

Inadvertent noncaval filter deployment and its management

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ABSTRACT

Inferior vena cava filters are placed to prevent life-threatening pulmonary embolism in a selected group of patients. Significant complications are known to occur with prolonged dwell times, and rarely during initial placement. In this report, we describe two cases of inadvertent noncaval inferior vena cava filter placements, specifically in the azygous vein and right renal vein, and the complex methods used to retrieve them, which exemplify the critical importance of routine and careful placement techniques. (*J Vasc Surg Cases and Innovative Techniques* 2019;5:360-4.)

Keywords: IVC filter; Venogram; Filter migration

Inferior vena cava (IVC) filters are indicated to prevent life-threatening pulmonary embolism (PE) in patients with deep vein thrombosis (DVT), who have contraindications to pharmacologic anticoagulation, have failed anticoagulation, or have prolonged immobility with elevated risk for or history of DVT/PE.^{1,2} Despite the benefits of IVC filters, there are significant risks of indwelling filters, including migration, fracture, thrombosis, and perforation, especially prevalent owing to the abysmal eventual filter removal rates.³ After obtaining the patients' consent, we describe two cases of noncaval IVC filter placements and the complex methods used to retrieve them, which exemplify the critical importance of routine and careful placement techniques.

CASE 1

A 32-year-old woman in the second trimester of pregnancy underwent IVC filter placement 9.5 years ago at the referring facility owing to DVT. She presented to our emergency department with severe abdominal and right flank pain, with 3 years of escalating opioid use and chronic dyspnea. Over time, the patient was unable to work or maintain her daily activities.

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A computed tomography scan of the abdomen and pelvis was obtained, which demonstrated a Gunther Tulip filter (Cook Medical, Bloomington, Ind), abnormally positioned in the infra-diaphragmatic abdominal azygous vein (Fig 1). Multiple filter struts were perforated through the azygous vein, with two legs penetrating the diaphragmatic crux. Upon further discussion, the patient reported worsening abdominal pain after IVC filter placement and three unsuccessful attempts to remove it. She was informed that the filter had migrated and would be permanent. After lengthy discussion with the patient as well as cardiothoracic and vascular surgery colleagues, the decision was made to attempt filter removal.

The patient was brought to the angiography suite under general anesthesia. Right internal jugular venous access was obtained with ultrasound guidance, and a venogram demonstrated patent central veins. Under a steeply oblique view, a 5F angled catheter was advanced into the azygos vein by angling the catheter posteriorly. An azygos venogram was performed, demonstrating patency central to the filter and adjacent intercostal veins. A 10F sheath was advanced over a stiff 0.035 guidewire with tip just central to the filter hook. A 0.018-in buddy wire was advanced caudal to the filter within the azygous vein.

Over both wires the sheaths were removed, and a 10F sheath exchanged over the 0.035 wire and subsequently the filter hook was captured with an EnSnare (Merit Medical, South Jordan, Utah). However, during the retrieval attempts, the sheath became distorted owing to the force required.

The sheath was exchanged for a 16F sheath over the EnSnare wire, still engaged on the filter hook. A 12F Spectranetics (Phillips, Colorado Springs, Colo) laser sheath was activated; however, it was unsuccessful and there was inadvertent fracturing of the snare. Attempts at retrieving the filter with the Gooseneck snare and then endobronchial forceps was performed, but ultimately unsuccessful. After unsuccessful attempts with the 12F and 14F laser sheaths, a 20F Dryseal sheath (W. L. Gore & Associates, Newark, Del) was placed into the azygous vein and 16F sheath was then used. With the laser sheath and simultaneous forceps counter tension, the filter was successfully removed. The patient tolerated the procedure without complication and venogram demonstrated patent

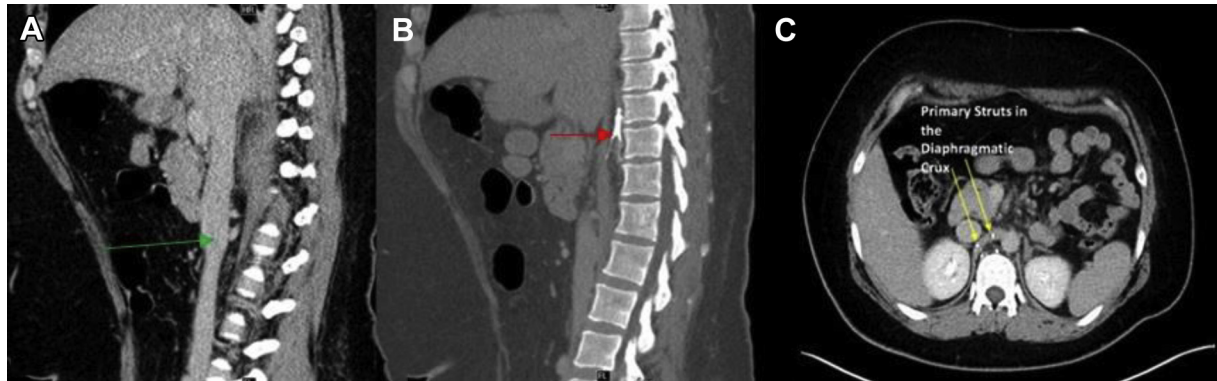


Fig 1. **A**, Sagittal contrast-enhanced computed tomography scan showing patent and unremarkable inferior vena cava (IVC; *green arrow*). **B**, Retrievable filter present just in front of the spine, in the azygous vein (*red arrow*). **C**, Axial contrast enhanced delayed computed tomography scan showing filter primary struts in penetrating the diaphragmatic crux (*yellow arrows*).

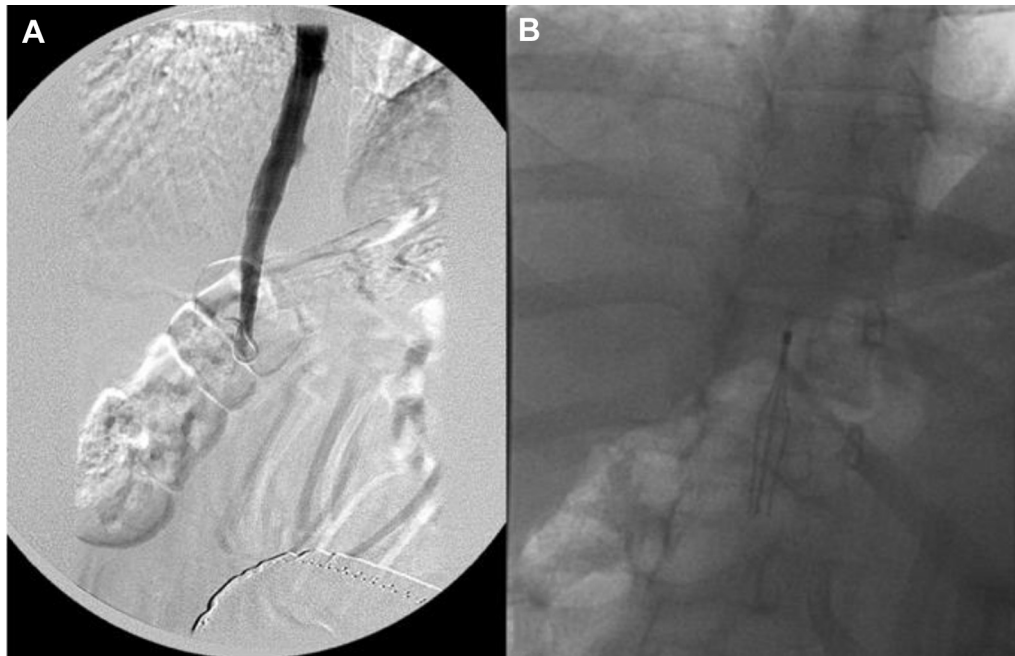


Fig 2. **A**, Digital subtraction angiography venogram shows tapered and small caliber appearance of the vessel, not typical for a patent inferior vena cava (IVC). **B**, Unexpanded filter from post placement spot image.

veins. Upon inspection, one secondary strut was missing, not visible in the abdomen or chest on spot radiographs, and on computed tomography scan it was shown to be completely embedded in the azygous vein wall.

Upon further image acquisition from the outside institution, the initial venogram was not performed from the iliac veins, and the small caliber/tapered appearance of the vessel in which the filter was placed should have alerted the operator that either the wrong vessel was selected or that the IVC was occluded. Also, the unexpanded appearance of the filter should have raised concern (Fig 2).

CASE 2

A 44-year-old woman with a past medical history significant for multiple sclerosis, neurogenic bowel/bladder, hip disarticulations, and amputations had an attempted IVC filter placement at an outside hospital for symptomatic DVT after suffering a femur fracture. Our service was contacted as a transfer request 1 day later for evaluation of a malpositioned filter. Upon radiographic review, there was an Option Elite (Argon Medical, Frisco, Tex) filter placed inverted in the right mid abdomen, and a second, Venatech LP (B Braun Medical, Bethlehem, Penn) filter cephalad to it, encroaching the cavoatrial junction (Fig 3).

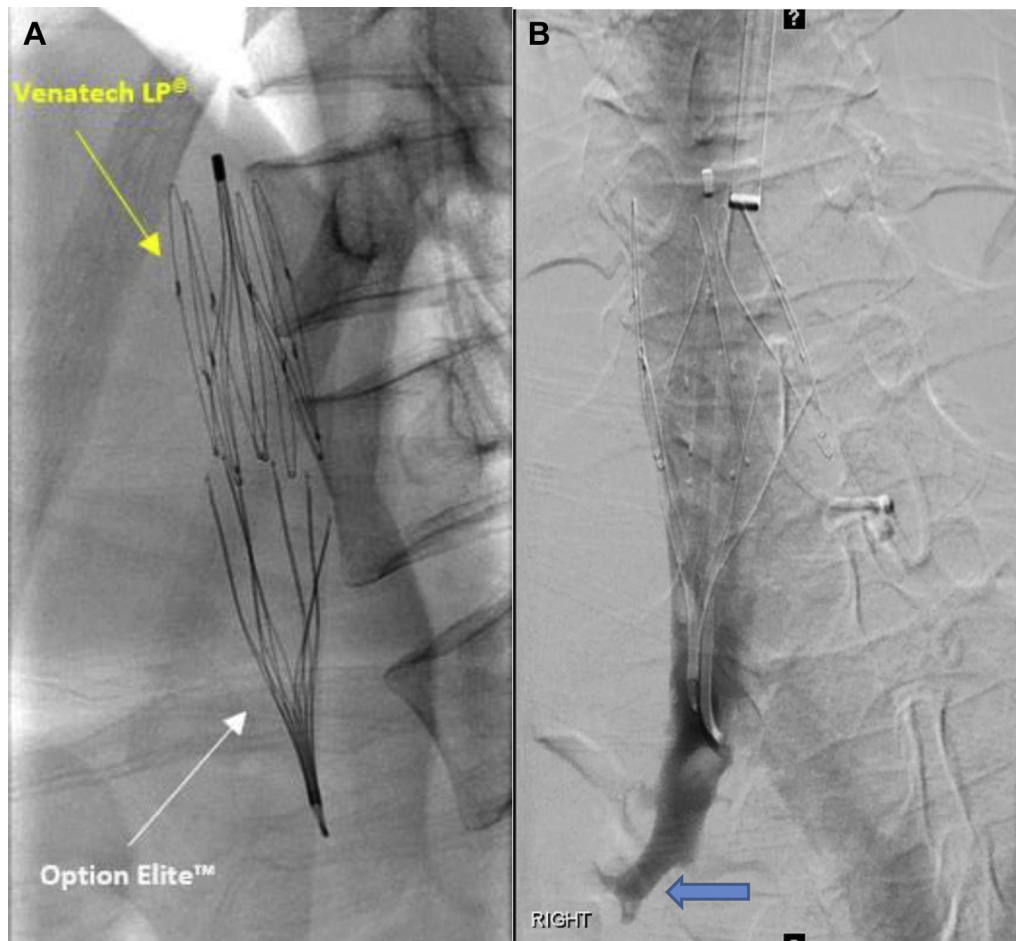


Fig 3. A, Initial spot image showing inverted retrievable Option Elite inferior vena cava (IVC) filter in the renal vein (*white arrow*), and more cephalad permanent Venatech LP IVC filter (*yellow arrow*). **B,** Additional venogram showing the inverted retrievable Option Elite IVC filter in the renal vein (*blue arrow*).

Right internal jugular venous access was obtained with ultrasound guidance. A 12F sheath was positioned superior to filters. Left femoral vein access was obtained with ultrasound guidance and a 5F sheath was introduced and positioned in the left iliac vein. Venograms were performed and demonstrated the Option filter within the right renal vein and the VenaTech in the supra-renal IVC. The apex of the VenaTech filter was captured with an Amplatz Goose Neck snare (Medtronic, Minneapolis, Minn). The 12F sheath was advanced over the snare to the filter base, the hook of the filter snared, and the legs of the filter collapsed subsequently. By applying traction to the filter, the filter was ensheathed and removed in its entirety.⁴ Subsequently, a 5F angled catheter and EnSnare was advanced into the right renal vein and the legs were collapsed, captured and retracted cephalad, followed by complete ensheathment and removal (Fig 4). Both filters were intact and completion venogram showed no complications. After that, we placed a properly positioned retrievable IVC filter in the IVC to protect the patient from a venous thromboembolism event.

A review of the initial placement images shows that the venogram was performed from the right renal vein, which seemed to be unusually vertical owing to patients contorted body position (Fig 5). The appearance of chronic occlusion, which was in actuality tapered hilar renal vein branches, should have prevented a filter from being placed. The upside-down placement of the first filter was owing to operator error in the back-table preparation of the device, because the Option filter can be placed via jugular or femoral routes. A left femoral venogram, presumably was done once the operator realized the error, followed by placement of the permanent filter in the supra-renal IVC to prevent migration of the renal vein filter.

DISCUSSION

Various complications associated with IVC filters have been described in the literature. These complications can be divided into procedure related complications,

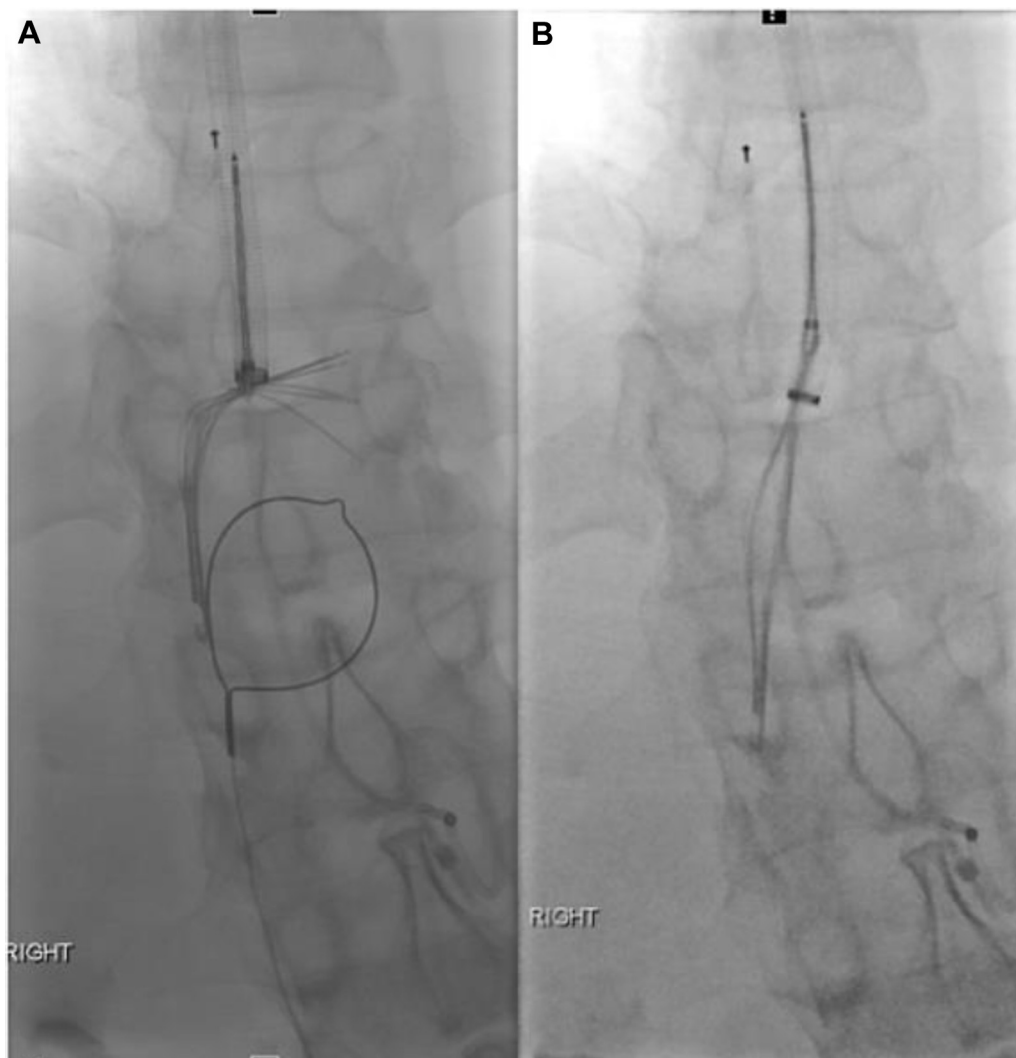


Fig 4. **A,** The inverted Option Elite inferior vena cava (IVC) filter legs are secured by the snare and filter is brought cephalad out from the renal vein into the IVC. **B,** Once in the IVC, the sheath is able to completely collapse the filter, with subsequent removal.

postprocedure complications, and complications associated with retrieval of the filter device. Although rarely described in the literature, operator error is a potential area of complication to bring to light. There have been case reports of filter placements in gonadal vein, ovarian vein, and right atrium.⁵⁻⁷ Another case reported incorrect orientation of the filter.⁸ These errors possibly left the filter nonfunctional and cause a challenging retrieval case. Nonstandard endovascular techniques to retrieve these IVC filters were described.⁷ These techniques include but are not limited to filter buddy wire, aggressive traction, laser sheath, and loop-snare technique. We recommend a thorough evaluation of the

patient's vascular anatomy as well as confirming the intracaval location of the sheath with contrast venography before filter deployment to avoid these potential complications.

CONCLUSIONS

IVC filters are placed to prevent life-threatening PE in selected groups of patients. Although rarely described in the literature, operator error is a potential area of complication to bring to light. A thorough evaluation of the patient's physical and vascular anatomy as well as standard diagnostic venogram and filter deployment techniques would have prevented the negative

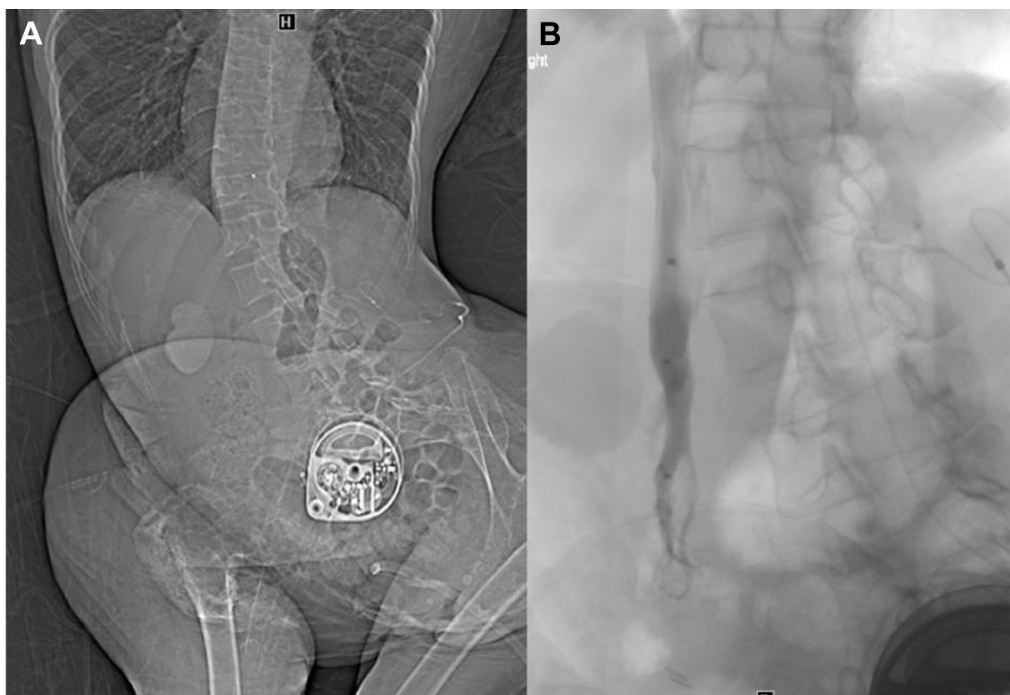


Fig 5. (A) Computed tomography scout image shows contorted body positioning of this patient with dextroscoliosis resulting in **(B)** vertically positioned appearance of the right renal vein on prefilter placement venogram. Tapered and chronically occluded appearance of distal vessels are in reality renal branching.

outcomes of the cases presented above. In such cases, advanced techniques can be used to successfully remove these filters.

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