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CASE REPORT
Other

Inferior vena cava filter limb embolization to the right ventricle: a case report

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Background Inferior vena cava (IVC) filters are used to prevent pulmonary embolism (PE) in patients at a high risk for venous thromboembolism with a contraindication to anticoagulation. Inferior vena cava filters are associated with rare but significant long-term complications such as filter fracture and embolization.

Case summary We report the case of a 53-year-old female with an IVC filter inserted 8 years back for the management of recurrent bilateral PE resistant to anticoagulation. Imaging revealed an incidental finding of IVC filter limb fracture and migration to the right heart and the hepatic and renal veins. The patient remained asymptomatic with no impairment in cardiac, liver, or renal function. Due to a high operative risk, the broken IVC filter and embolized filter limbs were not retrieved.

Discussion There is no consensus on the management of intracardiac embolization of IVC filters. Intravascular fragments may be removed by endovascular or surgical approaches, depending on the anatomical location. Following IVC filter insertion, an appropriate follow-up must be put in place to ensure removal and limit clinical sequelae that are otherwise avoidable. A multidisciplinary approach to the management of IVC filter fracture and embolization is recommended.

Keywords Inferior vena cava filter • Pulmonary embolism • Intracardiac embolization • Chronic thromboembolic pulmonary hypertension • Case report

ESC Curriculum 2.1 Imaging modalities • 9.5 Pulmonary thromboembolism • 9.4 Thromboembolic venous disease

Learning points

- Inferior vena cava (IVC) filters are indicated for recurrent pulmonary embolism despite anticoagulation or in patients with an absolute contraindication to anticoagulation.
- Intracardiac embolization of IVC filters is a rare but potentially fatal complication.
- Appropriate follow-up should be organized to ensure removal of IVC filters; if lost to follow-up, this case will demonstrate the severe complications of fracture and embolization.
- A multidisciplinary approach to the management of IVC filter fracture and embolization is recommended.

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Introduction

Inferior vena cava (IVC) filters are used to prevent pulmonary embolism in patients at a high risk for venous thromboembolism with a contraindication to anticoagulation.[1] Inferior vena cava filters are associated with rare but significant long-term complications such as filter degradation, fracture, and embolization. We describe a rare case of an asymptomatic patient with multiple embolization locations of a fractured IVC filter.

Timeline

10 years prior	Diagnosis of pulmonary hypertension after presentation to hospital with bilateral pulmonary embolism
9 years prior	Recurrent bilateral pulmonary embolism resistant to warfarin
8 years prior	IVC filter insertion
7 years prior	Pulmonary endarterectomy via median sternotomy
Day of presentation	Incidental finding of IVC filter embolization to the hepatic and renal vein
During admission	CT chest characterising IVC filter embolization to the right heart

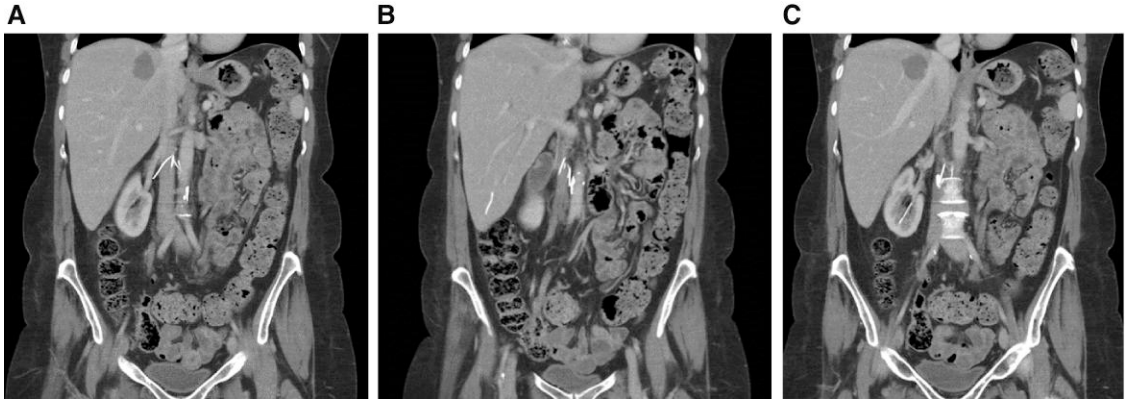

Figure 1 Computed tomography abdomen (coronal view) showing an inferior vena cava filter *in situ* (*A*) with limbs protruding beyond the inferior vena cava. Linear hyperdensities in the inferior pole of the liver (*B*) and right kidney (*C*) demonstrate embolized inferior vena cava filter limbs.

Case presentation

A 53-year-old female presented with lower back pain in the setting of a fall sustained 10 days before admission to hospital. Past medical history was significant for recurrent bilateral pulmonary embolism (PE) requiring IVC filter insertion, pulmonary endarterectomy via median sternotomy, and anticoagulation with long-term therapeutic enoxaparin due to warfarin resistance. This was further compounded by functional Class III chronic thromboembolic pulmonary hypertension on medical treatment with tadalafil and home oxygen. Chronic thromboembolic pulmonary hypertension was diagnosed 9 years back when the patient presented to the hospital with bilateral PE and right heart strain. At that time, a transthoracic echocardiogram (TTE) revealed a markedly dilated right ventricle, severe right heart dysfunction, and severe pulmonary hypertension (pulmonary artery pressure [PAP] 97 mmHg) which was confirmed on right heart catheterization. Pulmonary pressures remained elevated over the preceding years, while medical therapies, including bosentan, sildenafil, and epoprostenol, were trialled. Most recent imaging revealed no PE, normal right heart function on TTE, and improved pulmonary pressures (PAP 23 mmHg) following medical therapy, anticoagulation, and endarterectomy. Regular follow-up with respiratory and cardiac physicians was done. Other significant comorbidities included primary progressive multiple sclerosis on ocrelizumab with visual disturbances and a gait abnormality, moderate obstructive sleep apnoea, osteopenia, and severe back pain with lumbar fractures attributed to multiple falls. On presentation, a computed tomography (CT) abdomen was performed due to concerns for retroperitoneal haemorrhage, given long-term anticoagulation. Imaging revealed a lumbar spine (L2) compression fracture and incidental IVC filter limb embolization to the hepatic and renal veins and the right heart (*Figure 1*). The fractured IVC filter limbs were demonstrated on axial imaging (*Figure 2*).

A CT chest was then undertaken to further characterize the IVC filter embolization. Two embolized limbs of the IVC filter were present in the right heart (*Figure 3*). The first IVC limb was ~30 mm in overall length and located in the anterior–inferior aspect of the right ventricular myocardium; it had perforated through the myocardium into the epicardial fat by ~5 mm. The second IVC limb was at the junction of the membranous and muscular interventricular septum of the right ventricle (*Figure 3*).

The patient remained asymptomatic and haemodynamically stable with no recurrence of PE. Routine blood tests showed no impairment in liver or kidney function. A TTE was undertaken and demonstrated normal right heart size and function, normal left ventricular function, no significant valvular pathology, and no pericardial effusion. After extensive discussion and consultation with vascular, cardiothoracic, and respiratory teams, the patient was deemed too high risk for surgical intervention to remove the broken filter or embolized filter limbs due to significant comorbidities. The broken IVC filter was left *in situ*, and anticoagulation with therapeutic enoxaparin was continued. The chance of further embolization or progression of the embolized limbs was estimated to be very low.

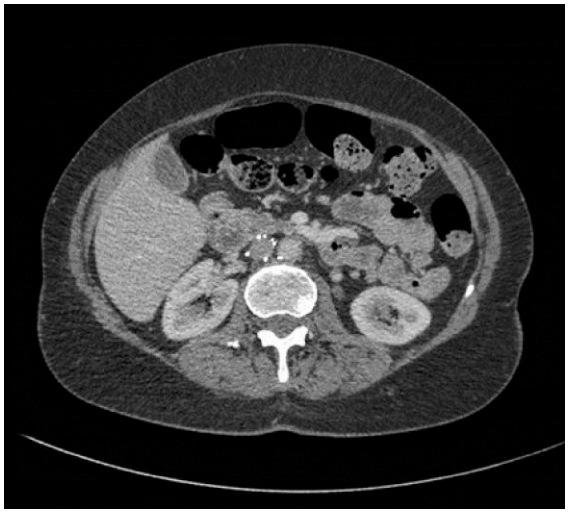

Figure 2 Computed tomography abdomen (axial view) demonstrating the missing inferior vena cava filter limbs.

Discussion

Inferior vena cava filters are inserted percutaneously into the IVC to prevent venous clots from reaching the pulmonary circulation. Accepted indications for IVC placement are recurrent PE despite adequate anticoagulation or an absolute contraindication to anticoagulation.[1] Despite widespread IVC filter use, there is limited evidence regarding the safety and efficacy of these devices.[1,2] A systematic review and meta-analysis of published studies showed that IVC filter insertion was associated with a 50% reduction in the risk of subsequent PE and no significant change in all-cause or PE-related mortality.[2] Long-term complications of IVC filters are uncommon but can include limb erosion through the IVC wall, filter migration, filter fracture, and embolization of fragments.[3,4] Intracardiac embolization of IVC filters is rare, although potentially life-threatening.[5] There have been a small number of case reports describing IVC filter or filter limb embolization to the right heart, with the occurrence of pericardial effusion, cardiac tamponade, and cardiac arrest in these patients.[6–8] A case series by Owens *et al.*[5] described varying clinical presentations of intracardiac embolization of IVC filters, ranging from chest pain, dyspnoea, and syncope to life-threatening arrhythmias and myocardial injury. Notably, up to 22% of patients were asymptomatic, as was the case with our patient.

Due to the very low incidence of intracardiac embolization of IVC filters, there is no consensus on management; however, removal via surgical and endovascular approaches has been described.[5,9,10] Intravascular fragments can be removed safely with variable success rates according to anatomical location.[10] Fractured IVC filter limbs located extravascularly within organs such as the heart, kidney, and liver are more difficult to remove due to issues with accessibility.[10] The long-term sequelae of an IVC filter retained within the heart of an asymptomatic patient is unknown, with a possible risk of further filter migration, cardiac perforation, or filter limb thrombosis.[5,10] In asymptomatic patients who are at high risk for intervention, a conservative approach with close observation may be appropriate.

This case demonstrates a rare case of a patient with multiple embolization locations of a fractured IVC filter. It is essential to ensure that post IVC filter insertion, the appropriate follow-up is in place; there must be clear documentation for the timing of removal to ensure that filters are not retained. Long-term clinical sequelae of retained IVC filters include degradation and embolization. A multidisciplinary approach to such issues is recommended.

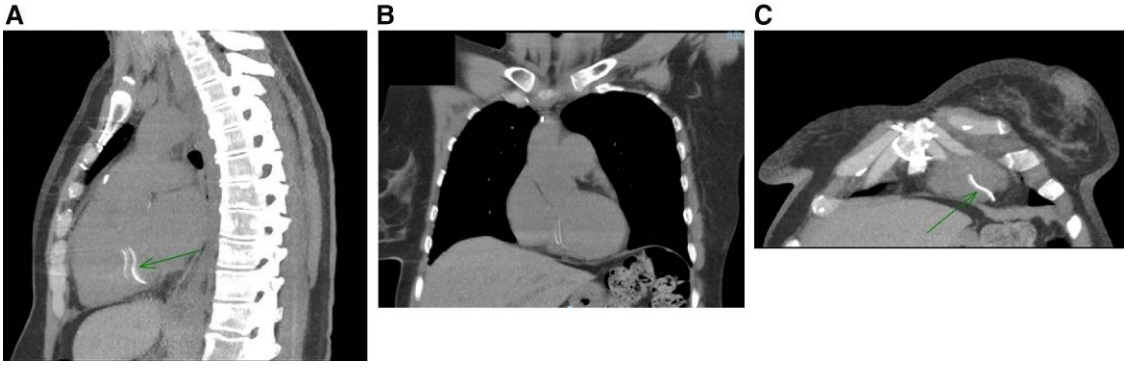

Figure 3 Computed tomography chest showing two inferior vena cava filter limbs within the right side of the heart, sagittal view (*A*) and coronal view (*B*), and mediastinal coronal view (*C*).

Lead author biography

Dr Abbey Knox is a surgical resident medical officer at a tertiary hospital in Australia. She obtained a Bachelor of Pharmacy degree and worked clinically as a hospital pharmacist for 4 years prior to completing postgraduate medicine. Abbey Knox is pursuing a career in cardiothoracic surgery.

Supplementary material

Supplementary material is available at *European Heart Journal - Case Reports* online.

Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as Supplementary data.

Consent: The authors confirm that written consent for submission and publication of this case report including the images and associated text has been obtained from the patient in line with COPE guidance.

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