A Complication of Ultrasound-Guided Inferior Vena Cava Filter Placement

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A 45-year-old woman with acquired immunodeficiency syndrome (AIDS) presented to the emergency department with altered mental status and tachycardia. Initial computed tomography (CT) of the head revealed hydrocephalus; an external ventricular drain was placed after the patient's condition continued to decline. She subsequently developed tachycardia, after which a pulmonary embolism protocol chest CT was positive for multiple subsegmental pulmonary emboli. Considering the patient's poor cardiopulmonary reserve and history of recent surgery, interventional radiology (IR) fellow was consulted for emergent after-hours inferior vena cava filter (IVCF) placement.

Due to the patient's hemodynamic instability, a bedside IVCF placement was performed under transabdominal ultrasound (US) guidance in lieu of standard venographic IVCF placement. An IR fellow performed the procedure at bedside under the direct supervision of an IR attending. The fellow performing the procedure had no experience placing a bedside IVCF, and the supervising attending had not performed the procedure in several years.

Preprocedural US revealed what appeared to be a retroaortic left renal vein (►Fig. 1a). The right common femoral vein was accessed with a 21-gauge needle. Using standard technique, the filter delivery sheath was advanced to the level thought to represent the retroaortic left renal vein. A Gunther Tulip IVCF (Cook Medical Inc., Bloomington, IL) was deployed under direct sonographic guidance (►Fig. 1b), and appeared to be in normal position on postprocedural US.

A follow-up abdominal radiograph revealed the filter to be in abnormal position in the projection of the right common iliac vein. The patient was subsequently transported to the IR suite the following morning for filter repositioning. Initial venography confirmed the filter to be in the proximal right common iliac vein (►Fig. 1c). The malpositioned filter was removed under fluoroscopic guidance following a jugular vein approach with a loop snare device. A venogram following filter retrieval revealed no evidence of vascular injury. A new Gunther Tulip IVCF was

placed in standard infrarenal IVC position under direct fluoroscopy (►Fig. 1d).

No further complications of filter placement were noted during the patient's hospital stay. Magnetic resonance imaging demonstrated multiple ring-enhancing brain lesions, and further workup revealed a severely decreased CD4 count with cerebral spinal fluid studies positive for cytomegalovirus and Epstein-Barr virus. Findings were concerning for infection versus central nervous system lymphoma; however, the patient's tenuous clinical status precluded biopsy and given her severely immunocompromised state, chemotherapy could not be safely offered. After palliative care consultation and discussion with her family, the patient was transferred to a hospice facility.

Discussion

IVCF placement is a routine procedure performed by interventional radiologists. Traditionally performed with contrast venography under fluoroscopic guidance,¹ US-guided techniques have been reported that mitigate transportation requirements in critically ill patients. Ultrasound guidance also obviates the need for ionizing radiation and nephrotoxic contrast administration.^{2–5} The techniques described in the literature include guidance with transabdominal US or with a combination of intravascular US (IVUS) and transabdominal US guidance.

Complication rates of IVCF placement, regardless of technique, are relatively low. When they do occur, these events can be classified as those that occur at the time of insertion, between the period of insertion and removal, and those that occur during removal. Complications occurring at the time of insertion include puncture site complications, delivery system complications, defective filter deployment, and filter malposition.⁶ Complications occurring after insertion but before removal include migration, thrombosis, filter fracture, device infection, and IVC perforation. It is worth noting that the frequency of penetration of the IVC wall by filter struts approaches 100%

Fig. 1 (a) Transabdominal ultrasound in the axial plane demonstrating a presumed retroaortic left renal vein (arrows). (b) Ultrasound-guided delivery of the inferior vena cava (IVC) filter in the expected location of the infrarenal IVC. (c) Inferior vena cavagram demonstrating the filter in the proximal right common iliac vein. (d) Placement of a new IVC filter in the infrarenal IVC under direct fluoroscopy.

with certain filters.⁷ However, a recent meta-analysis of 15 commonly used filter types describes the overall rate of penetration as 19%, with 19% of these penetrations (3.6% of all filters) showing evidence of adjacent organ involvement.⁸ Complications occurring during filter removal include large clot burden and filter adherent to the IVC wall, both of which may preclude filter removal at that time.

The current case describes an occurrence of filter malposition, which fortunately is usually not in and of itself a dangerous complication.⁹ The most serious risk of this complication would be pulmonary embolism arising from the contralateral deep venous system despite filter placement. Filter malposition is also a problem that may easily be remedied. The misplaced filter is simply moved into standard location, or as in this instance the first filter is removed and an additional filter is placed. Although usually not a serious complication, it would be ideal to have correct placement in the first place, saving patient's time, hospital resources, and the risk of additional adverse events.

The *Journal of Vascular and Interventional Radiology* quality improvement guidelines report the incidence of filter malposition as 1 to 9%¹; however, these guidelines are written for fluoroscopic IVCF placement, which is by far the most com-

monly performed IVCF placement technique and considered the standard of care. One would assume that the rate of filter misplacement would be higher when performed at bedside; however, studies report a surprisingly low malposition rate. A 5-year review of 284 patients who underwent transabdominal US-guided placement of IVCFs at Vanderbilt University showed a filter malposition rate of 2%, and an overall technical complication rate of 4%.³ These results were likely obtained by operators with significant procedural experience. In studies utilizing IVUS guidance, reported rates of filter malposition range between 1 and 4%.¹⁰⁻¹²

One may question why the reported malpositioning rate of bedside IVCFs is so low. It is likely that the operators performing these procedures are relatively experienced. In the current case, the operating attending physician had not performed a bedside IVCF placement in several years. One study recommended performing at least five venographic IVCF placements with US correlation before attempting US-guided IVCF placement.¹³ There are innumerable reports from the surgical literature, describing procedures other than IVCF placement, that document the correlation of complication rates with operator inexperience.¹⁴⁻¹⁶

In a case where the attending operator is relatively inexperienced, an alternative procedure should be considered. In the current case, standard venographic IVCF placement could have been performed, although it would have been difficult given the patient's hemodynamic instability. Alternatively, the procedure could have been performed at bedside when an operator with more experience performing the procedure was present.

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