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CASE REPORT

Endovascular Rescue of Sheath Perforation During Inferior Vena Cava Filter Retrieval

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Introduction: Inferior vena cava (IVC) filter retrieval is generally a straightforward procedure but can be challenging with unique complications. A technique used for endovascular rescue of a patient where sheath perforation by the IVC filter occurred during IVC filter retrieval is described.

Report: A 75 year old man underwent retrieval of an IVC filter that had been in place for 10 months. Using the IVC filter retrieval set from a standard right internal jugular vein approach and the loop—snare technique, the hook and collet were captured, and the filter was collapsed into the retrieval sheath. Approximately halfway through removal of the filter through the sheath, mild resistance was encountered and the tip of the IVC filter was found to have perforated the side of the retrieval sheath. The sheath appeared to have bent slightly in this region, probably weakening the sheath wall and creating angulation, which allowed sheath perforation to occur. From a right common femoral vein approach, an Amplatz wire was used to cannulate the distal end of the perforated sheath. A balloon was then used to pull the perforated sheath with the IVC filter into a larger sheath. After removing the Tuohy-Borst and Luer adapters on the perforated sheath, it was able to be internalised and removed via the femoral vein sheath.

Discussion: The endovascular rescue technique described herein may prove useful to other practitioners encountering similar situations, and the complication shows areas of caution when using the loop—snare retrieval technique.

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INTRODUCTION

Patients with venous thrombo-embolism continue to be treated by anticoagulation as the mainstay of therapy. However, patients who have experienced significant complications associated with anticoagulation, have contraindications to anticoagulation, or have developed recurrent or worsening thrombo-embolism despite anticoagulation are considered to be candidates for the placement of an inferior vena cava (IVC) filter.[1] Retrievable IVC filters have traditionally been chosen for patients in whom the contraindications to or complications of anticoagulation therapy are temporary or transient, thus allowing the filter to be removed when anticoagulation therapy is again deemed appropriate.[2] However, the retrieval rate is often suboptimal, with one study including >50 000 patients showing only 18.4% had their filter retrieved within one year.[3] Allowing these retrievable filters to stay in place longer is problematic as prolonged filter dwell time has been associated with complications, including device fracture, migration, organ penetration by device components, and elevated risk of deep vein thrombosis (DVT).[4] Some retrievable IVC filters are not removed owing to a lack of follow up, while others are not removed owing to technical challenges associated with the retrieval. The purpose of this report is to describe an endovascular rescue technique used in a case where sheath perforation occurred while using an advanced retrieval technique.

CASE REPORT

The patient was a 75 year old man with a history of rectal cancer, lower extremity DVT, and pulmonary embolism (PE), who was on therapeutic anticoagulation with warfarin. About 10 months prior, he had undergone IVC filter placement (Cook Celect Platinum Vena Cava Filter; Cook Medical, Bloomington, IN, USA) via a standard femoral vein approach without complication, in anticipation of abdominoperineal resection surgery, given his significant venous thrombo-embolism history and peri-operative contraindication to therapeutic anticoagulation. The patient had a somewhat prolonged recovery from this major surgery, but eventually

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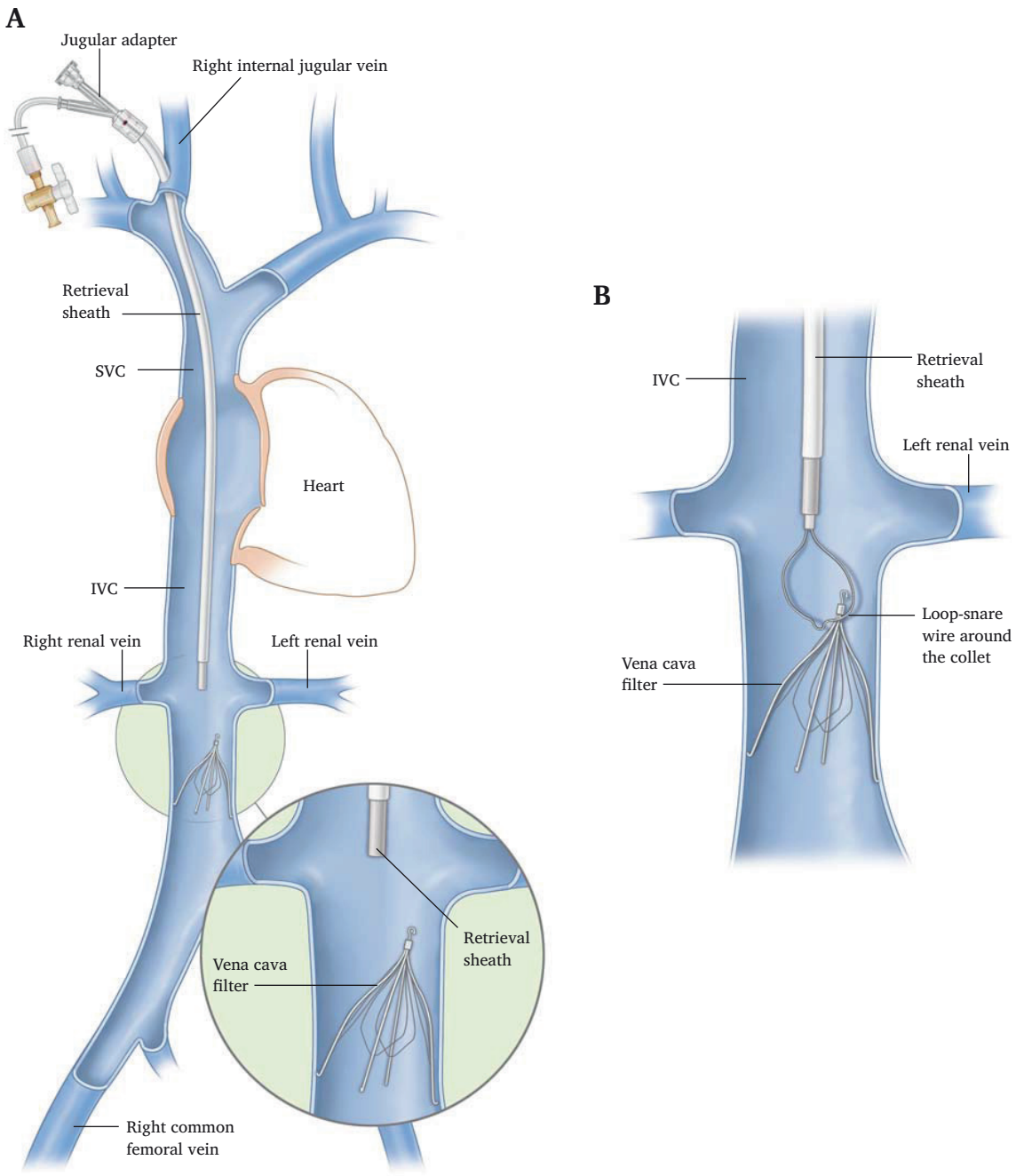


Figure 1. Step by step demonstration of the endovascular rescue technique (A) Standard access via the right internal jugular vein with inferior vena cava (IVC) filter retrieval kit (B) Using the loop—snare technique, the hook and collet of the filter were captured (C) Approximately halfway through removal of the filter through the sheath, the tip of the IVC filter was found to have perforated the side of the retrieval sheath (D) Via a 16 F, 45 cm sheath in the right common femoral vein, an Amplatz wire was used to cannulate the distal end of the perforated retrieval sheath and a six mm × four cm balloon was advanced into the distal end of the perforated retrieval sheath (E) After removing the Tuohy—Borst and Luer adapters on the perforated sheath, it was able to be internalised, along with the IVC filter, and removed via the femoral vein sheath. SVC = superior vena cava.

returned for IVC filter retrieval, which was felt to be indicated, given his ability to resume therapeutic anticoagulation successfully, no history of anticoagulation complications, ongoing contraindication to anticoagulation, or history of recurrent DVT or PE, despite anticoagulation. The patient was brought to the catheterisation laboratory suite and, using the Cook Gunther Tulip Vena Cava Filter Retrieval Set (Cook Medical), standard access procedures were performed via the right internal jugular vein (Fig. 1A). Initial attempts at snaring the hook on the filter using gooseneck and cloverleaf snares were unsuccessful, owing to some tilting of the IVC filter. Using the loop—snare

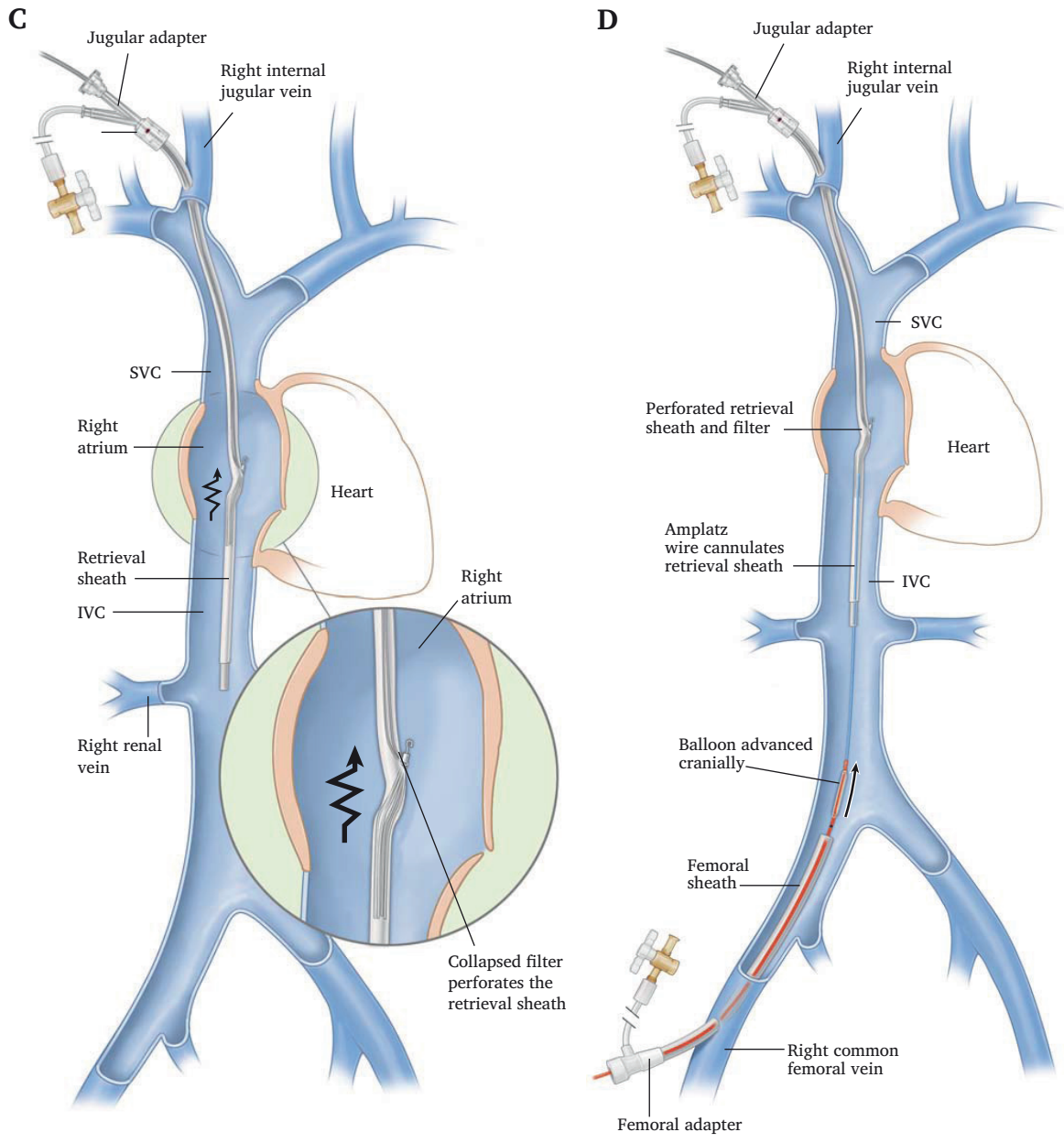


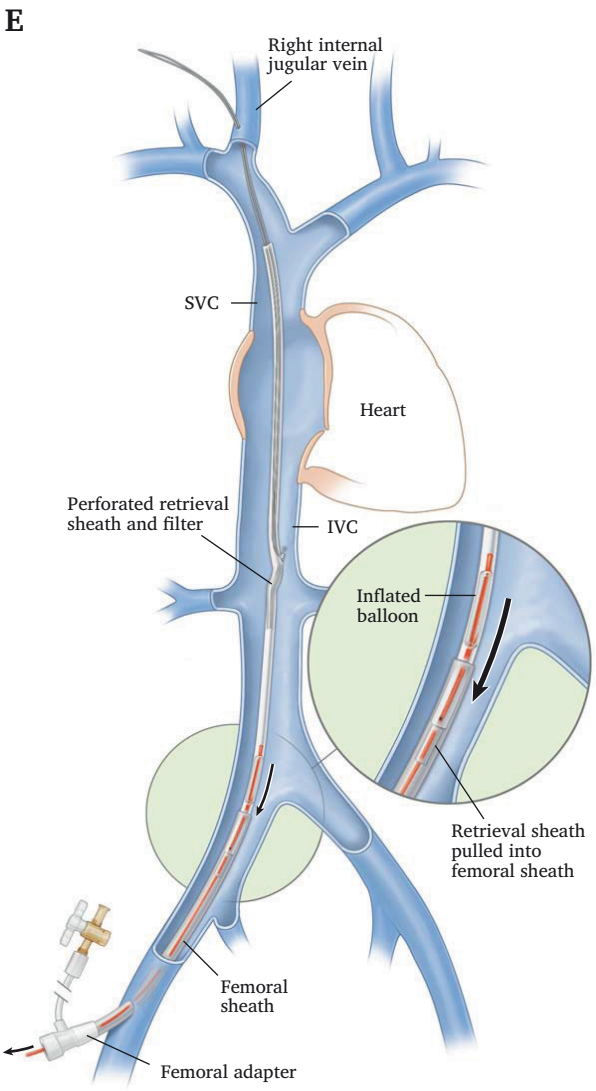
Figure 1. (*continued*).

technique, the hook and collet were captured (Fig. 1B) and the filter was collapsed into the retrieval sheath. Approximately halfway through removal of the filter through the sheath, mild resistance was encountered. The tip of the IVC filter was found to have perforated the side of the retrieval sheath (Figs. 1C and 2). The sheath appeared to have bent slightly in this region, probably weakening the sheath wall and creating angulation, which allowed sheath perforation to occur. The sheath could not be pulled superiorly, but it could be pushed inferiorly without resistance. Right femoral vein access was achieved and a 16 F, 45 cm sheath was placed. A short taper tip Amplatz wire was used to cannulate the distal end of the perforated retrieval sheath (Fig. 1D). A 6 mm $\times$ 4 cm balloon was then inflated in the distal end of the perforated retrieval sheath and was used to pull the sheath into the 16 F femoral vein sheath. After removing the Tuohy—Borst and Luer adapters on the perforated sheath, it was able to be internalised, along with the IVC filter, and removed via the femoral vein sheath (Fig. 1E).

Informed patient consent was obtained for all procedures and consent for publication was also obtained from the patient.

DISCUSSION

Various IVC filter retrieval techniques have been developed in recent years and continue to be improved upon. The standard approach to IVC filter retrieval begins by



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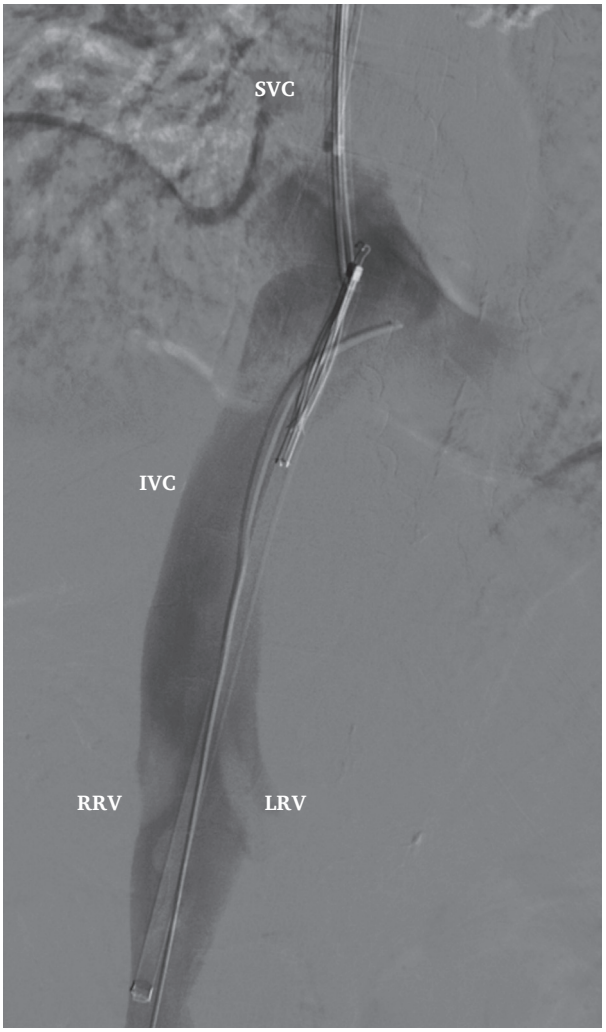

Figure 2. Intra-operative fluoroscopy demonstrating inferior vena cava (IVC) filter perforation through the initial retrieval sheath placed via the right internal jugular vein. SVC = superior vena cava; RRV = right renal vein; LRV = left renal vein.

achieving single venous access typically in the right jugular vein. A sheath and snare combination can then be introduced and guided into the IVC where the filter was initially placed. The sheath and snare combination can then be used to engage, collapse, and remove the filter. Although using the standard approach has had reported retrieval success rates of 80—90%, there are some scenarios where this approach is not appropriate or may fail on initial attempts.[5] Factors that significantly increase the risk of filter retrieval failure using the standard approach include embedded filter hook, severe tilt, and filter penetration into the caval wall.[6] When these factors are present, the individualised decision to attempt an advanced retrieval technique must be weighed against the outcomes associated with leaving the filter in permanently. Examples of indications where advanced retrieval techniques have been attempted include treating symptomatic filter related IVC stenosis, treating symptomatic filter penetration, avoiding the risk of long term thrombotic complications in a young patient, and avoiding the need for lifelong anticoagulation.[7]

One advanced technique known as the loop—snare technique has been used to retrieve tilted or embedded filters or after initial attempts with the standard approach have failed. This technique involves placing a reverse curve catheter below the level of the filter, which is then used to direct a guidewire through the filter legs. The end of the guidewire is snared and externalised, thus effectively forming a loop through the filter that can then be used to provide counter traction to collapse the filter into the sheath. One complication associated with this technique is re-orientation of the filter, which occurs if the loop is not formed directly underneath the filter apex.[5] When externalisation is attempted with the misplaced guidewire, the filter may move into a more transverse position that complicates retrieval.

When advanced single access techniques are unable to retrieve a tilted or embedded filter successfully, a wire and snare with dual access technique may be attempted. In this technique, both jugular and femoral access must first be achieved. A stiff wire is then introduced through either site and advanced between the filter apex and the caval wall. The stiff wire is then snared from the alternate access point and pulled back and forth in a "flossing motion", to disengage the filter from the caval wall or adjust its positioning. The snare can then be used to externalise the repositioned filter. Pitfalls to this technique include risk of vein laceration during the significant back and forth movement associated with the repositioning.[8]

When using the loop—snare technique in this case, the complication of IVC filter perforation through the retrieval sheath was experienced. Following this perforation, the sheath could not be pulled superiorly, but it could be pushed inferiorly without resistance. This led to the decision to achieve additional access via the femoral vein. This allowed cannulation of the distal end of the perforated sheath with a short taper tip Amplatz wire and a balloon inflated in the distal end of the perforated sheath was used to pull the perforated sheath with the IVC filter into the larger femoral vein sheath for externalisation. This novel technique was applied successfully and could be useful to other practitioners in similar endovascular rescue scenarios, particularly during IVC filter retrieval.[9]

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