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Use of wire as a snare for endovascular retrieval of displaced or stretched coils: rescue from a technical complication

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Abstract
Introduction The displacement or stretching of coils during coiling of cerebral aneurysms is not an unusual technical complication, thus causing potentially disastrous consequences. Here, a simple technique using a wire as a snare for the removal of displaced and stretched coils is described.
Methods The simple wire technique was used to remove a coil displaced in the distal M2 that a microsnare had failed to capture and another coil stretched during the coiling of cerebral aneurysms.
Results The displaced coil lodged in the distal small cerebral vessel was entwined and removed using a microwire that was shaped manually as a pigtail at the tip. To retrieve the stretched coil, where a proximally stretched portion of the coil still remains in the delivery catheter with the distal portion placed in the aneurysm, a guidewire with a J-shaped tip was used. The coil was hooked and entwined by twisting this wire tip, which could be removed without difficulty.
Conclusion This simple technique using a wire as a snare could be a useful method for removing displaced or stretched coils in selected cases.

Keywords Cerebral aneurysm · Coil · Complication · Retrieval

Introduction

Recently, a higher number of coil endovascular surgeries have been performed in the treatment of cerebral aneurysms. The growing number of coiling procedures may result in an increasing incidence of hazardous technical complications, such as the displacement or stretching of coils. These technical complications can cause potentially disastrous consequences, such as thromboembolic vessel occlusion, leading to serious ischemic stroke. Knowledge of how to retrieve displaced or stretched coils is crucial for the prevention of major neurological complications. Thus far, a limited number of devices and techniques have been introduced to address these complications [1–13]. There is no single device or technique available for the removal of all these coils because each situation is unique. Here, a novel technique for the retrieval of displaced and stretched coils is described.

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Technique and patients

Case 1

A 57-year-old female patient required repeat coiling of a recanalized aneurysm at the supraclinoid internal carotid artery (ICA). The patient underwent stent-assisted coiling 12 months previously. The recanalized aneurysm sac was occluded by deploying 11 coils sequentially through a Prowler-14 microcatheter (Cordis) that passed the Neuroform stent that was initially placed. To achieve complete obliteration of the aneurysm's neck portion, a 2 mm×2 cm small coil (Orbit; Cordis, Miami Lakes, FL, USA) was inserted, as the last one, and then was detached. However, the coil popped out of the aneurysm within a second after the detachment and was moved down to the distal M2, where it became lodged. Removal of the coil was attempted using a 2-mm Amplatz Goose Neck snare (Microvena Corp., White Bear Lake, MN, USA), which was the only device available for this purpose in the operator's angiosuite. The microcatheter was retrieved and replaced with a larger (0.021 in. internal diameter) catheter (Prowler Plus; Cordis), which the snare could engage. It was very difficult to snare the coil and ultimately the attempts ended unsuccessfully despite several maneuvers. In addition, the maneuvering of the snare caused the coil to migrate more distally (Fig. 1a). Thus, based on the author's previous experience, snaring using a microwire tip was attempted. The microcatheter was gently advanced until the tip was just distal to the coil, using a 0.010-in. microwire (Agility; Cordis) (Fig. 1b). The microwire was shaped manually like a pigtail at the tip and was then reintroduced through the microcatheter and pushed beyond the catheter tip. Next, the operator pulled the microcatheter proximally to the coil while keeping the wire tip in the place; the shaped microwire tip was pulled proximally to make contact with the coil, then the operator entwined the coil by twisting the wire carefully under fluoroscopic guidance (Fig. 1c). Both the microcatheter and the wire with the coil captured together were withdrawn successfully as a unit into the guiding catheter (Fig. 1d). The post-removal control angiography demonstrated no evidence of adverse effects on the vessels (Fig. 1e). The patient recovered without complications and was neurologically intact.

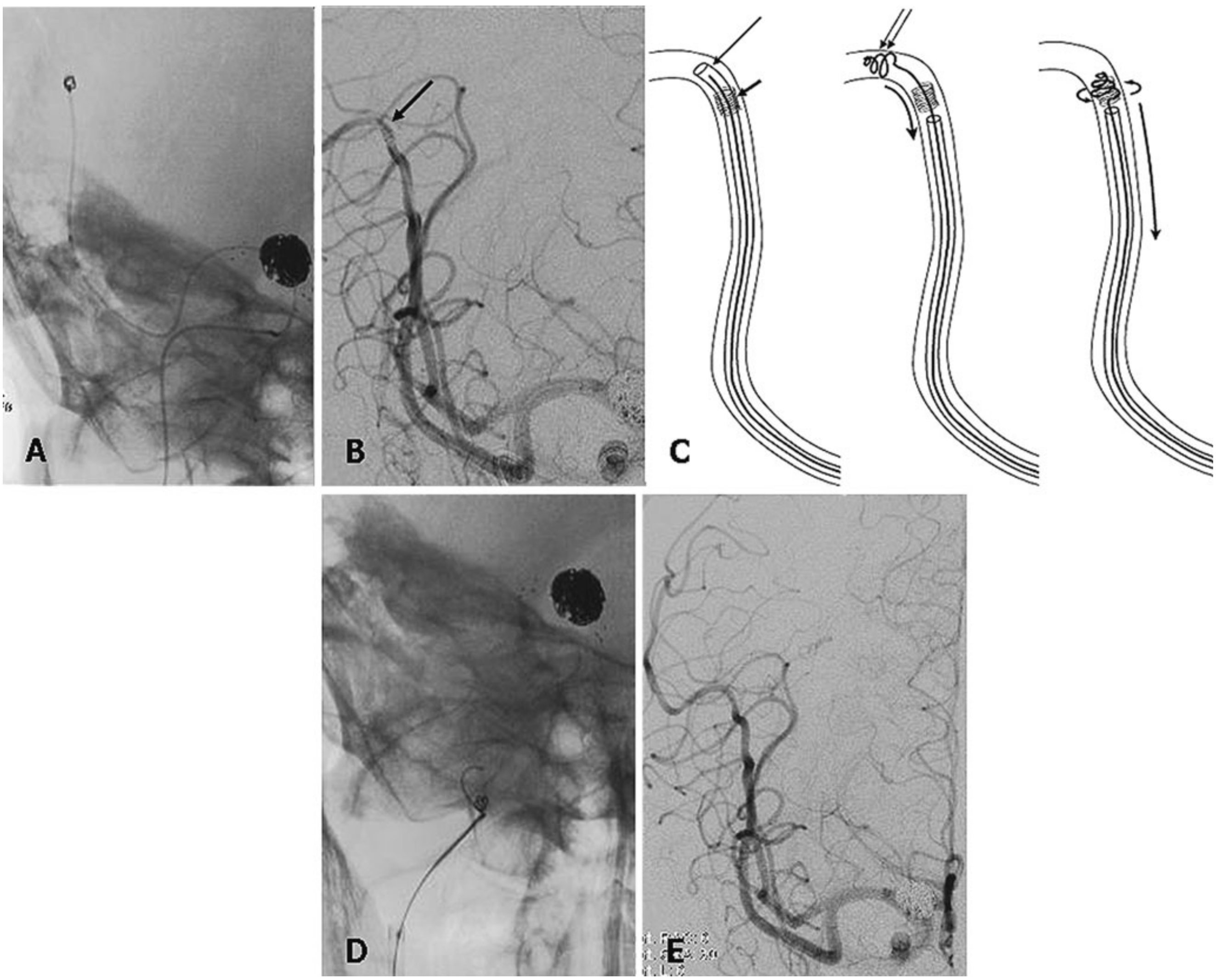

Fig. 1 Arteriograms and schematic drawing showing the removal of the displaced coil using the tip-shaped wire in case 1. **a** Digital unsubtracted fluorogram demonstrating the attempt of snaring the displaced coil in the distal M2 using a 2-mm gooseneck microsnare. **b** The coil migrated more distally after the failed snaring and the microcatheter's tip (*arrow*) was advanced distal to the migrated coil to capture it using the tip-shaped wire. **c** Schematic drawing showing the technique to catch the coil. The microcatheter's tip was advanced distally to the migrated coil. Next, the microcatheter was pulled proximally to the coil while keeping the wire tip shaped as a pigtail in place. The tip-shaped wire was then pulled down proximally to make contact with the coil, then the operator entwined the coil by twisting the wire carefully. *Long arrow*, the microcatheter's tip; *short arrow*, the displaced coil; *double thin arrow*, the wire tip shaped as a pigtail. **d** Both microcatheter and wire with the coil captured together are withdrawn as a unit. **e** Final arteriogram after the successful removal of the coil

Case 2

Balloon-assisted coiling was performed in a 68-year-old female patient with a 7.6 mm×6.2 mm unruptured paraclinoid aneurysm with a 5.4-mm-wide neck. A balloon (HyperGlide; Micro Therapeutics) over the Xpedion guidewire, with its tip shaped like a J, was placed in front of the aneurysm neck. The aneurysm was then catheterized using an Excelsior-10 microcatheter (Boston Scientific, Natick, MA, USA). During the coiling, a perforation of the aneurysm occurred when the second coil was deployed. It was controlled by continued insertion of the coil as well as additional coils while the balloon was temporarily inflated. For complete occlusion, a 2 mm×4 cm small coil (Microvention; Aliso, Viejo, CA, USA) was used in an attempt to pack the neck portion of the aneurysm sac. However, approximately 1 cm of the proximal coil was not inserted into the sac despite repeated repositioning of the coil by pushing and pulling of the coil. In an attempt to retrieve the coil in order to replace it with a shorter one, the coil was stretched and could neither be advanced into the aneurysm nor withdrawn.

Removal of this coil was attempted using a balloon guidewire (Xpedion guidewire) with a J-shaped tip instead of using an additional microwire. The microcatheter's tip was pulled back slightly outside of the aneurysm sac while keeping the coil pusher wire in place, thus exposing the distal unstretched portion of the coil and allowing it to be hooked easily by the balloon–wire tip (Fig. 2a). A balloon wire with a J-shaped tip was then moved toward the

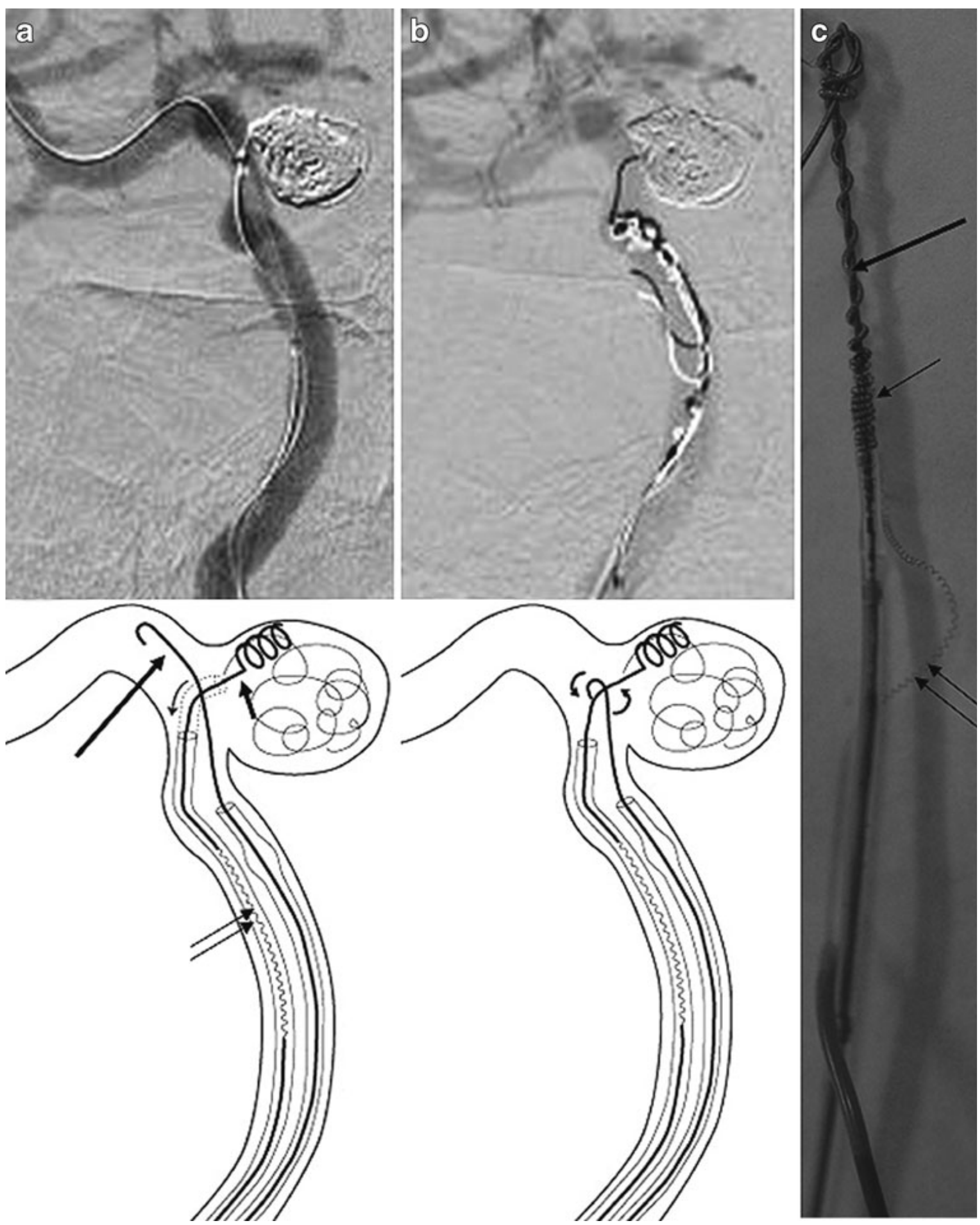

Fig. 2 **a**, **b** Arteriograms (*upper*) and corresponding schematic drawing (*lower*) of the retrieval of the stretched coil using the tip-shaped wire in case 2. **a** The microcatheter's tip was pulled back slightly and placed out of the aneurysm sac while keeping the coil pusher wire in place to expose the distal unstretched portion of the coil. **b** The wire with a J-shaped tip was then moved toward the exposed portion of the coil and entwined with it by rotating the wire. **c** Photograph of the snared coil, microcatheter, and tip-shaped guidewire removed as a unit. Note the coil entwined over the tip-shaped wire. *Long arrow*, balloon wire**;** *short arrow*, distal unstretched portion of the coil; *double arrow*, stretched portion of the coil; *thin arrow*, entwined coil

exposed portion of the coil and entwined with it by rotating the proximal wire (Fig. 2b). Removal of the coil was achieved successfully by retrieving the entire microcatheter–coil and balloon–wire system without disruption of the coil mass within the aneurysm sac (Fig. 2c). The control angiography demonstrated no evidence of bleeding from the aneurysm although there was minimal filling round the neck of the aneurysm. The procedure was terminated and close angiography follow-up was planned. The patient recovered without any neurological deficits despite a minimal subarachnoid hemorrhage.

Discussion

A limited number of procedures and devices, including medical approaches, surgical removal, and endovascular retrieval using devices, such as a retriever and snare, have been introduced to address the problem of displaced or stretched coils [1–13]. However, no single device or technique is applicable for all these coils because each one presents a unique situation. The removal of displaced coils floating free in the large intracranial circulation, such as the carotid artery or the M1, can be achieved successfully by the use of available equipment for retrieval, including the retriever and snare [2, 4, 11, 12]. However, these devices have limitations when navigating small, tortuous distal cerebral arteries; concerns with regard to their stiffness as well as the potential risk of vascular damage with the snare loop have been reported [3, 8]. Handling a microsnare to grab a displaced coil lodged in distal, small cerebral arteries <3 mm in diameter, as shown in case 1, is quite difficult because of the potential risk of vascular wall injury [2, 3, 8]. The Alligator Retrieval Device (Chestnut Medical Technologies, Menlo Park, CA, USA) or the Merci Retriever (Concentric Medical, Inc., Mountain View, CA, USA), although used as off-label devices, might help solve these problems [3, 11]. However, neither device is widely available, including at my country. Furthermore, use of the latter device in a small vessel <2 mm, as in case 1 described here, may have the potential risk of vessel injury by the loop of the helix (2.5 ~ 2.7 mm). In this situation, the use of a tip-shaped wire to snare a displaced coil, as in case 1, can be a useful approach. It can be easily provided in every angiosuite and used to safely navigate small tortuous peripheral arteries. Moreover, maneuvering the microwire to snare the coil is simple. The investigator has easily retrieved a displaced, free floating coil in the intracranial ICA using this simple technique with a J-shaped tip wire (not described here). A microwire used for this purpose would be better with a softer tip for easy access to tortuous distal vessels, a more shapeable tip that could be easily shaped, and excellent torquing for facilitating capture of the coil while minimizing the risk of vessel injury.

To retrieve unraveled or stretched coils where the proximal portion of the coil remains in the delivery catheter with the distal portion placed in the aneurysm, as in case 2, a number of safe and effective techniques have been developed [1, 5, 9]. Nevertheless, there are limitations and drawbacks. The dual guidewire technique [9], wedging the coil with two wires in the lumen of the catheter, which requires a large-diameter microcatheter, would not be acceptable for use with current advanced microcatheters with a smaller diameter. The twist technique [5], wrapping the catheter tightly with a goose neck microsnare, and the monorail snare technique [1], where the distal intact portion of the coil is snared using a microsnare with a microcatheter as a monorail guide, have been introduced to be effective means. However, these techniques often require a time-consuming and cumbersome process, such as cutting of the microcatheter hub and manipulation of the microsnare over the microcatheter. The simple wire technique used in case 2, on the other hand, was easy to perform. Furthermore, there was no need for additional particular devices, making this available for all angiosuites. Removal of the coil in a situation similar to that of case 2 may lead to a potential risk of an undesirable disruption of the coil mass already placed in the aneurysm. If the distal portion of the coil, which has been deployed in the aneurysm sac, is assessed to be long and tangled with other coil nests, pinning the free end of the proximal coil against the arterial wall with a stent may be a reasonable alternative [7]. In case 2, tangle with other coils was not thought to be present because the coil was small, short (2 mm×4 cm), and the last one used. If the free end of the proximal coil extends into the descending aorta (aorta downstream), a medical approach with antiplatelet therapy may be preferred; in this situation, symptomatic vessel occlusion is unlikely to occur [7]. The technique described here provides a procedure that is cost-effective, simple, safe, and universally available. It should be considered as an additional option for removing migrated and/or stretched coils.

Conclusion

Knowledge of how to retrieve displaced or stretched coils during coiling for the treatment of cerebral aneurysms can be crucial in avoiding major neurologic complications. Neuroendovascular therapists should be familiar with the various devices and technical procedures for removing these coils. A simple technique using a wire as a snare was safe and effective for removing displaced or stretched coils in selected cases.

Conflict of interest statement I declare that I have no conflict of interest.

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