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Transcutaneous Removal of an Intravenous Catheter Fragment Using a Spider FX™ Embolic Protection Device

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Long-term use of intravenous catheters can lead to catheter fracture and embolization of fragments. Transcutaneous retrieval of these catheter fragments can be challenging because of their fragility. We report an 8-year-old boy with Hemophilia disease who underwent removal of intravenous Port catheter after 7 years of use, resulting in embolization of fractured catheter fragments into the distal pulmonary arteries. The snare technique to pull the snared fragment into a sheath was unsuccessful, and it leads to further breakdown due to its fragility. An alternative technique using a combination of a snare kit and a Spider FX™ Embolic Protection Device was employed. This technique allowed the fragments to be secured proximally with the basket device and distally with the snare. The unit was then pulled through a sheath and removed from the body. To our knowledge, Spider FX™ Device has not been used in this way before. © 2015 Wiley Periodicals, Inc.

Key words: catheter embolization; removal of foreign body; spider FX™; embolic protection device; pediatric intervention

INTRODUCTION

Long-term intravenous catheter placement offers stable access to provide chronic infusion of medications, parenteral nutrition, fluids, or blood products and hemodynamic monitoring [1]. With its long-term use, catheters are prone to become fragile, posing increased risk of fragmentation and embolization [1,2]. When a catheter fragment is embolized into cardiac structures, transcatheter retrieval is a choice of treatment using a snare device [3–8]. A fragile catheter can become a challenge because of potential breakdown into smaller pieces, when a snared fragment is attempted to be withdrawn into a venous sheath. The Spider FX™ Embolic Protection device (ev3 Inc. Plymouth, MN) is a basket device that is normally used to trap and remove embolic debris that becomes dislodged during an interventional procedure [9]. We present a case of successful transcatheter retrieval of fragile embolized catheter fragments using a combination of snare and Spider FX™ Embolic protection device. In our case, SpiderFX™ helped secure a fragment and prevent further breakdown. To our knowledge, this device has not been used to remove a foreign body.

CASE REPORT

An 8-year-old boy with Hemophilia disease had an intravenous 5-French single lumen Vortex® Port catheter (AngioDynamics Latham, NY) that was placed for chronic factor replacement therapy shortly after the diagnosis at the age of 1 year. The Port catheter was inserted from the right subclavian vein with the tip being in the superior vena cava. After 7 years of use, the catheter had recently begun malfunctioning in that it would no longer draw back or flush. Therefore, the decision was made to remove this Port catheter and place a temporary peripherally inserted percutaneous central catheter (PICC) line. Interventional radiology attempted to remove this Port catheter. When it was being pulled out of the body, the catheter fracture occurred at the infraclavicular region between the clavicle and first rib. It was decided to remove the retained

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Conflict of interest: Nothing to report.

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catheter with a catheterization-based approach. A long 8-French vascular sheath was placed in the right femoral vein. The retained catheter was captured by the snare device and successfully withdrawn into the inferior vena cava. However, the catheter again fractured into two small fragments, as the snared catheter was withdrawn into the venous sheath. These fragments embolized into the distal pulmonary arteries. The patient was then transferred to the cardiac catheterization laboratory for removal of the embolized fragments from the pulmonary arteries.

Our initial approach was to use a larger venous sheath that may allow the snared embolized fragments to be withdrawn into the sheath without breakdown. After exchanging the sheath for a 9-French short sheath, a 7-French Berman Wedge catheter was advanced to the left pulmonary artery near the longer of the two fragments. The catheter was exchanged over a wire for a 4 French JB glide catheter (Boston Scientific, Boston, MA) and a 10 mm loop Amplatz GooseNeck® Snare Kit (ev3 Inc. Plymouth, MN). The embolized fragment was successfully snared from the left pulmonary artery and brought carefully down into the right femoral vein. As it was being pulled into the sheath, the fragment broke into two pieces (Fig. 1A and B). Both pieces then embolized to the pulmonary arteries. It was felt that the fragment was very fragile, likely due to being in the body for 7 years, and it may continue to break if the same process for removal was repeated. We decided to attempt to remove the fragments with the assistance of a 7 mm Spider FX™ Embolic Protection Device from a larger sheath.

After exchanging the sheath for a 14-Fr sheath, the largest of the three fragments was again snared using the 10 mm snare kit and JB glide catheter. The snared fragment was withdrawn into the inferior vena cava. Using a second JB glide catheter through the same 14-French sheath, the Spider FX™ device was advanced just distal to the snared fragment and its basket was exposed (Fig. 2A). The fragment was advanced into the basket of the Spider FX™ device (Fig. 2B). The basket was tightened at its mouth to contain the snared fragment inside by pulling Spider FX™ capture wire and advancing the JB glide catheter (Fig. 2C). The unit of Spider FX™ device and snared fragment was carefully withdrawn into the 14-French sheath without breakdown and removed to the outside of body (Figs. 2D and 3A). The same process was repeated for the other two fragments (Fig. 3B). In total, three fragments of various sizes were removed from the distal pulmonary arteries (Fig. 3C). The entire procedure lasted for 3 hr and 28 min. After the concept of using the Spider FX™ device to remove the fragments was initiated, the procedure only took 1 hr. The total fluroscopy time was 80 min. Anticoagulation was not used as the procedure was done entirely on the venous side of the body and the patient had a structurally normal heart.

DICUSSION

Long-term intravenous catheter access is commonly used in the management of patients requiring prolonged administration of drugs, parenteral nutrition, fluids, or blood products [1,5]. With the long-term use, the catheter becomes fragile with change of its material strength. As a result, there is a known risk of fracture and embolization with the reported incidence of 0.2–4.2% [1,5]. The most frequent access site is subclavian

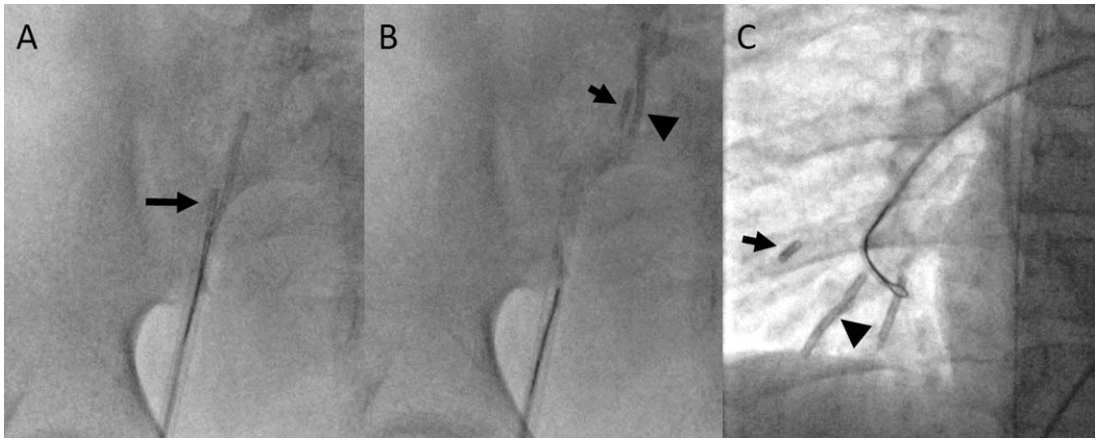

Fig. 1. (A) The embolized catheter fragment (arrow) is snared and being withdrawn to the 9-French femoral venous sheath. (B) After gradual withdrawal, the fragment broke into two pieces (arrow and arrowhead). (C) Snared fragment related to prior interventional radiology attempt and remaining two pieces from the most recent cath lab attempt (arrow and arrowhead).

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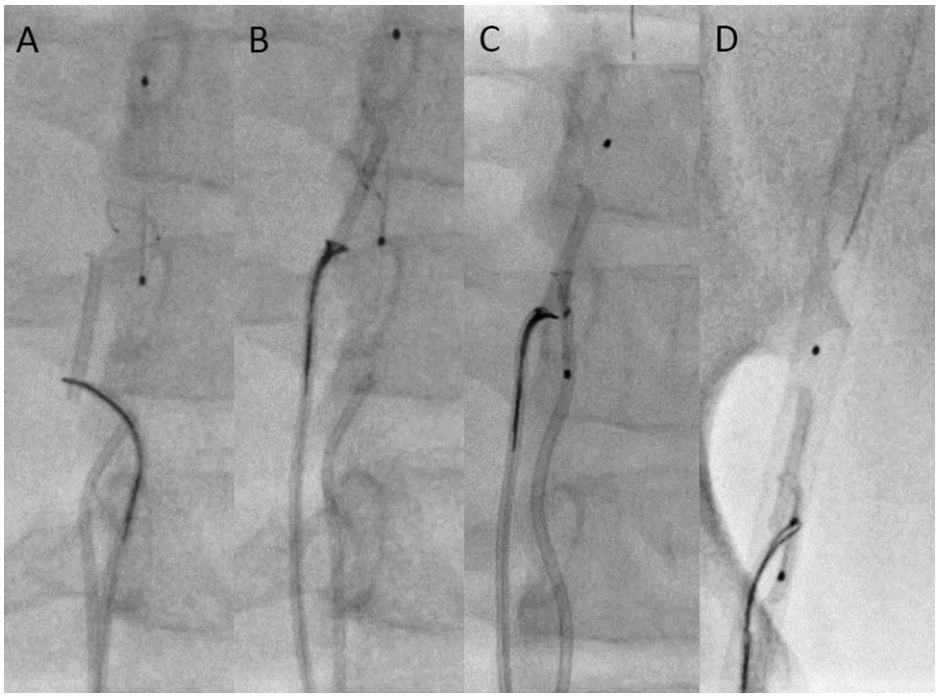

Fig. 2. (A) The proximal end of a catheter fragment is grabbed by a snare kit and 4-French JB glide catheter and withdrawn into the inferior vena cava. The Spider FXTM device is positioned distally. (B) The JB glide catheter is maneuvered to advance the snared fragment into the basket of the SpiderFX™. (C) The mouth of the Spider FX™ is tightened with pulling the capture wire of Spider FX™ and advancement of the JB glide catheter. (D) The fragment-SpiderFX™-snare unit is withdrawn into the sheath without breakdown.

vein for reported cases of fractured implanted catheters [1]. Although the lines can fracture in several locations, the common location of fracture is the infraclavicular region between the clavicle and first rib and has been labeled as "pinch off syndrome" [1,5,6]. It is believed that repeated stress in this region leads to weakening of the catheter and thus increases the risk of fracture [1,2]. Catheter embolization may result from fracture during removal, catheter disconnection, and catheter rupture [1,5,8].

In a large systematic review of 215 cases of embolization of venous catheter fragments, the fragments were most often found in the pulmonary arteries followed by the right atrium and right ventricle [1]. The most common presentation of fragment embolization is line malfunction or incidental diagnosis. Because the patients are often asymptomatic, embolization can be undiagnosed for prolonged time periods [1]. Natural history of retained embolized catheter fragments in the pulmonary circulation is unclear. Any retained foreign bodies increase risk of infection [1,5]. Retained catheter fragment in pulmonary artery potentially cause thromboembolism and pulmonary hypertension [10]. Therefore, it is preferable to remove those. When the percutaneous approach is unsuccessful, the decision needs to be made whether to pursue surgical removal or leave the retained fragments in situ in individual cases. Clinical follow up is warranted if the small foreign bodies are left in situ.

Removal by percutaneous techniques is often attempted as the first line treatment as it is less invasive than surgical approach. The percutaneous approach can be challenging, when a catheter is susceptible to breakdown because of fragility associated with its long-term use. In our case, the intravenous line had been in place for 7 years and had become fragile, making it difficult to manipulate without causing more fragmentation. As can be seen in Fig. 3C, the fragments were covered with debris that had built up over several years and likely contributed to weakening of the structure. Transcutaneous removal of embolized fragments has been reported in a large spectrum of patient ages and body weight [1,4,7]. There have been multiple reports of successful removal even in low birth weight premature infants [7].

Several techniques have been used in the cardiac catheterization laboratory. The most common technique is to use a snare device be it the commercially available "goose neck" snare or a modified hand-made loop snare [3]. Other techniques reported include using a

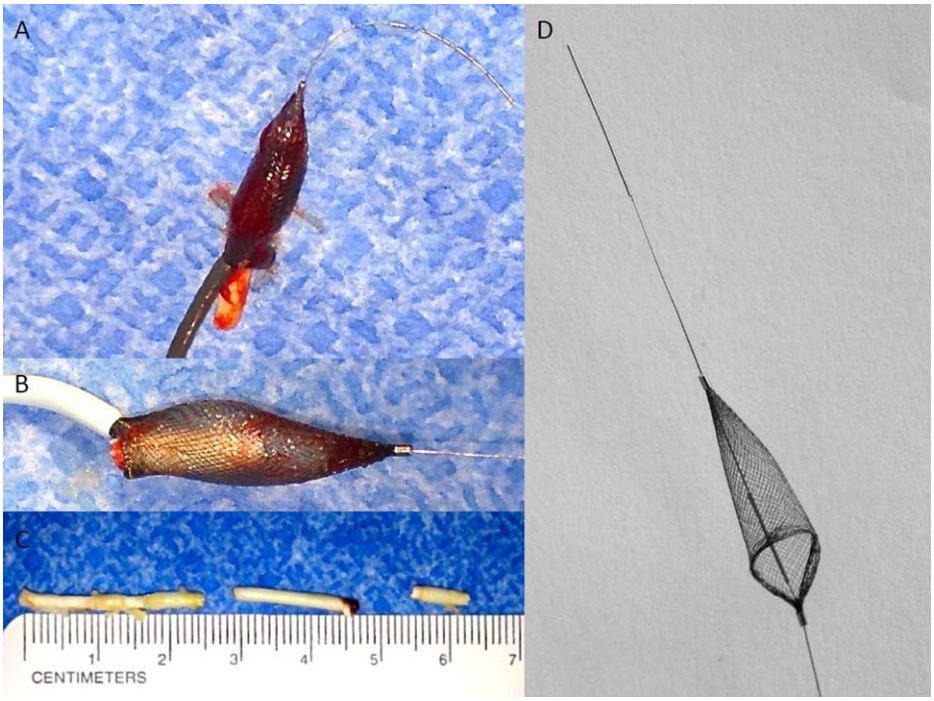

Fig. 3. (A) Post-retrieval. The longer fragment is captured by Spider FX™ Embolic protection device. (B) Post-retrieval. The smaller fragment is almost completely trapped by Spider FX™ device. (C) Three fragments of the intravenous catheter retrieved by Spider FX™. (D) Spider FX™ Embolic Protection Device. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

ureteric stone extractor, endoscopic forceps, hooked catheter, and catheter grasping forceps [1,2,5]. Loop snares are very thin and flexible. They are used to lasso the free-floating end of the catheter fragment and snare only one end of the fragment [1,3,5]. When a snared fragment is pulled into the venous sheath, the distal end of fragment usually needs to be bent (Fig. 4A). In our case, the snare was successful in retrieving the fragment but the fragility of the fragment made it difficult to remove without further breakdown. To avoid further breakdown, we used the Spider FX™ Embolic protection device, a conical shaped basket device that is used in endovascular procedures, such as carotid artery interventions (Fig. 3D) [9]. Spider FX™ prevents debris from traveling downstream by capturing it by the basket. The device can be delivered over a 0.014 in. or 0.018 in. guidewire and/or through any 0.035 in. catheter [9]. In our case, the Spider FX™ device ensured that the snared fragment was secure superiorly and would not become dislodged during manipulation through the sheath (Fig. 4B). Just as its intended use, it would have also allowed us to capture any small fragments that were to break free during retrieval of the foreign body. This was beneficial as the fragments were very fragile and fractured into smaller pieces with any significant force. We acknowledge that initial use of larger 14-Fr sheath might have precluded the catheter fracture in our case. After initial attempt using 9-Fr sheath, the more secure approach using Spider FX™ was elected rather than repeating the same process using 14-Fr sheath.

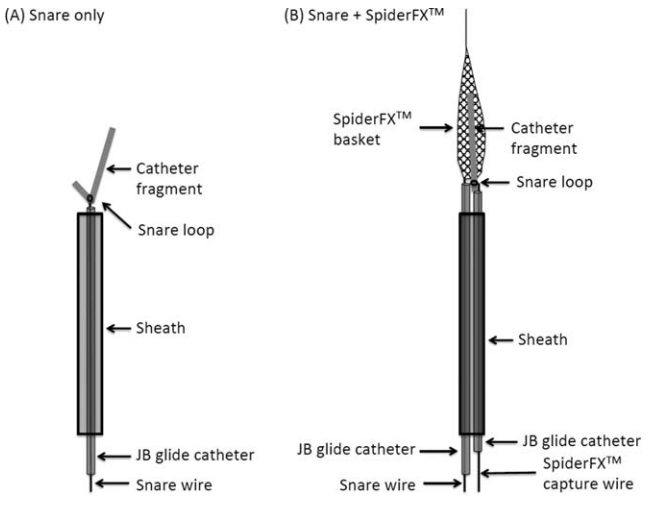

Fig. 4. Schematic figures of techniques of (A) snare only and (B) combined use of snare and Spider FX™ device.

CONCLUSION

Long-term use of intravenous catheters is a common practice in the chronic management of children and adults, with its associated risk for fracture of the catheter and embolization of fragments. The technique of using a combination of a snare and Spider FX™ Embolic Protection Device offers a reasonable alternative when trying to retrieve fragile fragments of an intravenous catheter.

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