Original Paper

Direct Aspiration Catheter Fracture and Retrieval during Neurothrombectomy

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Keywords

Thrombectomy · Complication · Catheter breakage · Retrieval · Snare devices

Abstract

Background: Application of direct aspiration catheters has revolutionized acute stroke care and has led to significant improvement in clinical outcome with a good safety profile. Catheter fracture and retention is a rare but potentially devastating complication. **Case Description:** Here we present two cases of acute stroke complicated by aspiration catheter fracture and retention. Successful catheter retrieval and revascularization was achieved in both cases. The stenosis or tortuosity of vascular anatomy appears to be the probable contributor to catheter breakage by anchoring the catheter with resultant fracture at the constraint point from catheter withdrawal tensile stress. **Conclusion:** This report describes application of snare devices in retrieving a broken catheter during thrombectomy in the anterior and posterior circulation, and therefore presents a technique that can be safely utilized to address catheter breakage complicating thrombectomy in different vascular anatomic locations.

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Introduction

With recent data supporting the benefit of mechanical thrombectomy for the treatment of acute ischemic stroke attributable to large vessel occlusion [1], there will be increasing use of this technique and concomitant encountering of potential complications. The overall procedure carries a low complication rate [2] with common adverse events including reperfusion injury, wire perforation, emboli in new territories and vasospasm as well as less

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Fig. 1. Retrieval of a broken catheter retained in the descending aorta (case No. 1). **a** Tip of catheter (arrow-head) retained in the descending aorta. The ENSnare device was passed through the catheter (arrow in **b**) and deployed (arrow in **c**) adjacent to the broken catheter. The ENSnare device was then resheathed (arrow in **d**) while pulling out the broken catheter (arrowhead in **e**). **f** Complete retrieval of the broken catheter piece.

common complications such as cavernous carotid fistula formation [3]. A less commonly reported complication is breakage and retention of the thrombectomy device. This can not only lead to the failure of thrombectomy, but also leave a thrombogenic foreign object inside the artery, which can potentially lead to clot propagation [4] and stroke progression.

There is currently a paucity of information on catheter breakage and retention reported in the literature. There are only a few reported cases of complications involving breakage and inadvertent device detachment during thrombectomy [4–8] with reported techniques describing retrieval of the detached stent [4, 7, 8]. To our knowledge, there has been no report on catheter breakage during neurovascular thrombectomy or techniques to safely retrieve it.

In this study, we report two cases of catheter breakage during thrombectomy, and describe the use of snare devices for device recovery.

Case Presentation

Case No. 1

A patient in the seventh decade of life presented to our facility with sudden onset of left-sided weakness and found to have a basilar artery occlusion. Patient underwent emergency angiography after accessing the right groin. A triaxial system consisting of the ACE 64 catheter (Penumbra, CA, USA), Headway microcatheter (MicroVention, CA, USA), and Synchro 2 soft microwire (Boston Scientific, MA, USA) were advanced into the distal left vertebral artery – segment 2 (V2) artery. Attempts to advance the Neuron MAX (Penumbra, CA,

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Fig. 2. Retrieval of broken catheter retained in the middle cerebral artery (case No. 2). **a** Catheter retained in M1 artery (arrowhead) extending into superior M2 artery (arrow) leading to occlusion of M2 artery. **b** Angiographic images taken after retrieval of the broken catheter using an Amplatz Goose Neck microsnare. Note the reperfusion of the superior M2 artery (arrow) achieved immediately after catheter retrieval.

USA) past the proximal V2 artery were unsuccessful. The ACE catheter was withdrawn, but it was noted that the distal tip of the ACE 64 catheter was retained in the Neuron MAX. It was decided to withdraw the Neuron MAX into the abdominal aorta. Using an ENSnare device (Merit Medical, UT, USA; Fig. 3b), the ACE 64 retained tip (Fig. 3a) was successfully retrieved (Fig. 1a–f; online suppl. Movie 1; for all online suppl. material, see www.karger.com/doi/10.1159/000486245). The left femoral artery was subsequently accessed and a triaxial system, which this time consisted of the Sofia Plus catheter (MicroVention, CA, USA), Headway microcatheter, and Synchro 2 microwire, was advanced into the distal left V2 segment and the clot was microaspirated using the Sofia Plus catheter. This led to recanalization of the occluded artery with a resultant Thrombolysis In Cerebral Infarction (TICI) 2b flow. Following successful reperfusion, the patient was transferred to neuro-intensive care unit, showed a mild neurological improvement, and was discharged to inpatient rehabilitation unit in stable condition.

Case No. 2

A patient in the sixth decade of life presented to our facility with right-sided weakness and language difficulty followed by unresponsiveness in the setting of a left middle cerebral artery (MCA) occlusion (segment 2, M2). Patient underwent emergency angiography after accessing the right groin. A triaxial system consisting of the ACE 64 catheter (Penumbra, CA, USA), Velocity microcatheter (Penumbra, CA, USA), and Synchro 2 soft microwire (Boston Scientific, MA, USA) was advanced into the left cavernous carotid. The microwire and microcatheter were then advanced past the MCA occlusion into the superior division of the MCA (superior M2 division). The ACE aspiration catheter was then advanced over the microcatheter-microwire combination. After withdrawing the microwire-microcatheter combination, aspiration was applied to the ACE catheter and the catheter was withdrawn under continuous aspiration. However, follow-up control angiography runs showed retention of the distal ACE catheter in the left MCA with TICI score 0 flow (Fig. 2a). To retrieve the ACE catheter, a microwire-microcatheter combination system was delivered to the left M2 artery. A microcatheter injection revealed patent distal vessel and a Solitaire stent retriever device (Medtronic, MN, USA) was deployed to attempt catheter retrieval. Additional attempts were made with a 5-mm balloon inflated in the distal cervical internal carotid artery and a 3-mm Amplatz Goose Neck™ microsnare (Medtronic, MN, USA; sample shown in Fig. 3c). Finally, successful retrieval was achieved with a 10-mm Amplatz Goose Neck microsnare through a 058 Navien catheter (Medtronic, MN, USA) delivered in the middle portion of the left common carotid artery to capture the proximal fractured ACE catheter. The follow-up angiographic runs revealed TICI 2b flow (Fig. 2b). Following successful revascularization, the patient was transferred to neuro-intensive care unit. The patient's hospital course was complicated by aspiration and respiratory distress. The patient's family adjusted the patient's care on comfort based on the patient's prior wishes to not undergo intubation or further aggressive measures.

Color version available online

Fig. 3. Examples of snare devices and retrieved catheter piece. **a** Retrieved catheter fragment using the EN-Snare device (**b**) from the descending aorta in case No. 1. **c** Sample of Amplatz Gooseneck microsnare used in case No. 2 to retrieve the broken catheter piece retained in the middle cerebral artery.

Fig. 4. Anatomy of cerebral arteries as a possible contributing factor to catheter breakage. Arrow in **a** shows a proximal loop in the left vertebral artery in case No. 1. Artery stenosis (arrow) is present in the cavernous segment of the left internal carotid (**b**; case No. 2).

Discussion

There are several additional reports describing the retrieval of retained materials during endovascular therapy. A multicenter case series estimated the rate of stent retriever detachment to be 0.66% in large-volume thrombectomy centers [8]. Snare devices [7, 8], manual aspiration [8], and a second mechanical thrombectomy device [4, 8] was used to remove the retained stent. Open surgical approach has also been used to remove detached stents [9, 10]. However, feasibility of open surgical approach depends on availability of a neurosurgery team and the accessibility of the retention location.

Here we report two cases of retrieval of broken catheters in subclavian artery (case No. 1) and MCA artery (case No. 2) using ENSnare and microsnare devices, respectively. Snare devices have been previously used to retrieve stretched platinum coils [11] or detached stents [7]. Microsnare have also been used to retrieve Onyx-entombed catheters [5]. Microsnare are favorable for foreign body retrievable due to flexible loops which allow entrapment of objects with different geometries and withdrawal into carrying sheath. In both cases thrombectomy and recanalization was ultimately achieved: in case No. 2, the catheter retrieval was coupled with clot removal, while in case No. 1, thrombectomy was performed subsequently. Given the probable endothelial damage, subsequent use of antiplatelets has been recommended [5], as this was done in the two presented patients. Mechanical vasospasm is a potential risk of retrieval maneuvers [5], but this did not occur in our reported cases.

Catheter retrieval was successful in two different vascular anatomic locations, i.e., the anterior and posterior circulations, suggesting that this technique can be broadly used.

Aspiration catheters are subject to torsional and axial strains. Tortuous vascular anatomy as well as material malfunction can contribute to catheter breakage [6]. Other luminal surface irregularities, such as stenosis and atherosclerotic plaques, can further contribute to retention of thrombectomy device parts [12]. In our series, a proximal loop of the left vertebral artery (case No. 1; Fig. 4a) and stenosis of the cavernous segment of the left internal carotid artery (case No. 2; Fig. 4b) may have been contributory. The flexible aspiration catheters follow the vessel contour with resultant catheter torqueing and kinking. Upon aspiration and withdrawing, the catheters endure additional tensile stress. It is possible that the formation of sharp turns in catheters will anchor the catheters leading to their breakage. Combination of vascular tortuosity and application of tensile stress to catheters seems to explain the breakage of catheters in the reported two cases, although controlled mechanical experiments are required for verification.

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Disclosure Statement

The authors have no conflicts of interest to disclose.

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