



Mechanical Thrombectomy Using a Stent Retriever with an Intermediate Catheter for Partially Occluded Middle Cerebral Artery Fenestration

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Key words

- Fenestration
- Intermediate catheter
- Mechanical thrombectomy
- Stent retriever

Abbreviations and Acronyms

DSA: Digital subtraction angiography

IC: Intermediate catheter

ICA: Internal carotid artery

MCA: Middle cerebral artery

MRI: Magnetic resonance imaging

MT: Mechanical thrombectomy

SWIM: Stent retriever partially retracted with intermediate catheter for mechanical thrombectomy

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INTRODUCTION

Positive results from recent randomized trials of patients with acute ischemic stroke and large vessel occlusion herald a new era in stroke therapy.¹⁻³ Many bolting techniques, such as Solitaire with Penumbra (Solumbra) and a direct aspiration first pass technique, have emerged,⁴⁻⁶ leading to improvements in the efficiency of mechanical thrombectomy (MT). Intracranial artery fenestrations are a rare vascular variant, presenting challenges to identification and recanalization when they are occluded. We present a case in which we successfully performed MT of partially occluded middle cerebral artery (MCA) fenestration.

CASE DESCRIPTION

A 65-year-old man with a medical history of ischemic stroke and homocysteinemia

■ **BACKGROUND:** Middle cerebral artery (MCA) fenestration is a rare vascular variant of the MCA. When this occlusion occurs, it presents challenges to identification and recanalization. We describe a patient with a partially occluded MCA fenestration in whom recanalization was successfully achieved via mechanical thrombectomy using a stent retriever with an intermediate catheter.

■ **CASE DESCRIPTION:** A 65-year-old man with a history of ischemic stroke and homocysteinemia presented with dysarthria and expressive aphasia 14 hours after symptom onset. National Institutes of Health Stroke Scale score was 12/42. Noncontrast computed tomography scan revealed encephalomalacia in the left cerebral hemisphere. Catheter angiography displayed a left internal carotid artery orifice and M1 segment subocclusion. The primary diagnosis was acute ischemic stroke. Mechanical thrombectomy was performed by passing a stent retriever through the subtotal occlusive segment of the left MCA. After angiography was completed, reperfusion was considered successful, with a modified Thrombolysis in Cerebral Infarction grade 3. The fenestration was discovered in the middle to distal part of the left MCA M1 segment where the thrombus was located. After 3 days, magnetic resonance imaging showed much ischemic damage to the left hemicerebrum area. The day after endovascular treatment, the patient's neurologic deficit recovered to its pre-onset state. At 6-months follow-up, stroke had not recurred, and the patient is living independently with a modified Rankin scale score of 1.

■ **CONCLUSIONS:** Mechanical thrombectomy may be feasible and safe in MCA fenestration occlusion.

presented with right hemiplegia, dysarthria, and aphasia 14 hours after symptom onset. National Institutes of Health Stroke Scale score was 12/42. Noncontrast computed tomography scan revealed encephalomalacia in the left cerebral hemisphere. Alberta Stroke Program Early CT Score was 10/10. Digital subtraction angiography (DSA) confirmed tandem systemic lesions in the left internal carotid artery (ICA) and left MCA M1 segment subocclusion. The patient's modified Thrombolysis in Cerebral Infarction grade was 1.

The patient immediately received endovascular treatment, beginning with intervention in the left ICA severe stenosis. We inserted an 8-F guide catheter (Cordis Corporation, Ciudad Juárez,

Mexico) into the terminal part of the left common carotid artery. A SpiderFX Embolic Protection Device (Medtronic, Minneapolis, Minnesota, USA) was deployed to the terminal end of the C1 segment of the left ICA. Balloon dilation with a 4 mm × 20 mm balloon (Boston Scientific, Heredia, Costa Rica) was then performed. We then passed the guide catheter through the C1 segment lesion and retrieved the SpiderFX Embolic Protection Device. Next, we performed MT to remove the clot from the left MCA. We chose a coaxial system consisting of a 5-F Navien 058 microcatheter and a Rebar 18 microcatheter (both Medtronic) to cross the MCA lesion. Next, we deployed a 4 mm × 20 mm Solitaire stent retriever (Medtronic) into the left M1 occluded

section to ensure full coverage of the lesion. The intermediate catheter (IC) was advanced just proximally, and the stent retriever was partially retracted by its anchoring force. We applied aspiration, and the stent was retrieved directly into the IC with the microcatheter. The left M1 was completely revascularized in a single pass (modified Thrombolysis in Cerebral Infarction grade 3) (Figure 1).

Angiography demonstrated no distal thromboembolic events and complete removal of the embolus: 2 small, dark red clots were captured by the stent retriever, 1 mm × 4 mm and 3 mm × 4 mm in size. Postthrombectomy three-dimensional DSA of the left ICA showed a fenestration in the middle to distal part of the left M1 segment where the thrombus was initially located (Figure 2). Noncontrast

computed tomography, performed immediately after thrombectomy, showed no evidence of intracranial hemorrhage.

Follow-up magnetic resonance imaging obtained 3 days later showed a great deal of ischemic damage in the left hemis cerebrum area. High-resolution MRI analysis of the vascular wall further confirmed fenestration of the left M1 segment (Figure 2). We found

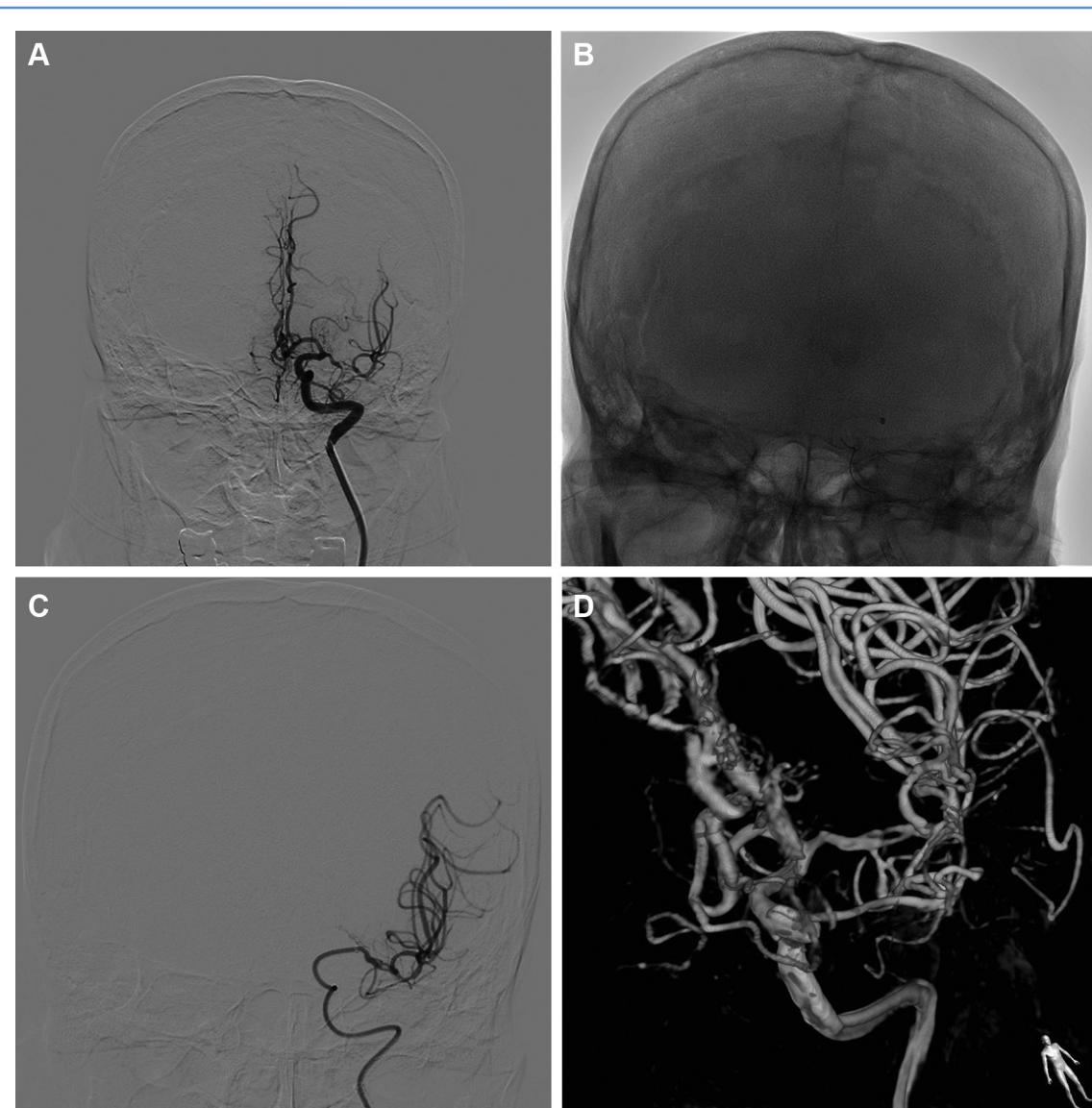


Figure 1. Thrombectomy. (A) Left internal carotid artery catheter angiography shows left middle cerebral artery M1 segment subocclusion. (B) Release of a stent retriever, which completely covers the lesions; a 5-F intermediate catheter was then advanced to the proximal end of the thrombus and partially retracted the stent retriever. (C) After thrombectomy,

angiography showed complete revascularization in a single pass (modified Thrombolysis in Cerebral Infarction grade 3). (D) Postthrombectomy three-dimensional digital subtraction angiography shows a fenestration in the middle to distal part of the left M1 segment where the thrombus was initially located.

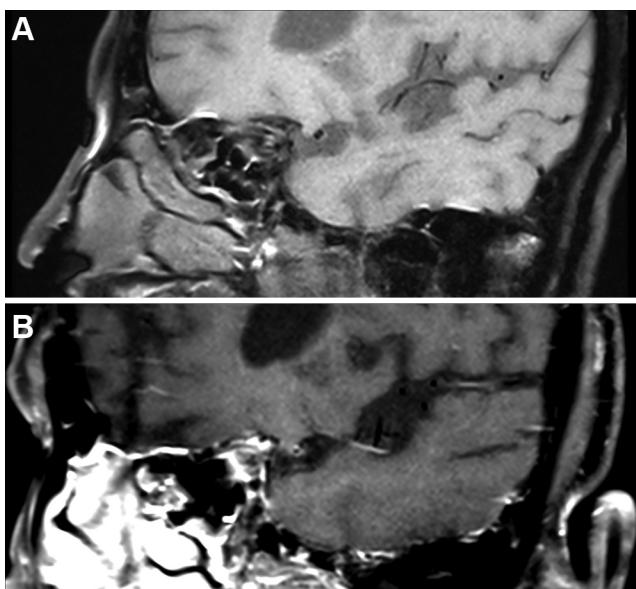


Figure 2. Three days after thrombectomy, high-resolution magnetic resonance imaging (MRI) analysis of the vascular wall was performed. **(A)** T1-weighted high-resolution MRI confirmed fenestration of the left M1 segment showing the double lumen sign, and the common arterial wall was seen in the center. **(B)** Enhanced T1-weighted high-resolution MRI showed the anterior and inferior wall of the fenestration artery was thickened and the lumen had slight stenosis, while the posterior superior artery wall was thickened, and the lumen showed no stenosis.

fenestrations of the MCA and hypoplasia of the Ar segment of the anterior cerebral artery, but these were not associated with any aneurysms on MRI or DSA. The day after intervention, the patient's neurologic deficit recovered to its pre-onset state (National Institutes of Health Stroke Scale score 3). At 6-month follow-up, stroke had not recurred. The patient has residual mild hemiparesis and is functionally independent with a modified Rankin Scale score of 1, just as he was before symptom onset.

DISCUSSION

Intracranial artery fenestrations are abnormalities of the congenital artery that are due to abnormal development of the congenital primitive embryonic blood vessel, the prevalence of which ranges widely (0.7%–28%) in the literature.^{7,9} The 2 most frequently encountered fenestration locations are the vertebrobasilar

artery system and the anterior cerebral artery. MCA fenestration is rare, with a prevalence of only 0.09%.¹⁰ MCA fenestration occlusion can be difficult to identify when it occurs. In cases where the media at the proximal and distal vascular walls of fenestrations is absent or thinning, misdiagnosis may be catastrophic. In our case, the morphology of the lesion was puzzling when we viewed it the first time after MT. Using three-dimensional DSA, we finally confirmed that it was MCA fenestration, avoiding another round of endovascular treatment, such as angioplasty. Based on the patient's medical history, the ipsilateral ICA system tandem lesion shown by DSA, and postthrombectomy high-resolution MRI, we speculated that the mechanism of fenestrated artery occlusion in this case was an artery-to-artery embolism. Meinel et al.¹¹ reported a case of partially occluded basilar artery fenestration on which thrombectomy was

performed successfully with a Solitaire stent retriever, proving that MT can be done safely in basilar artery fenestration. We reported this case to show that MT in occluded MCA fenestration was also feasible and effective.

Experimental and clinical evidence has shown that MT with stent retriever may cause damage to the vessel wall.¹² In the present case, we used a novel MT technique involving a stent retriever with an IC to successfully remove the thrombus. For convenience, we refer to this technique as stent retriever partially retracted with intermediate catheter for mechanical thrombectomy (SWIM). The details of the SWIM technique are shown in **Figure 3**. To our knowledge, although this technique may be in use by many neurointerventionalists, it has not yet been reported in published work.

We compared SWIM with the common MT technique Solumbra. The innovation of SWIM lies in using an IC to partially retract the stent retriever before thrombus removal as well as the opportunity to clamp the clots effectively and reduce the force of friction between the vascular wall and stent retriever, which decreases the chance of injury to the vessel intima. This may have already played a role in our case. However, these advantages need to be proven with additional cases.

CONCLUSIONS

In this case, we demonstrated that MT using the SWIM technique for MCA fenestration thrombus was feasible and effective.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

Geng Liao: Conceptualization, Methodology, Resources, Writing - original draft, Formal analysis, Project administration, Writing - review & editing. **Zhenyu Zhang:** Resources, Project administration, Writing - review & editing. **Xiujuan Che:** Resources, Writing - original draft, Formal analysis, Project administration, Writing - review & editing. **Hanxiang Liang:** Formal analysis.

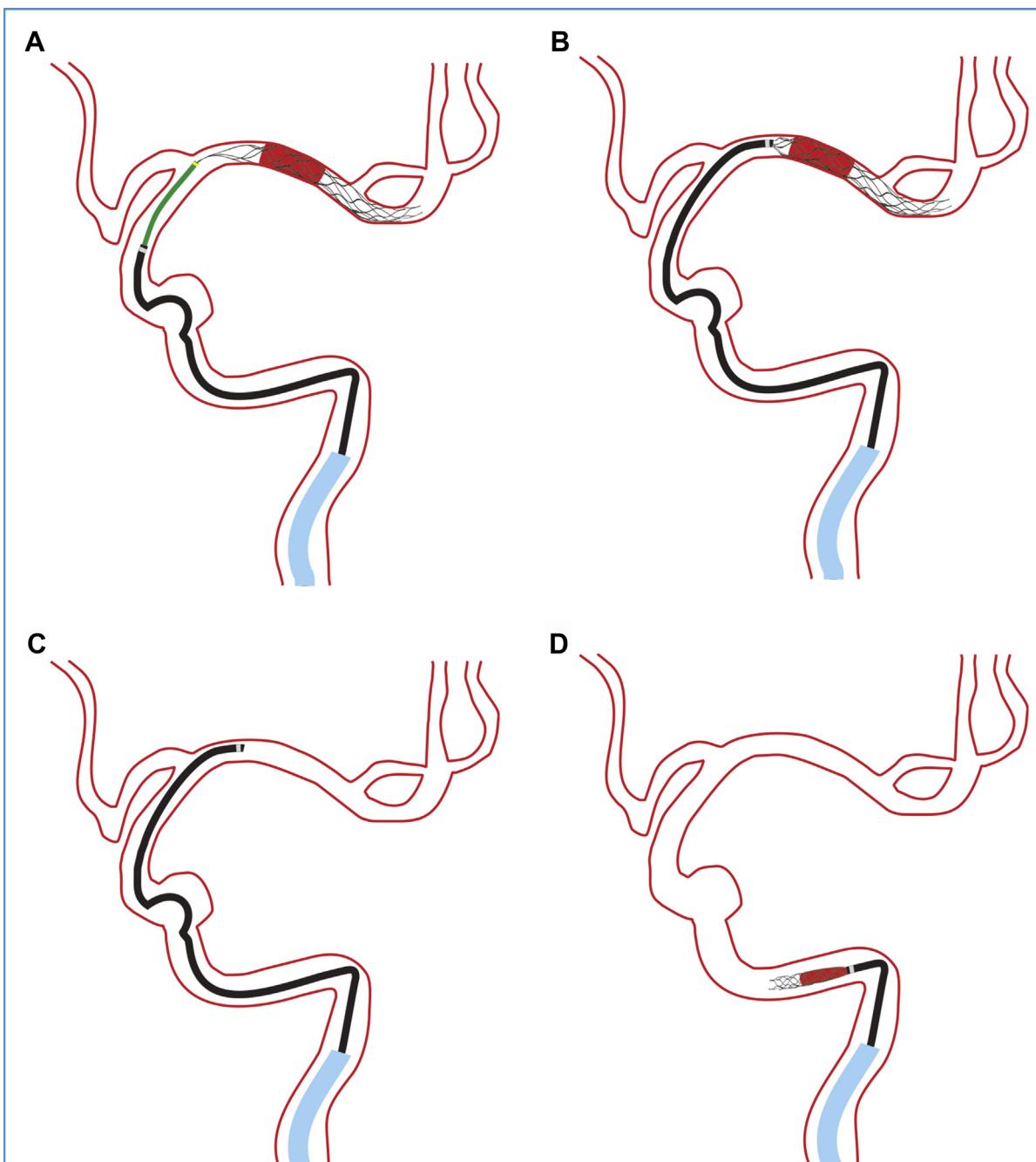


Figure 3. Stent retriever partially retracted with intermediate catheter for mechanical thrombectomy (SWIM) technique. **(A)** The surgeon constructs a three-axis system with the guide catheter, large-caliber intermediate catheter (IC), and microcatheter. The microcatheter passes through the occluded lesion, and the stent retriever is released and completely covers the lesions. **(B)** The IC

is advanced to partially retract the stent retriever. **(C)** The stent retriever is removed into the IC and away from the body in conjunction with aspiration-pull when there is no resistance met. **(D)** If there is resistance when the IC is advanced to retract the stent retriever, the IC and stent retriever are locked and pulled out of the body concurrent with persistent aspiration of the IC.

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