Percutaneous retrieval of an unexpected embolization of braided transseptal guiding introducer fragments

Krittapoom Akrawinthawong, MD, MSc, FACC, FHRS,* Takumi Yamada, MD, PhD†

From the *Cardiac Electrophysiology Service, Prairie Heart Institute/Southern Illinois University, Carbondale, and †Section of Cardiac Electrophysiology, Cardiovascular Division, University of Minnesota, Minneapolis, Minnesota.

Introduction

Intravascular fragments from broken catheters can cause serious complications whether they embolize or not. They should be retrieved percutaneously or surgically as soon as possible to prevent further lethal complications. Multiple retrieval techniques using a gooseneck loop snare and balloon have been reported.1–5 We report a successful percutaneous retrieval of a small fragment of a broken sheath with a technique using a balloon modified from a technique that was previously reported.3–5

Case report

An 82-year-old female patient with persistent atrial fibrillation underwent a successful electrical isolation of the pulmonary veins and left atrial posterior wall. Two years later, an atypical atrial flutter recurred despite multiple cardioversions, and she therefore underwent a repeat ablation. During the procedure, a 7.5F sheath in the right femoral vein was replaced with a St. Jude/Abbott SL2 transeptal sheath (Swartz Braided Transseptal Guiding Introducer, SL2™, 63 cm in length, 8.5F, Abbott Park, IL). Unexpectedly, the tip of the sheath was found to have broken after its dilator was removed (Figure 1A and 1B). The guidewire (0.035 × 180 cm) and dilator were reunited with the broken sheath, and the sheath was carefully pulled out with the dilator (Figure 1C and 1D). However, a 5-cm distal segment of the SL2 sheath remained inside the femoral vein. It was successfully removed with an Amplatz Goose Neck Snare Kit (ev3 Inc, Plymouth, MN; 35 mm × 120 cm × 6F [Figure 1E and 1F]). However, a 1-cm section of the distal tip was observed under fluoroscopy to be floating freely within the right atrium and quickly embolized down into the distal branch of the hepatic vein. This was confirmed by a venogram of the hepatic vein through another new SL2 sheath (Figure 2A and 2B). Retrieval of the tip was reattempted with smaller-sized gooseneck snares and coronary angiographic catheters (ST plus Cardiac Cath 6F JR4 × 0.038 × 100 cm), but it was unsuccessful (Figure 2C and 2D). Following this, the embolized tip of the sheath was passed through with a Whisper wire (Acuity Whisper View EDS CSJ Guidewire; 0.014 × 190 cm) and then with a coronary angioplasty balloon (Trek NC RX coronary dilatation catheter; 3.5 × 15 mm.) over the guidewire. The balloon was inflated distally from the sheath tip and pulled back. However, the retrieval with this
technique was unsuccessful because the small tip of the sheath could not be moved coaxially to the vessel that acutely branched from the inferior vena cava. Following this, the balloon was deflated and repositioned back into the sheath tip. The balloon was inflated inside the sheath tip to firmly affix the sheath tip and both were successfully pulled back together into the 12F venous sheath (Figure 2E and 2F, Figure 3A). Finally, the sheath tip, balloon, and venous sheath were removed out of the vein together with the Whisper guidewire left in the femoral vein (Figure 3A). A 4F groin sheath was introduced over the Whisper guidewire into the femoral vein, and it was replaced by a new 12F venous

Figure 1  A–D: Sequential fluoroscopic images exhibiting the technique of reinserting the dilator into the sheath to retrieve the main piece of the SL2 sheath’s fragments. E, F: Using an Amplatz Goose Neck Snare Kit (ev3 Inc, Plymouth, MN) (arrow), the 5-cm piece of the tip was successfully grasped inside the common femoral vein and removed out through the upsized 12F short sheath without any complications. CS = coronary sinus catheter; LAO = left anterior oblique view; RAO = right anterior oblique view; SL2 = SL2 transseptal sheath.
sheath. Following this, a transseptal access was achieved with the new SL2 sheath, and catheter ablation of a perimtrial atrial flutter was performed. The procedure was successfully completed without any other complications.

Our institutional investigation revealed that the fractured sheath did not expire and there were no other defective devices in storage. The fractured sheath was returned to the manufacturer for an investigation. The findings of the

Figure 2  A, B: Fluoroscopic images exhibiting a hepatic venogram and the location of the embolized 1-cm fragment of the broken SL2 sheath (arrow). C, D: Using smaller-sized gooseneck snares and coronary angiographic catheters to retrieve this small fragment proved to be futile. E: A Whisper wire was passed through the embolized tip of the sheath, and then a coronary angioplasty balloon was advanced into the broken tip and inflated within it. F: The inflated balloon firmly affixed the tip, and the tip was successfully removed without any complications. JR4 = JR4 coronary angiographic catheter; Snr = 4F Snare catheter. The other abbreviations are as in Figure 1.
investigation were as follows: (1) the introducer sheath had been fractured in multiple locations along its length and the distal tip was detached from the sheath; (2) the fractured tubing remained connected by the braided wires; (3) several cracks were noted throughout the length of the sheath; and (4) the sheath tubing was a light-yellow color. The investigation report concluded that the cause of the fractured sheath was consistent with a poor product storage leading to material degradation from light exposure. It was unclear how long the sheath had been in storage before use. However, it should not have been stored in our electrophysiology laboratory for a long period because our institute was a high-volume center and a lot of SL2 sheaths had been used regularly. All sheaths had been stored in locations without any direct sunlight once they had been delivered to our hospital.

**Discussion**

Multiple case studies have demonstrated a successful retrieval of a broken catheter using a gooseneck snare and balloon\(^1\)\(^{-6}\) with\(^2\)\(^{-4}\)\(^,\)\(^6\) or without\(^1\)\(^{,}\)\(^3\)\(^,\)\(^5\) the combined use of a large-diameter preshaped or steerable sheath. In those cases, a large fragment of the broken catheter was retrieved. When a catheter is broken into multiple small fragments, a retrieval of all of them would be challenging. If a small broken fragment were to embolize into a peripheral vessel, its retrieval would become more challenging. Previous studies demonstrated a successful retrieval using a balloon inflated distally from a large fragment of a broken catheter,\(^3\)\(^{-5}\) but that technique was not successful in this case because a small fragment of a broken sheath had embolized into a vessel acutely branching from the inferior vena cava. This report illustrated a modified retrieval technique using a balloon inflated within the small fragment of the sheath that was successful in such an extremely challenging scenario.

The St. Jude/Abbott Swartz sheaths may be the most commonly used for transseptal procedures. To the best of our knowledge, there have been no reports of the disintegration of that sheath. However, the material of that sheath can be damaged by sunlight exposure. This kind of sheath damage can be recognized by a change in the material color. An inspection of the sheath integrity would be recommended before the use of the sheath to avoid any trouble as reported in this report.

**Conclusion**

This report illustrated a modified retrieval technique using a balloon inflated within a small fragment of the sheath that was successful in an extremely challenging scenario.

**References**

1. Patra S, Sadananda KS, Agrawal N, Manjunath CN. Successful retrieval of a fractured and embolised Judkin’s catheter during a coronary angiogram. BMJ Case Rep 2013;2013:bcr2013009848.
2. Vijayalakshmi IB, Agrawal N, Mallikarjun K, Manjunath CN. The retrieval of the diagnostic catheter which broke and embolised twice. BMJ Case Rep 2013;2013:bcr2013200058.
3. Lee SN, Jo MS, Yoo KD. Percutaneous retrieval of a fractured dialysis catheter using a balloon. J Vasc Access 2017;18:e42–e44.
4. Jamshidi N, Chiang J. Inline balloon-assisted vascular sheath fragment removal. CVIR Endovasc 2020;3:53.
5. Doğduç M, Dündar F, Türköylmez E, Dündar B, Tungur B, Ö Candan. Successful percutaneous transvenous removal of a fractured port catheter via novel technique: balloon-supported retrieval. Anatol J Cardiol 2021;25:671–672.
6. Ströthmer B, Altenberger J, Pichler M. A new approach of extracting embolized venous catheters using a large-diameter steerable sheath under biplane fluoroscopy. Clin Imaging 2012;36:502–508.