Case Report

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Suction thrombectomy using a microcatheter as a salvage method for acute distal occlusion during cerebral aneurysm embolization: A case report

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Abstract:
The aneurysm coiling process presents a risk of thromboembolic complications, mostly in patients with ruptured aneurysms, given the fact that they cannot receive antiplatelet therapy. Management strategies include medical anticoagulation or antiplatelet therapy, intra-arterial thrombolysis, and mechanical thrombectomy using direct aspiration first-pass technique or stent retrievers. We report our own experience of using an Excelsior SL-10 Microcatheter (Stryker, Fremont, California, USA) with an internal diameter of 0.0165", originally designed for coil delivery, for contact aspiration of a thrombotic occlusion of a distal anterior cerebral artery during coiling of a broad-based trilobar anterior communicating artery aneurysm. The clot was removed under continuous manual aspiration, and complete recanalization has been accomplished. Mechanical thrombectomy through microcatheter aspiration may be a safe and feasible treatment option for acute distal artery occlusions, especially in the case of tortuous distal vessels during embolization of cerebral aneurysms.

Keywords:
Cerebral aneurysm, coil embolization, direct aspiration first-pass technique, distal occlusion, mechanical thrombectomy, microcatheter

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Introduction

Thromboembolic events are the most commonly reported complication during coil embolization of ruptured cerebral aneurysms.[1] Thromboembolism accounts for 80% of all endovascular coiling-associated complications, and it affects approximately 4% of patients with ruptured cerebral aneurysms as a whole.[2,3] Mechanical thrombectomy using suction catheters (direct aspiration first-pass technique [ADAPT]) has been widely performed and assessed as a successful revascularization method in ischemic stroke.[4] However, most of the studies refer to large artery occlusions.[5,6] There have been limited reports related to mechanical thrombectomy of distal small artery thrombi, as any catheter manipulation, application of aspiration technique, or use of stent retriever in narrow vessels may pose a greater risk of further complications, such as vessel injury or clot dislodgment.[7-9]

We report a case of a successful anterior cerebral artery (A2 segment) recanalization using an Excelsior SL-10 Microcatheter (Stryker) with an internal diameter of 0.0165″ for contact aspiration of a thrombus during coiling of a broad-based trilobar anterior communicating artery (Acomm) aneurysm.

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Case Report

A 55-year-old man was admitted to our hospital due to sudden suboccipital headache, vomiting, and nuchal rigidity with a Glasgow Coma Scale score of 14. Computed tomography (CT) revealed subarachnoid hemorrhage, whereas computed tomographic angiography illustrated a trilobar broad-based Acomm aneurysm with a maximum diameter of 6 mm [Figure 1], which was considered a flow-associated aneurysm with a concomitant arteriovenous malformation in the right frontal lobe [Figure 2]. Endovascular treatment was considered feasible and safe by our interdisciplinary neurovascular team. The intervention was performed under general anesthesia. A 6F long sheath was inserted into the right femoral artery and a 6F coaxial guiding catheter (Guider Softip XF, 6F 90 cm, Stryker) was advanced into the left internal carotid artery (ICA). A heparinized saline solution was continuously perfused through the guiding catheter and the microcatheter intraoperatively. Subsequently, a microcatheter (Excelsior SL-10, Stryker) over a microwire (Transend™ EX Platinum, Stryker) was used for catheterization and coiling of each aneurysm's lobe. No additional intravenous (IV) heparin has been administrated throughout the embolization due to initial aneurysm rupture. At the end of the procedure, complete embolization of the aneurysm (Class I according to Raymond–Roy Occlusion Classification) has been accomplished without the use of microballoons. Nevertheless, a thrombotic occlusion of the proximal segment of the A2 artery has been noted postoperatively [Figure 2b and c]. Immediate IV administration of tirofiban (glycoprotein IIb/IIIa antagonist) has been administered so as to prevent further accumulation of thrombus (solution: 50 μg/ml bolus IV 38 ml and then 14 ml/h for 24 h). In order to deal with this devastating complication, a Velocity Delivery Microcatheter (0.025″ inner diameter [ID], Penumbra, Inc., Alameda, California, USA), that is designed to deliver 3D Revascularization Device (Stent Retriever System, Penumbra), was attempted to reach the thrombus, but navigation was proved not to be feasible due to acute A1-A2 angulation. Subsequently, a microcatheter (Excelsior SL-10, Stryker, ID 0.0165″) was navigated over a microwire (Transend™ EX Platinum, Stryker) through the thrombus [Figure 2d]. After the removal of the microwire, manual aspiration was performed with a 20-cc syringe, adapted directly to the microcatheter hub, over the Excelsior microcatheter that was gently pulled back throughout the thrombus. The microcatheter has been completely withdrawn under continuous aspiration. Simultaneously, aspiration has been performed over the guiding catheter. Thus, the solid blood clot was removed and complete revascularization was confirmed on the final angiography [Figure 2e] after 67 min. Thrombus fragmentation has been performed during withdrawal through the hemostatic valve attached to the guiding catheter. The venous phase of the left ICA angiography illustrates a delayed filling of some arterial branches of the A2 segment [Figure 2f]. Twenty-four hours after the procedure, the postoperative CT and magnetic resonance imaging revealed an ischemic area in the left frontal lobe 2.3 cm × 4 cm [Figure 3]. The patient experienced gradual improvement of his level of consciousness and was discharged 14 days after the event without any obvious neurologic deficit.

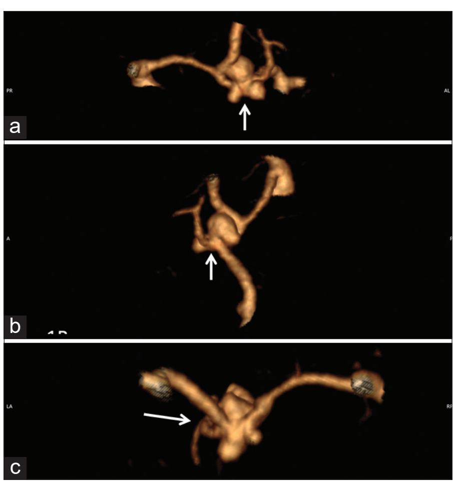

Figure 1: (a) Computed tomographic angiography (anterior/right lateral view) illustrates a trilobar anterior communicating artery aneurysm (white arrow), (b) computed tomographic angiography (left lateral view) shows the left A1-A2 angulation (white arrow), and (c) computed tomographic angiography (inferior view) illustrates the relation of the left A1-A2 junction to the anterior communicating artery aneurysm (white arrow)

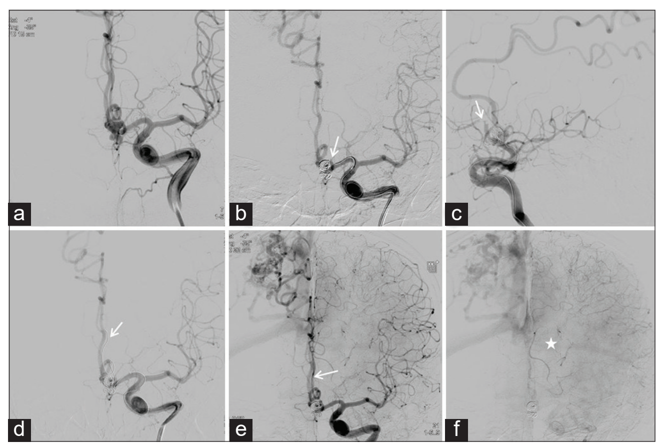

Figure 2: (a) Digital subtraction angiography (anterior view) illustrates a trilobar anterior communicating artery aneurysm which was considered a flow-associated aneurysm with a concomitant arteriovenous malformation in the right frontal lobe, (b) digital subtraction angiography (anterior view), (c) digital subtraction angiography (lateral view) shows the thrombotic occlusion of the proximal segment of the A2 artery that has been noted postoperatively (white arrow), (d) digital subtraction angiography (anterior view) shows the microcatheter being navigated over the microwire that seems to penetrate the thrombus into A2 segment (white arrow), (e) complete revascularization of the distal anterior cerebral artery was confirmed on the final angiography (white arrow), and (f) venous phase of the left internal carotid artery illustrates an ischemic area in the left frontal lobe (white star)

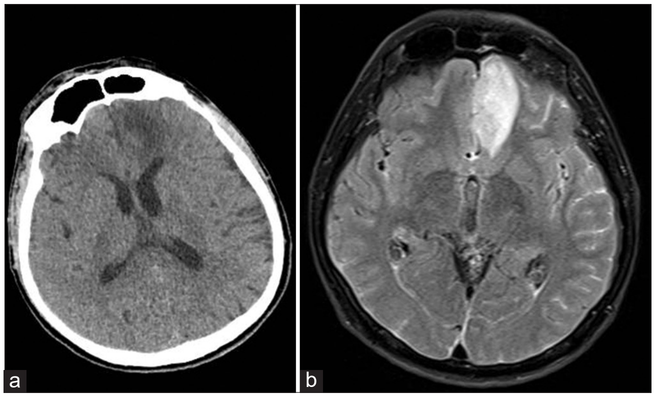

Figure 3: (a) Postoperative computed tomography (24 h after the procedure) revealed an ischemic area in the left frontal lobe and (b) postoperative magnetic resonance imaging (flair, axial view) illustrates the infarct in the left frontal lobe

Discussion

Although diffusion-weighted imaging detected ischemic lesions after coiling of cerebral account for 45%,[10] thromboembolic complications range from 2.7% to 10.5%.[2,3,11,12] According to an older literature review among 1,547 patients, the percentage of thromboembolic events was reported to be 8.7%, leading to stroke for 5.6% of patients and accounting for permanent morbidity of 3.7% and mortality of 0.77%.[13]

There are various reasons for thrombus formation during embolization, such as dislodgment of a friable plaque, iatrogenic dissection, migration of a preexisting thrombus, newly created clots inside the aneurysm, protruding loops of coils, catheter manipulation into the parent vessel that may reduce the distal flow and lead to thrombosis, and other anatomical factors including larger aneurysm diameter.[7,13,14] Administration of IV heparin may prevent further thrombus progression, but it does not seem to achieve optimal recanalization results. Local intra-arterial fibrinolysis with urokinase or recombinant tissue plasminogen activator may be a treatment option in order to achieve vessel patency, but there is a high risk of severely bleeding at the aneurysm site.[1] As opposed to the abovementioned pharmaceutical options, GpIIb/IIIa inhibitors, such as tirofiban, are associated with notably superior outcomes in both ruptured and unruptured aneurysms.[15] Specifically, tirofiban exhibits a short half-life of 2 h, which results in a more controlled drug administration, lower rebleeding rates, significantly fewer postprocedural neurologic complications, and improved discharge status.[1,15] Therefore, we decided to administer only tirofiban as antiplatelet therapy.

Mechanical thrombectomy is an alternative treatment strategy, that includes stent retrieval and/or ADAPT, both of which stand as the most popular methods.[16] According to an older study, stent retrievers seemed to have exhibited superior angiographic and clinical results compared to other devices, such as the Merci Retrieval System (UCLA Technology Development Group, Los Angeles, California, USA), in patients with acute ischemic stroke, as early recanalization was achieved.[17] Thus, this approach has been generally applied in stroke as well as in thromboembolic complications.[7,17] Besides a considerable number of stent retriever devices utilized in clinical practice, ADAPT has been proved to be a safe and successful method for retracting intracranial thrombi.[18] In a more recent meta-analysis, ADAPT technique actually outweighs stent retrievers considering recanalization rates (93.8% vs. 74.2%), favorable clinical outcomes (55.9% vs. 42.2%), and procedure duration.[19]

The philosophy of the ADAPT technique is to capture the clot with a catheter and keep it attached to the catheter tip with suction force.[20] This is why large-bore catheters are typically used, as they present a better aspiration flow and catheter tip force.[20,21] As stated by an established model for minimal catheter diameters needed for ADAPT, an ID of >0.040″ seems to be more effective in mechanical thrombectomy, as far as the middle cerebral artery is concerned.[20] This model is in line with the most commercially available large-bore catheters, whose diameter is over 0.05″, such as ACE (Penumbra) and 5 MAX (Stryker), with a distal ID of 0.060″ and 0.054″, respectively.[21] However, most studies concerning mechanical thrombectomy with reperfusion catheters refer to large artery occlusions.[5,6] In the case of occlusions in distal vessels, endovascular maneuvering bears certain risks, given that their longer, more tortuous access route and thinner arterial walls possibly increase the likelihood of dissection, perforation, and vasospasm.[22]

We also encountered such difficulties while trying to approach the thrombotic occlusion in the proximal segment of the A2 artery as none of the commonly used aspiration catheters (3 MAX, 0.035″ distal ID, Penumbra) or even the velocity delivery microcatheter (0.025″ ID, Penumbra) was feasible to reach the lesion, due to acute A1-A2 angulation. Subsequently, a microcatheter (Excelsior SL-10, Stryker) was navigated through the thrombus [Figure 2c] and then was gently pulled back throughout the thrombus under continuous manual aspiration. Despite this microcatheter's small ID (0.0165 in), which may seem inadequate for thrombus aspiration, we eventually achieved flow restoration in the distal anterior cerebral artery. Possible revascularization mechanisms could be the partial aspiration of microthrombi through the microcatheter and removal of the remaining clot attached to the catheter tip by pulling back the microcatheter which has been fragmented during withdrawal through the hemostatic valve attached to the guiding catheter.

Some similar cases have also been reported, where microcatheters were used effectively in the management of distal occlusions.[16,23] Despite the limited amount of relevant studies and the limitations of this technique, mechanical thrombectomy of distal cerebral artery occlusions presents recanalization rates comparable to those of proximal artery occlusions.[8] Our case report describes aspiration of a thrombus in the distal anterior cerebral artery during coiling of an Acomm aneurysm, resulting in successful recanalization. Although complete recanalization has been achieved within 67 min, the venous phase of the left ICA angiography illustrates a delayed filling of some arterial branches of the A2 segment which resulted in an ischemic area in the left frontal lobe. Nevertheless, this area has been limited due to the aforementioned lifesaving technique, without any obvious neurological deficit. To the best of our knowledge, aspiration of distal cerebral thrombus through such a small internal diameter (0.0165″) microcatheter has not been previously reported in the literature.

From our standpoint, the ADAPT using a microcatheter, originally designed for coil embolization, could be a feasible and alternative treatment option for mechanical thrombectomy and could be used as a lifesaving procedure when dealing with thrombotic events in distal and tortuous vessels. This stems from the fact that microcatheters present better maneuverability and therefore allow easier and less traumatic access to the occlusion site.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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