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Placement and retrieval of bilateral iliac vein filters in patients with mega cava

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ABSTRACT

Temporary interruption of the inferior vena cava is the recommended treatment to prevent pulmonary embolism in patients with venous thromboembolism (VTE) and active contraindications for therapeutic anticoagulation. In patients with mega cava (diameter >30 mm), temporary inferior vena cava filters are contraindicated. In the present report, we have described the successful placement and retrieval of bilateral iliac vein filters in two patients with VTE, mega cava, and active contraindications for therapeutic anticoagulation. At the last follow-up, both patients had recovered without recurrent VTE and had had all filters successfully retrieved without complications. (J Vasc Surg Cases Innov Tech 2022;8:610-5.)

Keywords: Hangman technique; Iliac vein filter; Mega cava; Temporary inferior vena cava filter; Wire-loop technique

Temporary filters are indicated for inferior vena cava (IVC) interruption in patients with venous thromboembolism (VTE) and a contraindication for anticoagulation.[1] However, temporary IVC filters are contraindicated for patients with mega cava (diameter >30 mm). The deployment of IVC filters in veins larger than indicated by the instructions for use can lead to fatal complications related to migration.[2] In patients with mega cava, the placement of IVC filters in the iliac veins can serve as a feasible alternative; however, most of these studies had investigated permanent filters.[3-5] Also, iliac vein filter placement and retrieval have not been well described in the current literature. In the present report, we have described the successful placement and retrieval of bilateral iliac vein filters in two patients with mega cava, active venous thromboembolism (VTE), and contraindications to anticoagulation. We have highlighted the technical considerations and challenges. The patients provided written informed consent for the report of their case details and imaging studies.

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CASE REPORT

Patient 1. A 44-year-old male avid runner had sustained polytrauma after being struck by a truck. His injuries were notable for subdural hemorrhage, subarachnoid hemorrhage, multiple cervical spine fractures with anterior longitudinal ligament rupture requiring posterior cervical spinal decompression fusion, a grade V splenic laceration requiring urgent laparotomy and splenectomy, bilateral rib fractures, skull base fractures, and humeral head dislocation. During the hospitalization, he developed bilateral calf deep vein thrombosis (DVT) and acute segmental pulmonary embolism (PE). Because of his injuries, anticoagulation therapy was contraindicated, and temporary IVC filter placement was indicated.

Venography demonstrated an IVC diameter of 32 mm below the renal veins and 36 mm at the confluence of the iliac veins (Fig 1). The right common iliac vein (CIV) was short, and the left CIV was large (diameter, 33.6 mm). The diameter of the right external iliac vein (EIV) was 27 mm and that of the left EIV was 25 mm, both of which were suitable for IVC filter placement. Denali filters (Bard Peripheral Vascular, Tempe, AZ) were deployed in the bilateral EIVs via bilateral femoral venous access. The fluoroscopy time was 5.7 minutes, and the procedure required 140 mL of contrast. No perioperative complications were noted. At the 6-month follow-up, the patient was ambulating independently and receiving oral anticoagulation therapy. Doppler ultrasound showed no DVT in either lower extremity, and computed tomography venography (CTV) demonstrated no associated filter thrombus, although significant apposition of the hook of the left filter was present on the wall of the iliac vein with a grade 1 perforation (Fig 2).

The bilateral EIV filters were simultaneously retrieved through a single access jugular approach. Given the natural tortuosity of the iliac veins, the right EIV filter was retrieved using the wire-loop technique.[6] An Omniflush catheter (Angiodynamics,

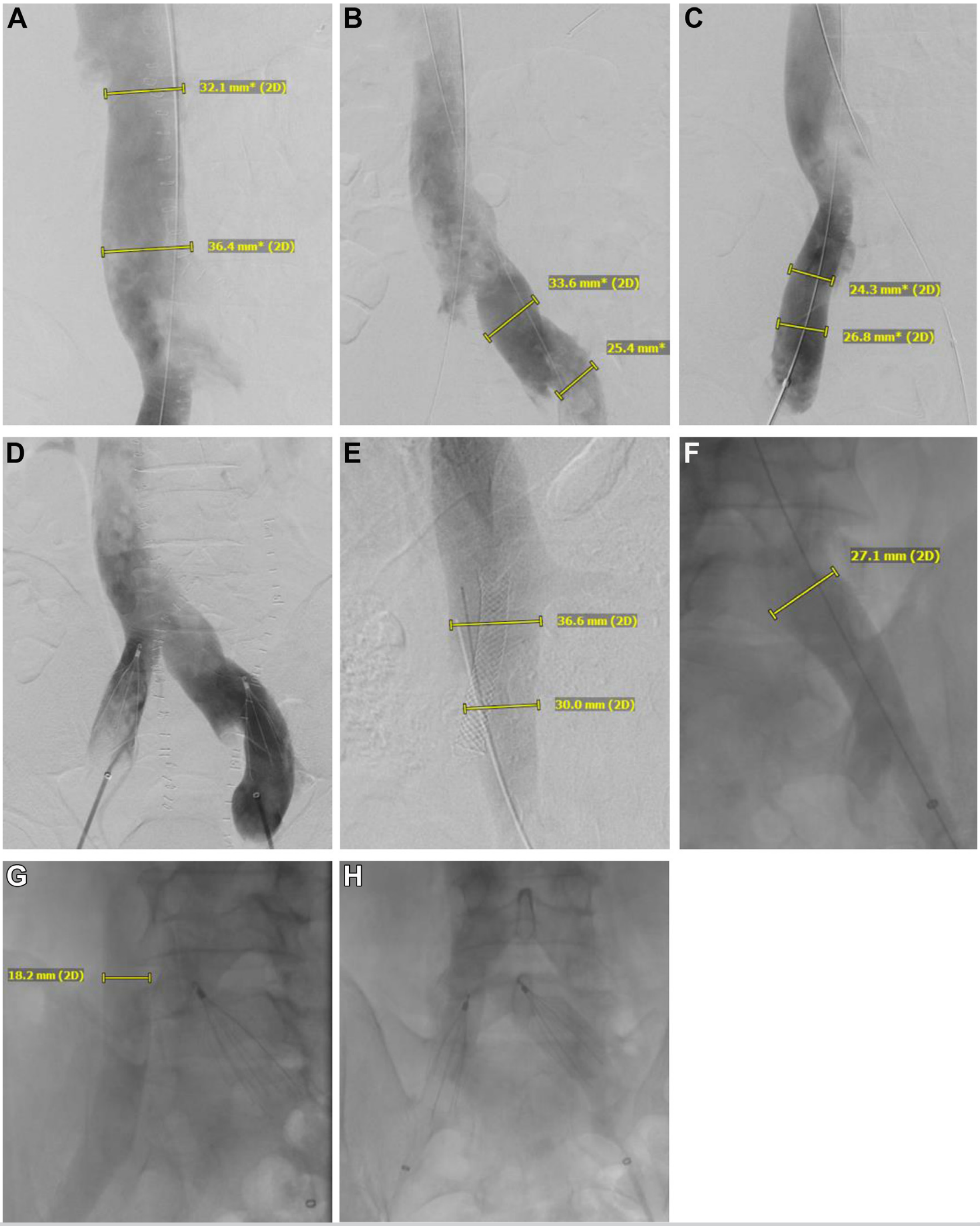

Fig 1. Venography at filter placement in patients 1 and 2. **A,** Venography of patient 1 showing large inferior vena cava (IVC) diameter (32.1-36.4 mm). **B,** Venography of patient 1 depicting a very large left common iliac vein (CIV; 33.6 mm). **C,** A short right CIV with a right EIV with a diameter of 26.8 mm suitable for implantation in patient 1. **D,** Completion venography of patient 1 after placement of bilateral EIV filters, highlighting the natural curvature of the left EIV. **E,** Venography of patient 2 showing a large caliber infrarenal inferior vena cava (30-36.6 mm). **F,** Left CIV with a diameter of 27 mm suitable for filter implantation in patient 2. **G,** Right CIV diameter of 18.2 mm adequate for placement in patient 2. **H,** Completion venography of patient 2 after placement of bilateral CIV filters.

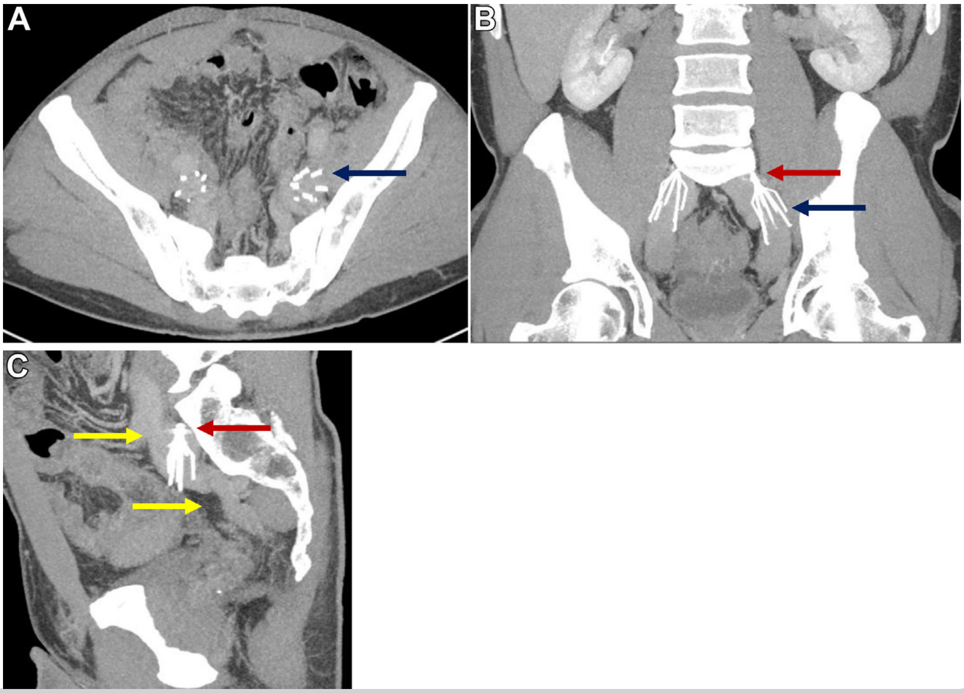

Fig 2. Computed tomography venography (CTV) depicting iliac vein filter configuration in patient 1. **A,** Axial section of CTV depicting grade 1 perforation of filter struts (*blue arrow*). **B,** Coronal section of CTV highlighting the filter tilt (*red arrow*), grade 1 perforation (*blue arrow*), and natural tortuosity of iliac veins. **C,** Sagittal view of left iliac vein filter showing filter tilt with the hook abutting the venous wall and natural tortuosity of the iliac vein.

Tempe, AZ) was used to hook the apex of the right EIV filter, through which a Glidewire (Terumo, Somerset, NJ) was introduced. Using an ENsnare (Merit Medical, South Jordan, UT), a wire loop was formed around the filter (Fig 3, *A*). However, because of a severe filter tilt and the filter hook abutting the wall of the EIV, a combination of the wire-loop and hangman techniques was required for retrieval of the left EIV filter[7] (Fig 3, *C*). Using an Omniflush catheter, a Glidewire was introduced between the apex of the filter and the IVC wall. The wire was then snared using an ENsnare to form a "hangman's noose" around the apex of the IVC filter to disengage the hook of the filter from the IVC wall.[7] We found no evidence of extravasation or thrombus on the completion venography. The fluoroscopy time was 44.2 minutes, and 86 mL of contrast was used. No perioperative complications developed, and the patient was discharged home from the recovery room. At 2 years after retrieval, the patient had not experienced any filter-related complications or recurrence of VTE, and the patient was leading an active lifestyle without cardiovascular morbidity.

Patient 2. A 63-year-old male patient with stage I pancreatic adenocarcinoma and a biliary stricture requiring stenting was found to have a right lower extremity femoropopliteal DVT with bilateral PEs. He had initially been treated with oral anticoagulation therapy. After completion of neoadjuvant chemotherapy, the patient was prepared for pancreaticoduodenectomy (a Whipple procedure), which necessitated interruption of oral anticoagulation and IVC filter placement.

Venography, performed via a femoral approach, demonstrated an IVC diameter of 37 mm below the renal veins (Fig 1, *E*). Bilateral CIV Denali filters (Bard Peripheral Vascular) were deployed, given the adequate caliber of both (right CIV, 18 mm; left CIV, 27 mm). The tips of the filters were positioned at the confluence of the CIVs in a nearly kissing fashion but did not touch. This position would facilitate retrieval because the hook will be less likely to tilt and abut the wall of the cava or iliac veins (Fig 1, *H*). Patient 2 underwent a Whipple procedure with an unremarkable recovery. At 8 months of follow-up, venous duplex ultrasound demonstrated a small amount of residual thrombus in the right femoral vein, and CTV showed appropriate positioning of the filters with no evidence of thrombus within the filters.

Bilateral CIV filter retrieval was performed through a jugular approach using the wire-loop technique as described previously.[6] The right sided filter was retrieved first, and completion venography was performed before attempting to retrieve the left sided filter to confirm the absence of extravasation or other complications. The filter retrievals were performed with the patient under general anesthesia, with a fluoroscopy time of 16 minutes and 30 mL of contrast used. No perioperative complications developed, and patient 2 was discharged home from the recovery room. At 6 months after filter retrieval, no filter-related complications or VTE recurrence had developed. The patient continued anticoagulation therapy. He was noted to have oncologic progression in the form of metastatic disease, and adjuvant chemotherapy was initiated.

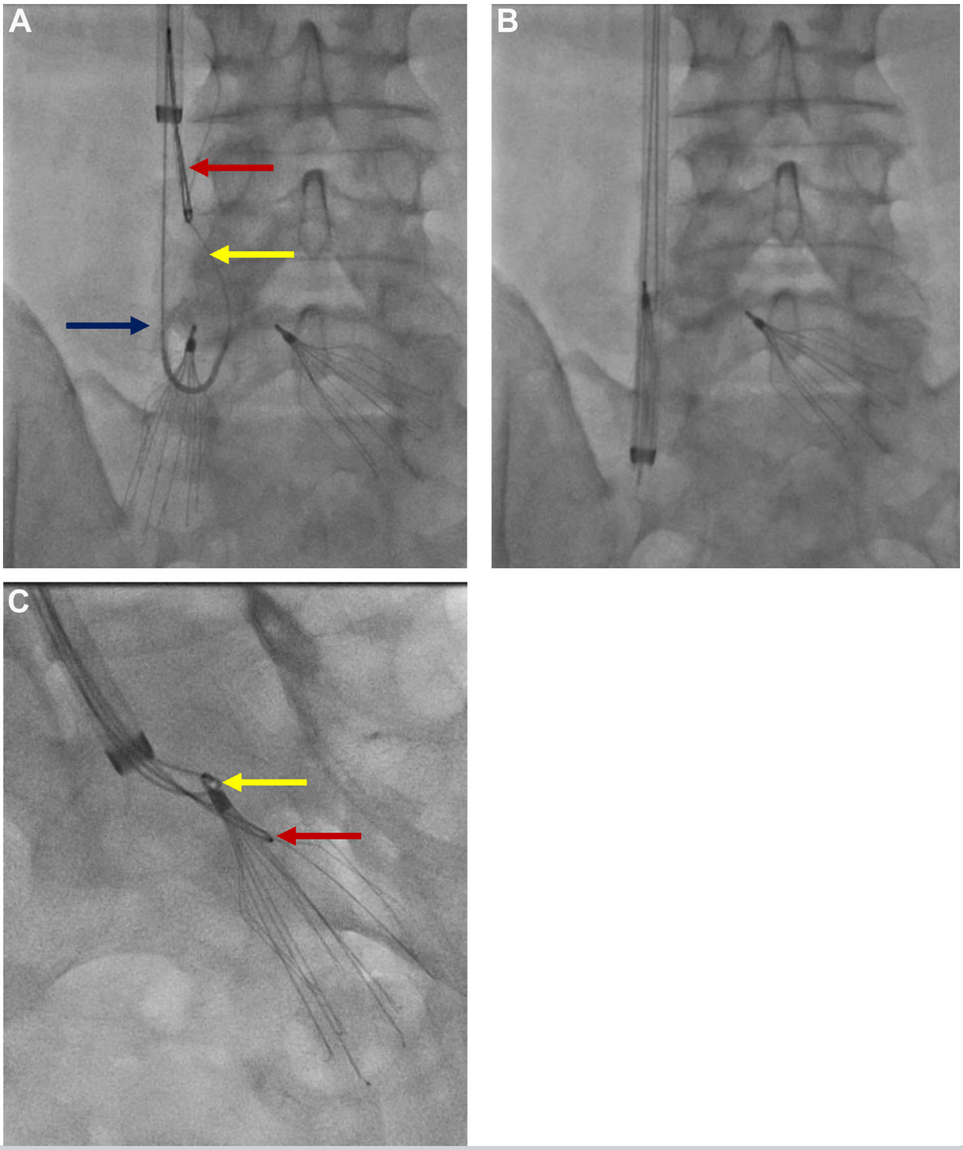

Fig 3. Fluoroscopy at bilateral external iliac vein (EIV) filter retrieval in patient 1. **A,** Retrieval performed with the wire-loop technique. The wire-loop was formed using an Omniflush catheter (*blue arrow*) and a Glidewire (*yellow arrow*), which was captured by a snare (*red arrow*). **B,** Successful capture of the right iliac vein filter. **C,** Intraoperative fluoroscopy depicting left iliac vein filter retrieval with a combination of the hangman technique (a wire between the filter and vein wall; *yellow arrow*) and the wire-loop technique (wire between the filter struts; *red arrow*).

DISCUSSION

In the present report, we have shown that bilateral iliac vein filter placement and removal is safe and effective for the interruption of lower extremity venous return in patients with mega cava and contraindications to anticoagulation therapy. However, the retrieval of iliac vein filters can pose challenges, given the natural venous tortuosity, especially on the left side, which can be overcome using advanced endovascular techniques, as demonstrated by the wire-loop and hangman techniques.[8,9] However, placement of filters in the iliac veins is outside the recommended device instructions for use. Thus, extreme caution and an individual risk/benefit evaluation must be performed before iliac vein filter placement. Iliac vein filters should be placed temporarily, with the intention to retrieve them as soon as clinically possible, because no data are available on the safety of these devices in the iliac veins. This is especially related to placement of a filter in the left EIV. Because of the natural curvature of the left iliac veins and the rather rigid, metallic, and sharp consistency of the filter, the device is prone to perforating the iliac vein and potentially eroding into the surrounding structures. Given that the current data related to iliac vein filters is limited and that placement of iliac vein filters is not common, the true incidence of filter tilt in this anatomic location is unclear. In patient 1, the hook of the filter had been deployed at a curvature and was rather challenging to retrieve. A technical modification to avoid this problem that we plan to use the next time we encounter a similar scenario is to perform access in the femoral vein in the upper thigh on the left instead of the common femoral vein at the inguinal crease, as routinely used. That will provide more access and a greater working length in the transition zone from the common femoral vein into the EIV transition. Such an approach could allow for the deployment of a filter in the more inferior and straighter portion of the EIV, avoiding the area of curvature in the iliac veins. The device would then be deployed in a straight vein as intended, optimizing filtration, avoiding a tilt, and, likely, facilitating subsequent retrieval.

The placement of iliac vein filters is not the only option for IVC interruption in patients with mega cava. The Bird's Nest filter (Cook Medical Inc, Bloomington, IN) is a permanent filter approved for deployment in IVC diameters ≤40 mm. However, multiple reports of visceral penetration, aortic penetration, and migration to the right atrium have made its use less desirable.[10-13] Leaving in place a permanent filter associated with a high risk of complications in patient 1 who was young and very active would have been a poor option, especially considering that he has recovered from his injuries and has excellent long-term survival. In contrast, patient 2 had been scheduled for a planned Whipple procedure, and an argument could have been made for placement of a permanent IVC filter, given his overall prognosis. For our two patients, the Denali filter was used based on operator preference owing to the stability of the deployment system in tortuous iliac veins.

Bilateral iliac vein filter placement has previously been safely performed using the Greenfield filter.[3,4] The use of permanent filters in the iliac veins must warrant caution, owing to the higher risk of associated filter-related DVT due to the smaller venous caliber.[14] More recently, Van Ha et al[5] reported the placement and retrieval of the Günther-Tulip filter (Cook Medical Inc) from the CIV for prophylactic interruption of venous return in 10 high-risk surgical patients. In contrast to these studies, we have described the placement and retrieval of temporary filters in the EIV in addition to the CIV. Moreover, we have described the technical challenges associated with EIV filter retrieval due to the natural venous tortuosity. In the series by Van Ha et al,[5] all retrievals were standard using the proprietary Günther-Tulip retrieval set (Cook Medical Inc). In contrast, we have described the use of advanced endovascular techniques for the retrieval of iliac vein filters with challenging configurations. In addition, we have described the placement and retrieval of Bard Denali filters (Bard Peripheral Vascular), which represent second-generation filters.

Standard IVC filter retrieval can be performed using a vascular snare from the Günther-Tulip retrieval kit (Cook Medical Inc) or retrieval cone from the Recovery Cone Removal System (Bard Peripheral Vascular).[15] However, advanced techniques such as the wire-loop technique or the hangman technique are required in scenarios with severe filter tilt, prolonged dwell times, or a filter hook abutting the venous wall. In both of our patients, the wire-loop technique in conjunction with a 16F sheath was used. Given the tortuosity of the iliac veins and the propensity for an augmented filter tilt with iliac vein filter implantation, this retrieval technique offers more stability with retrieval. The wire-loop and hangman techniques are our preferred advanced retrieval techniques for iliac vein filters, because they help provide sturdy support around the filter to aid in its capture. The success of the wire-loop and hangman techniques requires application of direct force on the filter apex and filter hook, respectively. Although the wire-loop technique, combined with a large caliber sheath, will be more effective in disengaging filter struts from the venous wall, the hangman technique is effective in straightening the filter hook and releasing the apposition to the wall of the IVC. Thus, we suggest the use of the hangman technique in clinical scenarios with severe filter tilt and hook apposition to the venous wall and the use of the wire-loop technique for filters with strut penetration or filter struts with scar tissue owing to long dwell times. In addition, these two techniques use readily accessible tools such as a Glidewire (Terumo) and an ENsnare (Merit Medical) and do not require additional equipment that will not always be available such as bronchoscopy forceps or laser sheaths.

CONCLUSIONS

Bilateral iliac vein filter placement is a safe, temporary alternative for PE prophylaxis in patients with DVT, mega cava, and contraindication to anticoagulation therapy. The retrieval of bilateral iliac vein filters can be challenging owing to the natural tortuosity of the iliac veins. Advanced endovascular retrieval techniques are available and could be required.

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