting in occlusion of the posterior trunk (arrow). The occluded posterior trunk was recanalized in the same manner.
E：Postprocedural angiography showing complete recanalization.
F：Postprocedural CT revealing subarachnoid hemorrhage.
G：Axial MR fluid-attenuated inversion recovery image 10 days after the procedure. Spotted acute infracted areas are noted in the left basal ganglia and temporal lobe. Subarachnoid hemorrhage is washed out.

basket-shaped microsnare[3,4], goose-neck microsnare[13], manually uncoiled spring tip microguidewire[5], J-shaped microguidewire[12], deflated microballoon catheter[2], and helix-shaped nitinol wire (Merci Retriever)[11]. Some studies included a combination of mechanical clot disruption or embolectomy and intra-arterial infusion of thrombolytic agents. Sorimachi et al. reported 23 cases of acute ischemic stroke which were managed by mechanical clot disruption using a J-shaped microguidewire in conjunction with intra-arterial infusion of urokinase[12]. The recanalization rate was as high as 96%; however, the average interval from the initiation of angiography to the completion of the thrombolytic therapy was rather long (86 minutes)[12]. On the other hand, Imai et al. reported 14 cases of acute ischemic stroke treated with mechanical embolectomy without the use of any thrombolytic agent[4]. The recanalization rate was lower than those of Sorimachi et al. (50%), however, the procedure interval was as short as 70 minutes on average[4]. In our cases, the average procedure interval was 55 minutes. Although the number of cases is small, it could be suggested that mechanical clot embolectomy is advantageous because it requires less time as compared with pharmacological thrombolysis.

To our knowledge, this is the first report describing an additional neuroendovascular approach for clot removal using a Soutenir after IV rtPA infusion. The basket portion of a Soutenir consists of 4 microwires which are threedimensionally configured (**Fig. 1B**). Compared to a J-shaped guide wire which is two-dimensionally configured, the Sounteir is expected to remove clots more efficiently. MERCI Retriever is a helix of flexible nitinol wire, which is used for mechanical clot extraction, and is reported to be beneficial in acute ischemic stroke patients[11]. The technique of clot removal described here is similar to the techniques using the MERCI system. In contrast, the Soutenir, which has a smaller profile than that of the MERCI Retriever, is expected to capture a thrombus located more distal than M2. However, our technique of thrombectomy using the Soutenir microsnare is more dependent on the skill of the operator and is less certain to catch a clot compared with the MERCI system, which was developed exclusively for clot removal.

To facilitate retrieval of the clots and avoid migration of the entrapped clots, a balloon guiding catheter was used in Case 2. The proximal blood flow was blocked by inflating the balloon of the guiding catheter when the thrombus was retrieved. In the study of Imai et al., the recanalization rate was higher with the use of balloon guiding catheter than without it[4]. Although the use of balloon guiding catheter may improve the retrieval of a clot, the requirement of a relatively large-sized sheath (7 Fr or larger) is disadvantageous.

The use of an additional neuroendovascular treatment to recanalize occlusive vessels after IV rtPA may elicit a perfusion injury that could result in a severe hemorrhagic infarction. In our cases, no hemorrhagic infarction developed. Interventional Management of Stroke (IMS) Study, in which 62 patients with acute ischemic stroke were treated with intra-arterial infusion of rtPA after IV rtPA, demonstrated the feasibility of the combined treatment[6]. In that study, the rate of symptomatic cerebral hemorrhage was similar to that reported by NINDS rtPA stroke trial (6.3% vs 6.6% in NINDS)[6,10]. However, other hemorrhagic complication including pseudoaneurysm, retroperitoneal hematoma, and groin hematoma was reported in 5 patients in the IMS study[6]. Of the 5 patients, 2 patients required blood transfusion. Puncture of the artery is possible after IV rtPA, however, an operator should be aware of such risks of hemorrhagic complications. In our cases, no extracranial hemorrhagic complications occurred.

Other potential intracranial complications of thrombectomy include vessel perforation, arterial dissection, and vasospasm[9]. In Case 2, postprocedural CT revealed SAH; no treatment was required. Because no definite extravasation was noted during the procedure, it is difficult to determine the exact cause of SAH. The possible mechanism may include vessel damage due to the manipulation of the Soutenir microsnare, stretching of the vessel by the microguidewire, or inappropriate manipulation of the microguidewire or microcatheter. Gentle and careful manipulation of microcatheter and microguidewire may minimize these risks.

Conclusion

We reported two cases of acute ischemic stroke patients who were unresponsive to IV rtPA and were successfully treated by thrombectomy using a Soutenir microsnare. This technique may be promising as one of the technical options to remove a clot in patients with major arterial occlusion. Further study with a large number of patients is required to establish the efficacy and safety of this technique.

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