Percutaneous Extraction of an Embolized IVC Filter Strut Embedded in the Right Ventricle

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**ABSTRACT**

The incidence of IVC filter fracture is high with risk for embolization and may require open surgery. We present a minimally invasive approach of complex transcatheter extraction of an embolized and embedded IVC filter strut from the right ventricle. *(Level of Difficulty: Intermediate.)* *(J Am Coll Cardiol Case Rep 2020;2:2318–22) © 2020 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).*

**PRESENTATION**

A 29-year-old female presented to the emergency department with acute onset sharp and pleuritic chest pain which woke her out of sleep. Her chest pain was severe and made worse by leaning forward and deep inspiration. Physical examination was pertinent for clear lung fields, a heart rate of 110 beats/min, and blood pressure of 110/70 mm Hg with a pulsus paradoxus of 16 mm Hg. Echocardiography revealed a >10-mm circumferential pericardial effusion *(Figure 1A)* with echocardiographic evidence of tamponade.

**MEDICAL HISTORY**

The patient had a history of a large burden, deep venous thrombosis and pulmonary embolism 7 years prior for which she was treated with therapeutic anticoagulation and an Eclipse inferior vena cava (IVC) filter (Bard, Tempe, Arizona). Six years previously, 2 attempts to remove the filter were unsuccessful due to the tilt of the filter in relation to the IVC and neointimal coverage of the filter hook. No subsequent catheter procedures through the IVC filter were reported. Furthermore, due to suspicion of a hypercoagulable state, she had remained on therapeutic anticoagulation with warfarin.

**DIFFERENTIAL DIAGNOSIS**

The differential diagnosis included pericarditis, myopericarditis, myocardial infarction complicated by pericardial effusion, pulmonary embolism, and IVC filter-related complications such as fragment embolization and right ventricular (RV) perforation.

**INVESTIGATIONS**

Approximately 600 ml of brown-colored hemorrhagic fluid was removed during pericardiocentesis from the apical approach, using ultrasonographic,
fluoroscopic, and electrographic guidance. A metallic foreign object was noticed within the right ventricle during echocardiography and on subsequent imaging (Figure 1). Computed tomography (CT) scanning further characterized the foreign body in the right ventricle and identified it as an embolized IVC filter strut (Figure 1). The CT scan also revealed a dislocated strut still attached to the main body of the filter in the IVC. The images were reviewed with vascular surgery, interventional cardiology, electrophysiology, and cardiothoracic surgery staff, and a multidisciplinary decision was made to attempt percutaneous extraction first with cardiothoracic surgical backup.

**MANAGEMENT**

Extraction attempts were initially performed using a right internal jugular vein approach. An Amplatz gooseneck snare (Medtronic, Minneapolis, Minnesota) was used first to attempt to snare the object (Figure 2A). When the object could not be snared...
with this approach, an ENsnare (Merit Medical, South Jordan, Utah) was used (Figure 2B). This too proved unsuccessful, and intracardiac echocardiography was used at this point to better understand the foreign body’s position within the RV. Intracardiac echocardiography revealed that the foreign body was in fact embedded in the RV free wall on one end and in the interventricular septum on the other end (Figure 1B, Video 1) with no free end to lasso. At that point, femoral venous access was obtained, and an initial attempt to use a needle’s eye snare was unsuccessful due to the inability to advance the snare into the right ventricle and orient it toward the strut. Subsequently, a deflectable Agilis sheath (Abbott, Santa Clara, California) was placed in the right atrium after carefully negotiating the IVC filter. A glide wire was passed beyond and around the foreign body and then lassoed on the other side with a goose neck snare (Figures 2C and 2D). Once the strut was encircled, the wire was tightened while advancing the Agilis in an attempt to envelop the strut prior to encountering the tricuspid valve. The entire ensemble was then retracted into the catheter, folding and retracting the foreign body along with it (Figure 2E). There were no procedural complications, and follow-up echocardiography showed no reaccumulation of pericardial fluid. The patient was discharged from the hospital pain free.

**FIGURE 2** Extraction of IVC Filter Strut from the Right Ventricle

(A) An Amplatz gooseneck snare is used to attempt to capture the foreign body (white arrow) around its free end in a straight LAO 30° projection. (B) An ENsnare (Merit Medical) is used to attempt to capture the foreign body around its free end in straight RAO 40°. (C) A lasso technique is used to extract the foreign body using an Amplatz gooseneck snare and wire in a straight LAO 30° and (B) straight RAO 40°. (E) The successfully extracted and intact filter strut is shown. IVC = inferior vena cava; LAO = left anterior oblique; RAO = right anterior oblique.
DISCUSSION

Use of IVC filters is an alternative or adjunctive guideline-supported treatment for venous thromboembolism but is associated with risk of fracture, perforation, and embolization (1–5). Because of these risks, it is essential that these filters be removed and that the pros and cons of this approach be discussed with the patient during their follow-up visit. Although percutaneous extraction of embolized filter struts have previously been described (6,7), the present case of an embolized strut embedded in the RV free wall and septal myocardium on both ends illustrates the role for attempted percutaneous extraction in even the most difficult cases. IVC filter fractures (incidence of up to 16%) and migrations to the heart or lungs (incidence of 1.0% to 4.5%) are well-described risks with long-term filter implantation and are proportional to filter dwell time (6). Inability to retrieve temporary IVC filters, with a retrieval failure rate as high as 5.5% in prospective studies, compounds the long-term complication rate (8). This problem has resulted in considerable complication reporting in the Manufacture and User Facility Device Experience (MAUDE) database (9). Several techniques, including the use of rigid endobronchial forceps, have been described to remove embedded, fractured, or tilted retrievable IVC filters from patients in whom standard retrieval techniques were unsuccessful (10, 11). Similarly, techniques including use of electroanatomical mapping and 3-dimensional ultrasonography have been used to successfully remove IVC struts embolized to the right ventricle (7). The needle’s eye snare can also be used to capture a foreign body without a free end. Lack of deflectability and directionality with this approach makes it challenging to snare a small embedded strut. The ability to deflect and orient the snare and sheath toward the embedded strut using an Agilis sheath made the retrieval feasible in this case. Percutaneous extraction, as detailed here, is a potential option that avoids open-heart surgery.

FOLLOW-UP

The patient was referred to a center with expertise in complex tip-embedded IVC filter extraction, and she underwent successful percutaneous removal of the retained IVC filter using an endobronchial forceps technique (11). This patient had no further sequelae or hospitalizations.

CONCLUSIONS

This report describes unusual case of an embolized IVC filter strut in which both ends of the strut were embedded in the RV free wall, and interventricular septal myocardium leading to hemorrhagic pericardial effusion and tamponade. Percutaneous extraction was shown to be a viable management approach.

AUTHOR DISCLOSURES

Dr. Harjai has received honoraria from Edwards Lifesciences, Cordis, and Boston Scientific. Dr. Vijayaraman has served as a speaker and consultant and performed research for Medtronic; and has served as a consultant for Boston Scientific, Abbott, and Biotronik. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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KEY WORDS cardiac tamponade, extraction, intracardiac echo, IVC filter

APPENDIX For supplemental video, please see the online version of this paper.