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Case Report

Successful inferior vena cava filter removal using pacemaker lead extraction methods

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ABSTRACT

Inferior vena cava (IVC) filters are often used to treat deep vein thrombosis. IVC filters may become difficult to extract because of adhesion around the device, and those permanently left inside the patient may cause injurious complications. We describe a novel IVC filter extraction technique using pacemaker lead extraction tools. A 26-year-old woman, diagnosed with deep vein thrombosis by computed tomography, received an IVC filter (Gunther Tulip, Cook Medical, Bloomington, IN, USA) implantation for prevention of pulmonary thromboembolism. Eleven weeks later, extraction of the IVC filter by a manual method and snaring technique was unsuccessful because of adhesion to the blood vessel wall. The patient was referred to our hospital for filter removal using pacemaker lead extraction tools. Extraction was performed in an operation room under general anesthesia in the presence of a cardiovascular surgeon, to manage inadvertent perforation. Part of the adhered tissue around the four limbs of the filter was dissected using a 12 Fr laser sheath; protruding anchors were carefully dissected with a telescoping mechanical sheath using a counter-traction technique. Her postoperative course was uneventful, and she was discharged without complications. A sophisticated removal procedure with pacemaker lead extraction tools can be used to remove problematic IVC filters.

<**Learning objective:** Inferior vena cava (IVC) filters are often used to treat deep vein thrombosis. Although IVC filters are temporary implants, they may become difficult to extract because of adhesion around the device. Many IVC filters that cannot be retrieved are permanently left inside the patient, which may cause injurious complications. We describe a novel IVC filter extraction technique using pacemaker lead extraction tools, and this technique can be helpful for the management of problematic IVC filters.>

Introduction

Inferior vena cava (IVC) filters are often employed for patients with thromboemboli who have acute proximal venous thrombosis along with an absolute contraindication for anticoagulation, anticoagulation complications, or thromboembolism recurrence during anticoagulation [1]. In many cases, the filter is used only in the acute phase of thrombosis and should be removed within two weeks. If the filter cannot be extracted, it has to be modified for permanent fixation. Sustained use of an IVC filter carries the risk of thrombosis and perforation because of permanent indwelling and so various removal methods have been considered. While some IVC filters are extracted with an excimer laser, we herein report on successful removal of an IVC filter using pacemaker lead extraction tools.

Case report

A 26-year-old woman visited a local hospital with pain and marked swelling in her left lower limbs. Computed tomography

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(CT) revealed massive thrombi in the IVC, iliac veins, and bilateral femoral veins (Fig. 1). Oral contraceptives taken two months prior were suspected to be the cause. A temporary IVC filter (Gunther Tulip, Cook Medical, Bloomington, IN, USA) was implanted to prevent pulmonary embolism and anticoagulant therapy with heparin and edoxaban was commenced. The filter was left implanted two weeks later as the thrombi had not diminished completely. At 11 weeks, extraction of the IVC filter by a conventional removal method following thrombus resolution was unsuccessful because of adhesion to the blood vessel wall. A second removal session by superior vena cava and femoral approaches using a snaring technique at 14 weeks after implantation also failed. As the patient was young, recently married, and planned to get pregnant, both anticoagulant therapy cessation and IVC filter extraction were deemed necessary. She was referred to our hospital for removal of the IVC filter using pacemaker lead extraction techniques.

Upon admission, the patient's vital signs and test results were normal. Laboratory data disclosed no evidence of systemic lupus erythematosus or antiphospholipid syndrome (anti-CL · β2 GP1 antibody <1.2 U/mL, anti-cardiolipin antibody <8 U/mL, lupus anticoagulant negative). Although her D-dimer level was increased (38.7 μg/ml) when she visited the local hospital, her activated partial thromboplastin time, prothrombin time, and D-dimer level were normal (0.5 μg/ml) at our hospital. Her plasma protein C, protein S, and α2-PI levels were decreased because of heparin use. The CT revealed mural thrombi in the left superficial femoral veins with diminished thrombi in the iliac veins. Angiography demonstrated that all anchors of the IVC filter had penetrated the IVC wall and that a leg of the filter was inside the left renal vein, which was occluded on ultrasonography (Fig. 2).

We held a conference with other cardiovascular surgeons on how to retrieve the IVC filter. We decided to remove the IVC filter using an excimer laser sheath and mechanical sheath because adhesion was severe and a leg of the filter had penetrated the portal vein. Certainly, extraction laparotomy could ensure IVC filter removal, but the procedure is highly invasive. In the case of open surgery, extracorporeal

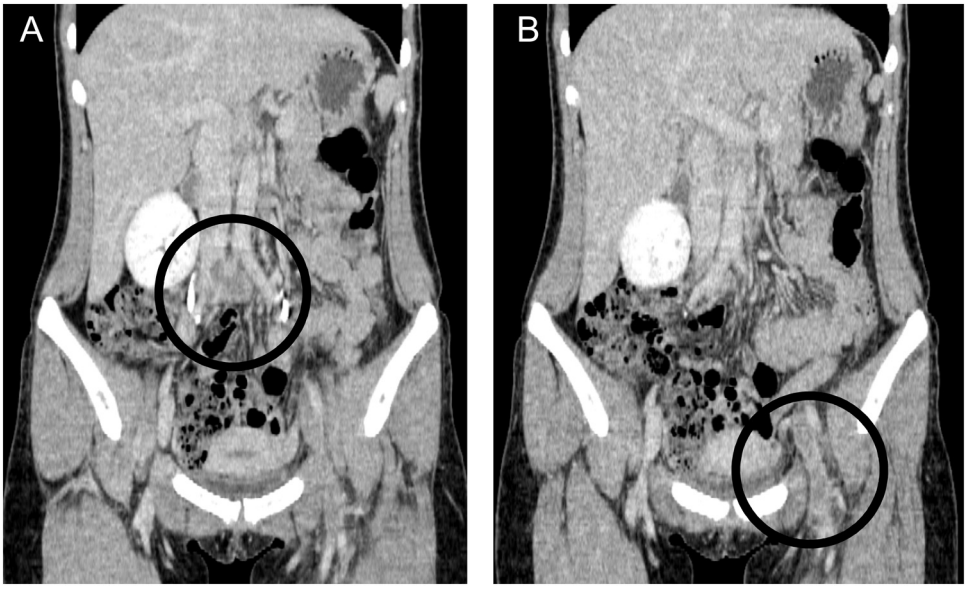

Fig. 1. Enhanced computed tomography before inferior vena cava (IVC) filter implantation. (A, B) There were massive thrombi from the IVC to the femoral veins (circles).

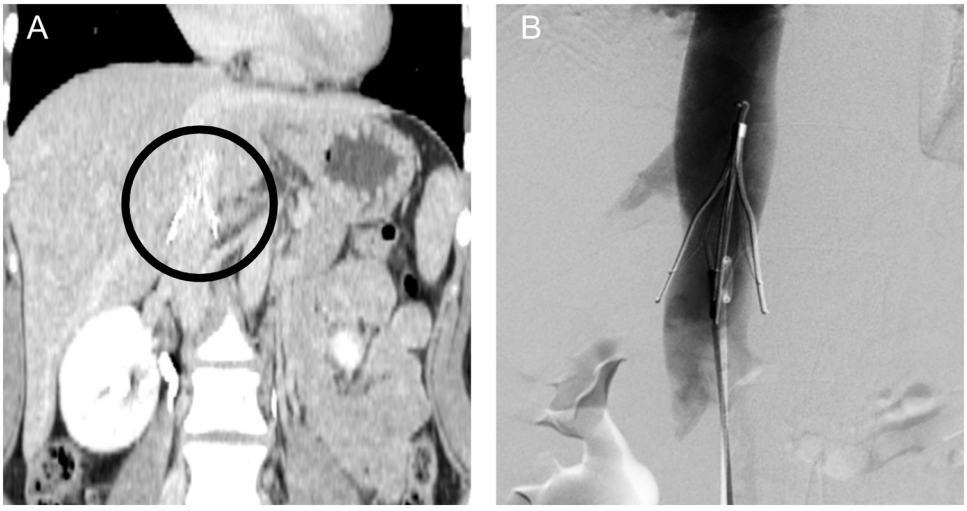

Fig. 2. (A) Enhanced computed tomography and (B) angiography during admission. All anchors of the inferior vena cava (IVC) filter had penetrated the IVC wall, and a leg of the IVC filter was on the left renal vein (circle).

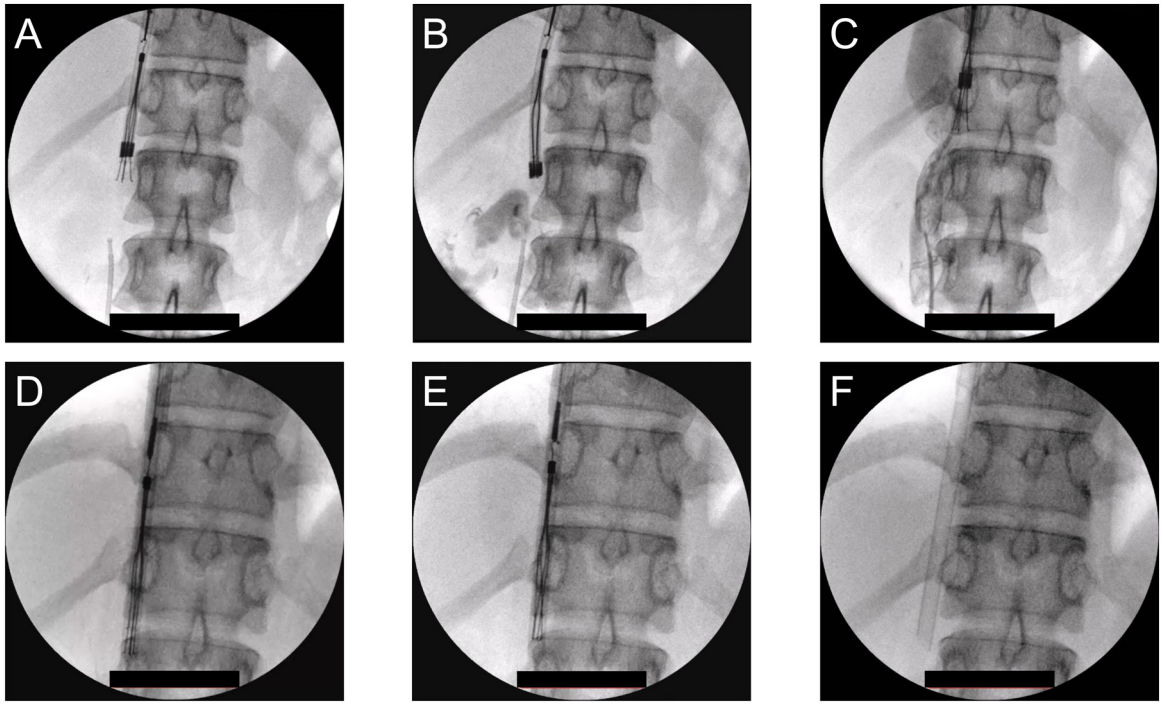

Fig. 3. Removal of the inferior vena cava (IVC) filter using an excimer laser and mechanical sheath. (A) A lasso-type snare was used to catch the proximal hook and a 12 Fr laser sheath was advanced to the IVC filter. (B, C) The adhesion tissue around the 4 limbs of the filter was dissected successfully by lasering, but the protruding anchors could not be detached from the IVC wall. (D–F) The sites of tight adhesion were carefully dissected by a telescoping mechanical sheath with a counter-traction technique for complete removal of the IVC filter.

circulation may have to be used. We explained the treatment in detail to the patient and asked her to decide whether she would like to undergo surgery or leave the IVC filter and continue anticoagulant therapy if the IVC filter could not be retrieved using this procedure. The procedure was performed in an operation room under general anesthesia in the presence of a cardiovascular surgeon, to manage inadvertent perforation. In this case, we intended to insert an intra-aortic balloon occlusion into the site of perforation and perform emergency laparotomy.

A lasso-type snare was used to catch the proximal hook, and a 12 Fr laser sheath (Spectranetics, Colorado Springs, CO, USA) from the right jugular vein was advanced to the IVC filter. Although the adhesion tissue around the four limbs of the filter could be dissected successfully by lasering, the protruding anchors could not be detached from the IVC wall. The sites of tight adhesion were carefully dissected by a telescoping mechanical sheath (Cook Medical) with a counter-traction technique for complete removal of the IVC filter (Figs. 3 and 4). The postoperative course was uneventful with no bleeding complications on CT (Fig. 5). After discharge, although CT and ultrasonography were not performed, the patient has remained D-dimer-negative.

Discussion

Increasing numbers of IVC filters have been implanted into patients with pulmonary emboli or deep vein thrombosis since their introduction in 2003 [2]. If a temporary IVC filter is difficult to retrieve, it is often left permanently. However, a non-retrieval group had a worse prognosis and higher recurrence rate of deep vein thrombosis than did a retrieval group [1]. Moreover, intravenous perforation by IVC filters was reportedly 5.5–9.0% [3], and 26% of filters were associated with penetration [4]. Previously, a case of an emergency operation for an IVC filter perforating the IVC wall was reported in Japan [3].

According to the Japanese Circulation Society guidelines, implantation of the IVC filter is recommended for patients with venous thromboembolism who have a contraindication to anticoagulation, but it is controversial in other cases [5]. In this case, the patient was able to tolerate anticoagulant therapy; thus, it was not easy to decide whether to proceed with implantation. It might have been necessary to prevent severe pulmonary embolism because there were massive thrombi even in the IVC. Unfortunately, the filter could not be removed by the conventional technique. Physicians who use IVC filters should consider the indications carefully to avoid complications.

According to a study from Stanford University, IVC filter removal by an excimer laser of 251 cases over 5 years had a success rate of 99.2%, defined as complete filter detachment and removal from the body, and a major complication rate of 1.6%, with no recorded deaths. In that study, patients presenting with filter penetration were included, as in this case [6]. On the other hand, Iwamoto et al. reported that permanent IVC filters with anticoagulant therapy might be effective

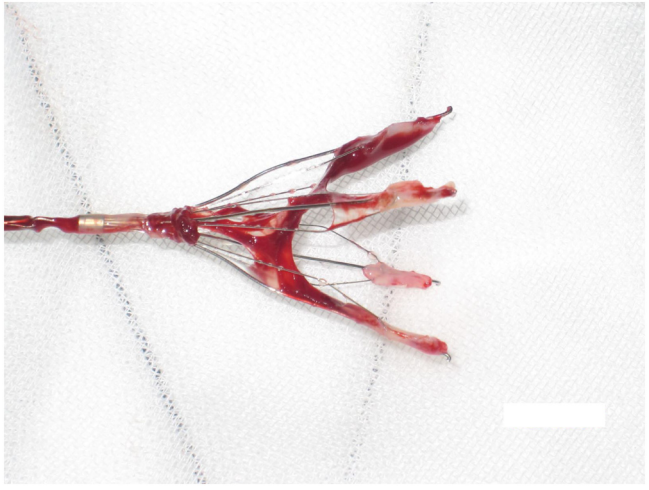

Fig. 4. Image of the retrieved filter.

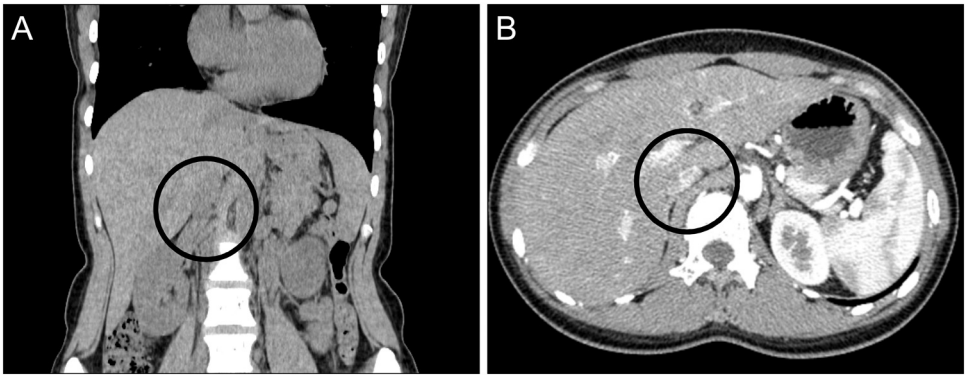

Fig. 5. Postoperative computed tomography. (A, B) There were no findings of bleeding or inferior vena cava stenosis (circles).

for preventing death from new pulmonary emboli in Japanese deep vein thrombosis patients [7].

Since permanent indwelling of an IVC filter has the risk of thrombosis and perforation, filter removal should be considered for younger individuals such as in the present case. Extraction procedures by laparotomy are highly invasive. Thus, sophisticated removal methods with pacemaker lead extraction tools can be helpful to troubleshoot problematic IVC filters.

Conclusion

Sophisticated removal procedures with pacemaker lead extraction tools may be advantageous for the management of strongly adhered IVC filters.

Conflict of interest

The authors declare that there is no conflict of interest.

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