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INTERVENTIONAL RADIOLOGY

TECHNICAL NOTE

Direct superior vena cava puncture for inferior vena cava filter retrieval

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ABSTRACT

Most inferior vena cava (IVC) filters are designed for retrieval from a superior approach. Retrieval becomes technically challenging when the central veins in the chest are occluded. In a patient with thrombosis of the bilateral brachiocephalic veins, the authors describe direct puncture of the superior vena cava (SVC) under fluoroscopy, followed by the successful retrieval of a fractured IVC filter using forceps. A snare inserted into the SVC via the common femoral vein was used as a radiopaque target for direct SVC puncture from the lower neck. Cone beam computed tomography and pullback tractography were used to confirm a safe access trajectory. Thus, direct SVC access may be used for filter retrieval in similar clinical scenarios.

KEYWORDS

Advanced filter retrieval, deep vein thrombosis, filter, inferior vena cava, inferior vena cava filter, IVC filter retrieval, superior vena cava

An inferior vena cava (IVC) filter is typically retrieved via internal jugular (IJ) venous access. Subclavian venous access can be used when the IJ veins are occluded. Filter retrieval becomes technically challenging when both the IJ and subclavian veins are occluded. The authors describe direct superior vena cava (SVC) puncture to obtain access for IVC filter retrieval. Institutional review board approval is not required for case reports at the author's institution.

A 38-year-old woman with systemic lupus erythematosus-induced renal failure who had undergone a kidney transplant was admitted with coronavirus disease-induced respiratory failure and found to have an IVC filter (Recovery G2, Bard, New Providence, USA), which had been placed approximately 20 years prior. The filter, positioned within the hepatic IVC, had tilted and fractured (Figure 1a). It was decided to retrieve the IVC filter, given the concern about its migration into the heart. Of note, the patient had bilateral brachiocephalic vein occlusions and a persistent left SVC.

Technique

Intravascular ultrasound was performed via right common femoral venous (CFV) access, confirming the wide patency of the IVC and SVC to the level of the azygous inflow. Attempts to traverse the occluded upper extremity veins were unsuccessful. Similarly, the SVC could not be accessed via the collateral veins in the neck. Consequently, a 10-mm gooseneck snare (Medtronic, Dublin, Ireland) was deployed from the CFV access into the cranial-most aspect of the SVC. A 21-Gauge, 15-cm Chiba needle was inserted from a supraclavicular approach into the right neck under fluoroscopic guidance, targeting this snare, and the needle was successfully advanced through the snare loop. A 0.018 inch angled Glidewire (Terumo, Somerset, USA) was inserted through this Chiba needle, snared, and pulled through the femoral access (Figure 1b). Cone beam computed tomography (CBCT) was then performed, showing the initial puncture to be trans-pleural; this process was then repeated via a more medial approach (Figure 1c, d). Pullback tractography was also performed, ensuring the absence of arterial transgression. The cervical access site was then upsized using a 3–5 Fr transitional dilator, and a 16-Fr, 30-cm sheath was introduced. Through this, the filter and fractured fragment were retrieved using rigid endobronchial forceps (Figure 2a). Post-retrieval digital subtraction

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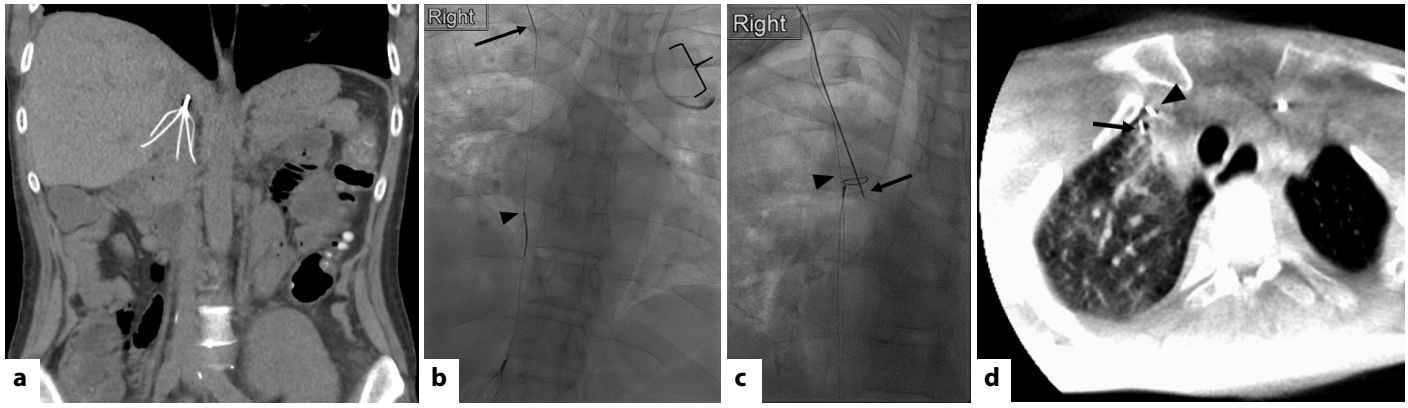

Figure 1. (a) Coronal non-contrast computed tomography showing the filter position within the hepatic inferior vena cava. **(b)** Fluoroscopic image demonstrating the initial needle pass (arrow) and snared wire (arrowhead). The left internal jugular central line (brace) is incidentally seen. **(c)** Fluoroscopic image showing the second, more medial approach (arrow). The wire from the initial puncture remains in place (arrowhead). **(d)** Axial cone beam computed tomography demonstrating the positions of the first (arrow) and second (arrowhead) passes.

venography demonstrated no abnormality (Figure 2b), so the sheath was removed, and hemostasis was obtained with manual compression.

Discussion

Most retrievable IVC filters are designed to be retrieved via a superior approach. Occlusion of the neck and/or the central veins in the chest makes IVC filter retrieval technically challenging. A recent study described external jugular venous access as a feasible alternative to IJ venous access.[1] However, since this patient had occluded brachiocephalic veins, it was not surprising that SVC could not be accessed via the smaller neck veins, including the collateral veins in the neck. Two cases have been reported in which percutaneous transhepatic access was obtained, and the IVC was accessed via the hepatic veins.[2,3] This approach may pose a higher bleeding risk and risk of injury to the liver. Advanced maneuvers for filter retrieval, such as the loop-snare technique, could be more challenging given the acute angulation in such cases. Similarly, retrieval via rigid forceps would be impossible. Hence, transhepatic access was not a suitable option in this case, as the filter had been placed 20 years ago and was fractured, necessitating its removal via forceps. Filter retrieval via femoral venous access would have necessitated inverting the filter. This was considered unsafe, as the filter was fractured and likely to be fragile, thus posing a high risk of filter fragment migration to the heart while attempting this maneuver. Snaring the guidewires out through the femoral access may have eased the process of tract dilation. The potential risks of direct SVC puncture include transgression of the pleura and/or lungs with associated complications, inadvertent puncture of the arteries within the thorax with the potential difficulty in achieving hemostasis, and transgression of a high pericardial insertion. These risks were mitigated with a thinner 21 Gauge needle for the initial access, CBCT to provide direct visualization of the needle trajectory, and pullback tractography. Thus, direct SVC access may be safely used for filter retrieval in similar clinical scenarios.

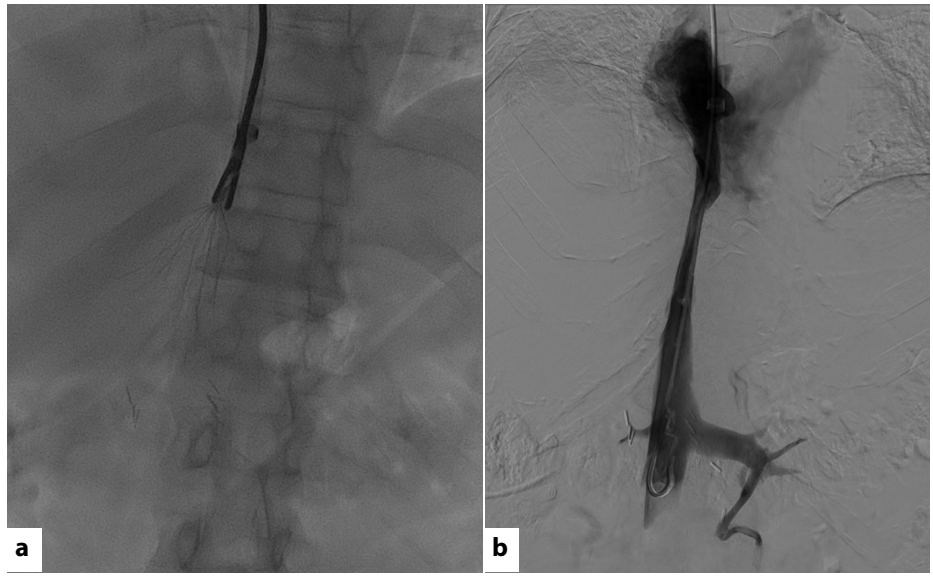

Figure 2. (a) Fluoroscopic image demonstrating filter retrieval. **(b)** Post-retrieval digital subtraction venogram confirming the absence of complication.

Main points

- Most inferior vena cava (IVC) filters are designed to be retrieved via a superior approach.
- Retrieval becomes technically challenging when bilateral jugular and subclavian or bilateral brachiocephalic veins are occluded.
- In this technical modification, the authors describe direct puncture of the superior vena cava to obtain central venous access and successfully retrieve a longstanding, fractured IVC filter.

Conflict of interest disclosure

The authors declared no conflicts of interest.

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