Case Report

Vol. 8, No. 2; 2024; pp 58–61
DOI: https://doi.org/10.26676/jevtm.24646

Management of Failing Coils During Embolization of Intracranial Aneurysms: A Case Report and a Review of the Literature

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Coils failing through processes such as unraveling, fracturing, and distal migration are rare during embolization of intracranial aneurysm, but these intraoperative complications might lead to serious consequences. Although several rescue techniques have been reported, the standard technique remains unclear. Herein, we report a case pertaining to removing a failing coil by a simple and economical measure. Literature on the concerned topic was also reviewed. Based on the literature, rescue techniques are classified into two types: removing the failing coils; and keeping the failing coils steady in the blood vessel by applying some appropriate measures. The former type consists of twisting, gripping, aspiration, and wedging techniques, whereas the latter includes stent-compressed techniques and end-fixing techniques.

Keywords: *Intracranial Aneurysm; Failing Coils; Rescue Technique*

Received: 26 May 2024; Accepted: 25 June 2024

INTRODUCTION

Endovascular therapy is an increasingly popular and minimally invasive option for patients with intracranial aneurysms. Coils failing through processes such as unraveling, fracturing, and distal migration are rare during embolization of intracranial aneurysm, but these complications might lead to serious consequences. Cerebral infarction is the most obvious complication. Some studies have introduced several remedies to deal with failing coils [1–5], but the optimum method remains unclear.

Recently, we retrieved a failing coil successfully using a simple and economical method which we termed as a "wedging technique." We report the details as follows.

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CASE REPORT

A 75-year-old man with headache was diagnosed with a right intracranial aneurysm (12 mm × 17 mm in size) located in the posterior communicating artery (PcomA) segment of the internal carotid artery (ICA). Coiling for the aneurysm was planned. Under general anesthesia, the patient received systemic heparinization. Afterwards, with the guidance of the guidewire (Terumo Corporation, 0.035 inch), the guiding catheter (6F ENVOY® DA, Cerenovus Corporation, inner diameter 0.071 inch) was navigated into the petrous segment of the right ICA. A stent microcatheter (Cerenovus Corporation, PROWLER Plus, the distal outer diameter 2.3 F/0.030 inch) was placed into the right middle cerebral artery. A coil delivery microcatheter (ev3TM Corporation, Echelon 14) was then navigated into the aneurysm sac. It went well until the tenth coil (Jasper Corporation, 3D 10 mm × 30 cm) was being positioned. The tenth coil was stretched. Retrieving the unraveled coil was attempted but was unsuccessful. The unraveled coil was then fractured, and the coil delivery microcatheter was removed. X-ray fluoroscopy showed that the distal portion of the failing coil was located in the aneurysm sac and a proximally stretched portion was located in the guiding catheter. We planned to wedge the failing coil in the guiding catheter with the stent microcatheter and guidewire (Terumo Corporation, 0.035 inch), subsequently withdrawing them as a single unit. As expected, the failing coil was wedged firmly in the guiding catheter and retrieved successfully (Figure 1). This simple and economical method was named a "wedging technique." After receiving endovascular treatment, the patient developed no complications.

Ethical Approval and Informed Consent

The study design was approved by Medical Ethics Committee of the Chengdu Second People's Hospital. Informed consent was obtained from the patient for publication of this case report and accompanying images.

LITERATURE REVIEW

Several other rescue techniques have been reported, so literature on the concerned topic was searched on the PubMed database and critically reviewed. Based on the literature [1–12], rescue techniques are classified into two types: removing the failing coils; and keeping the failing coils steady in the blood vessel by applying some appropriate measures. The former type consists of twisting, gripping, aspiration, and wedging techniques, whereas the latter includes stent-compressed techniques and end-fixing techniques. The techniques are described in Table 1. Figure 2 presents a vivid depiction of the techniques of twisting and wedging.

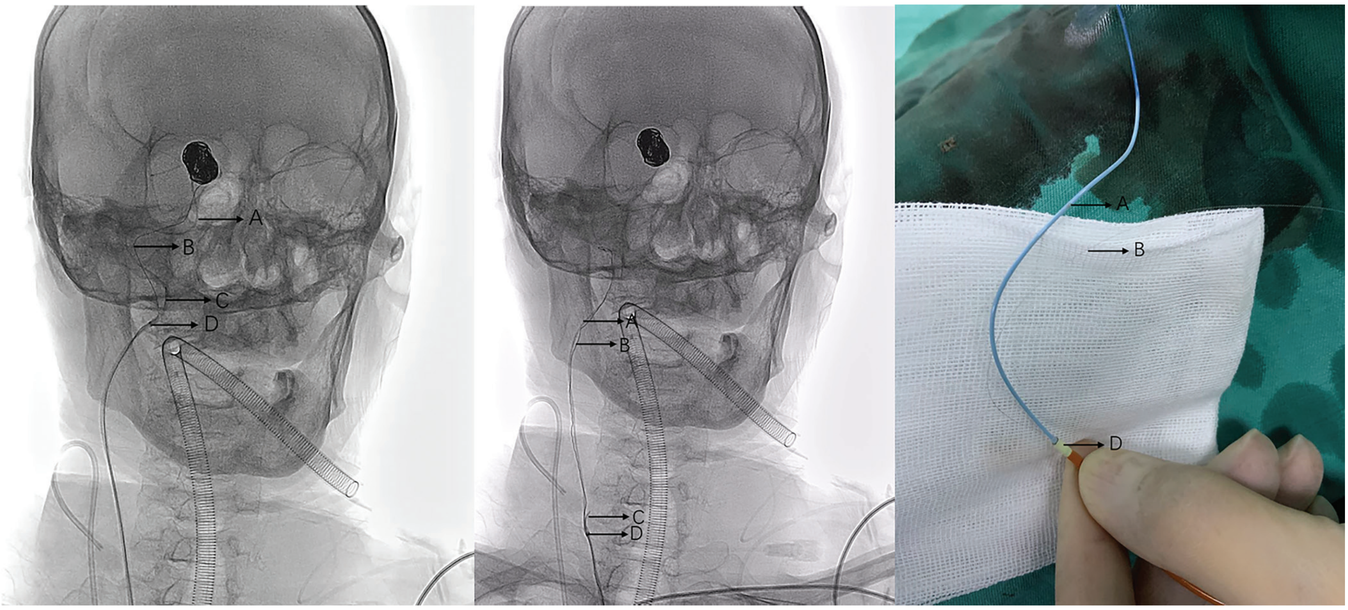

Figure 1 The failing coil was wedged in the guiding catheter (inner diameter 0.071 inch) with the microcatheter (the distal outer diameter 2.3F/0.030 inch) and the terumo guidewire (0.035 inch). Finally, all were withdrawn successfully as a single unit. Labels A, B, C, and D indicate the microcatheter, failing coil, terumo guidewire, and guiding catheter, respectively.

Table 1 Several rescue techniques to deal with failing coils.

Technique	*Description*
Removing the failing coils	
Twisting	Twisting the tip of a microcatheter or microwire to entwine a failing coil and then retrieving them as a single unit (Figure 2)
Gripping	Pulling back a failing coil by the loop of the goose neck snare, a device which was initially designed to retrieve and manipulate foreign objects in the cardiovascular system or hollow viscus
	Gripping a migrated coil using a handmade microwire-snare device, made from a microcatheter, microwire, and silk thread (Figure 3)
	Gripping a failing coil using a stent device, mimicking mechanical thrombectomy in ischemic stroke
	Gripping a failing coil in a chopstick-like manner using a magnetic device, comprising two microwires characteristic of small magnetic rings near to the tips
Aspiration	Aspirating a failing coil, mimicking mechanical thrombectomy in ischemic stroke
Wedging	Wedging a failing coil in a guiding catheter with microcatheters or guidewires, and withdrawing as a single unit
Retaining the failing coils	
Stent-compressed	Compressing the coil between a stent and vascular wall
End-fixing	Fixing the loose end of the coil at the distal end of the external carotid artery
	Fixing the loose end of the coil at the puncture site of the artery

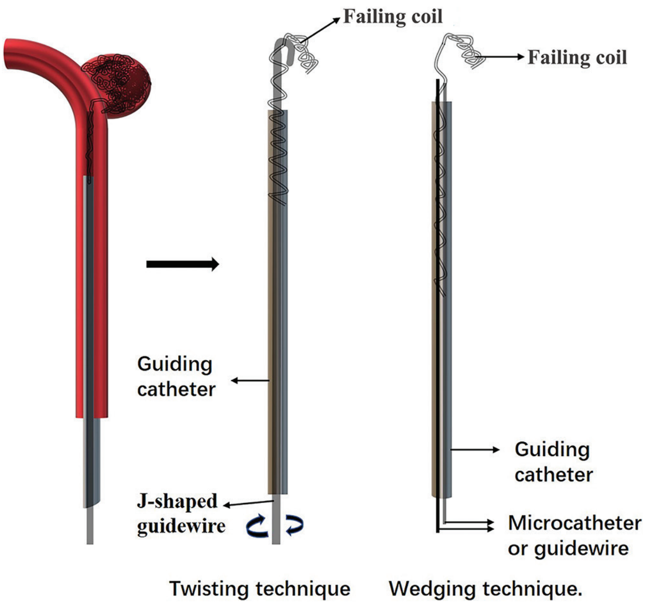

Figure 2 Vivid depiction of the techniques of twisting and wedging.

DISCUSSION

Unraveling, fracturing, or distal migration of coils are rare but challenging complications during intracranial aneurysm embolization. Inappropriate management of these complications likely leads to catastrophic consequences, such as cerebral infarction. However, the optimum method to deal with these complications remains unclear.

In our case, the failing coil was retrieved successfully using a wedging technique. The devices we used to retrieve the failing coil were already being used intraoperatively. As there were no extra devices, this technique is very economical. The process of wedging and retrieving is also simple and feasible.

Several other techniques to remove the failing coils have been reported in the literature. Mimicking mechanical thrombectomy in ischemic stroke, removing the failing coils based on a stent device [2,9] or aspiration device [4,10] is a good modality. However, this technique has a high risk of endothelial injury of cerebral vessels [3,13]. Another disadvantage of this modality is that the stent or aspiration devices are expensive.

The twisting technique is an approach where the tip of a microcatheter or a microwire is twisted to entwine a failing coil firmly and all of the parts are then retrieved as a unit (Figure 2) [6,7]. However, maneuvering in this manner seems to be difficult in clinical practice. He and colleagues [1] reported that a handmade microwire-snare device was used to remove a migrated coil. The handmade device was composed of a microcatheter, microwire, and silk thread (Figure 3). It is true that the handmade snare is economical, but the microwire and microcatheter are so smooth that the snare is likely to be unstable and the thread probably slips easily, which can lead not only to failure of capture, but also have a risk of the thread slipping into cerebral vessels. A magnetic device which consists of two microwires with small magnetic rings near to the tips was developed to catch a target coil in a chopstick-like manner in an animal test [3]. However, the "chopsticks" are long and soft, so that we do not think it is easy to control the "chopsticks."

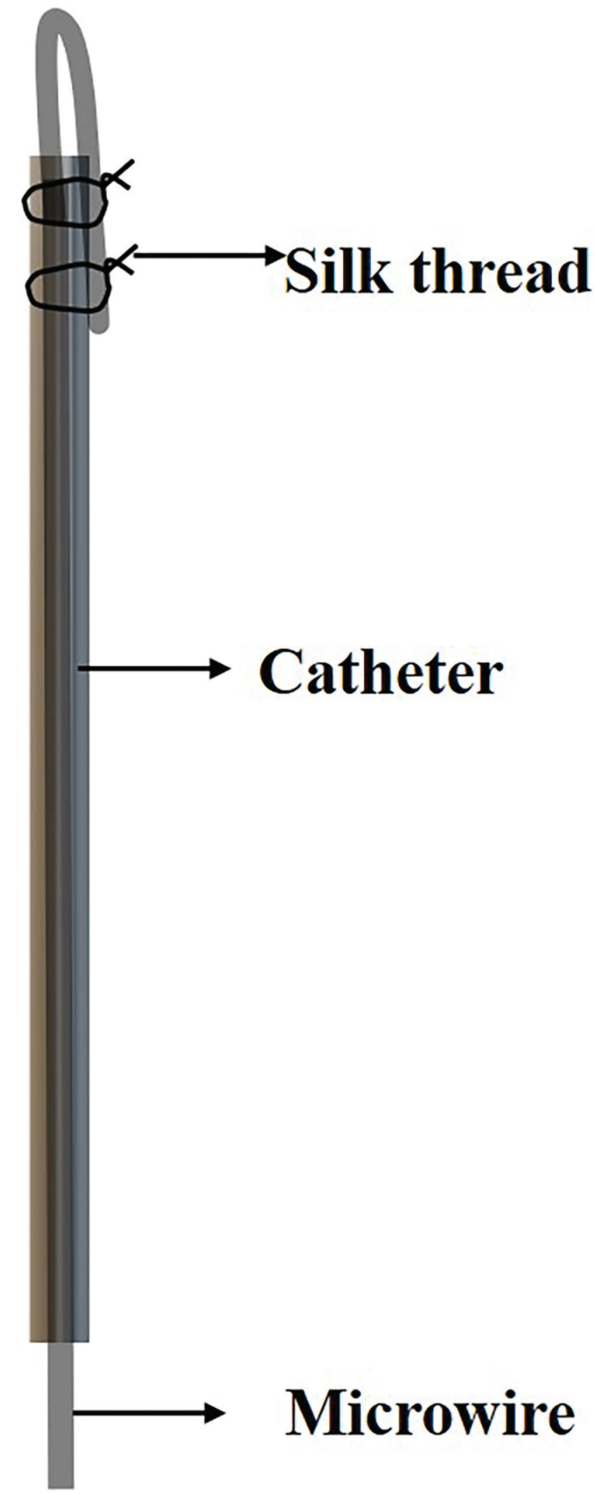

Figure 3 Handmade microwire-snare device, made from a microcatheter, microwire, and silk thread.

Although retrieving failing coils is the best strategy, retrieval is not always possible. If coil retrieval cannot be achieved, some measures should be taken to keep the failing coils steady. Compressing the coil between a stent and vascular wall is likely to be a good option [11]. If the loose end of a failing coil is long and a stent-compressed technique is not applicable, fixing the end at the distal part of the external carotid artery [5] or at the puncture site of the artery [12] is an alternative method. Patients with failing coils retained in the cerebral vessel tend to receive antiplatelet therapy to prevent thrombo-embolic complications.

CONCLUSION

This study suggests that a wedging technique is the simplest and most economical procedure and should be considered as the primary technique. Other rescue techniques might be alternative options when the wedging technique is not applicable.

Ethics Statement

(1) All the authors mentioned in the manuscript have agreed to authorship, read and approved the manuscript, and given consent for submission and subsequent publication of the manuscript.
(2) The authors declare that they have read and abided by the JEVTM statement of ethical standards including rules of informed consent and ethical committee approval as stated in the article.

Conflicts of Interest

The authors declare that there is no conflict of interest.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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