CASE REPORT

A case of hepatic, renal and duodenal penetration by a Celect inferior vena caval filter

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SUMMARY

Inferior vena caval (IVC) filters are used as a mechanical option for the treatment of venous thromboembolism (VTE) when standard anticoagulation therapy is either contraindicated or VTE recurs despite adequate anticoagulation. Filters are not without risk, however. Reported complications include filter migration and fracture of filter components, leading to IVC rupture and penetration into pericaval tissues (notably kidney, heart, pericardium, thoracic cavity, liver, bowel and aorta). Here we describe an extreme case of multiple organ penetration by a standard Celect caval filter.

BACKGROUND

Inferior vena caval (IVC) interruption for venous thromboembolism (VTE) has been used as a means of mechanical intervention ever since Trousseau (1868) proposed surgical ligation of the IVC for prevention of pulmonary embolus. Since then, several transvenous filters have been developed for this purpose. The first surgically placed filter developed by Mobin-Uddin (1967) was subsequently superseded by Greenfield's percutaneously inserted device (1973).¹ Today IVC filters are used as a mechanical option for the treatment of VTE when standard anticoagulation therapy is either contraindicated or VTE recurs despite adequate anticoagulation. Filters are not without risk, however. Reported complications include migration and component fracture, leading to IVC rupture and penetration into pericaval tissues. Here we describe a patient with multiple organ penetration by a standard Celect caval filter.

CASE PRESENTATION

A 39-year-old woman presented to the emergency department with a 5-day history of increasing pain and swelling in the left leg and thigh. Past medical history was unremarkable and chest, cardiac and abdominal examination was normal. A venous Doppler ultrasound scan revealed extensive deep vein thrombosis (DVT) in the left common femoral vein and the patient was subsequently given therapeutic dose enoxaparin and warfarin before being discharged. The patient returned to the emergency department 11 days later with increasing pain and swelling in the thigh. Despite a supratherapeutic international normalised ratio (INR) level, duplex ultrasound revealed extension of the femoral DVT to the left common iliac vein. Thrombolysis of the iliofemoral DVT was performed. After

thrombolysis, residual 'loose' thrombus remained in the left proximal common iliac vein along with a stenosis at its origin. A Celect retrievable IVC filter was deployed in the infrarenal IVC and the stenosis balloon dilated and stented using a popliteal approach (subsequent CT venography confirmed the anatomy was in keeping with May-Thurner syndrome). Anticoagulation was subsequently restarted.

Filter retrieval was attempted 2 months later. Through an internal jugular venous puncture, a cavogram was performed which showed tilting of the filter. Despite using two separate snares, the hook of the filter could not be engaged and thus the filter could not be retrieved. The risks associated with alternative techniques at retrieval were difficult to quantify and a conservative approach with follow-up imaging was instead taken.

Seven months post attempted retrieval, a surveillance CT venogram was performed demonstrating a dislodged IVC filter with its hook penetrating into the aortocaval soft tissue with two limbs trapped in the right renal vein. Two other limbs projected anterolaterally into the pericaval soft tissues, towards the pancreas and duodenum. It was decided that the filter was now irretrievable to radiological techniques and that the risks of retrieval via open surgery outweighed any intended benefit.

Follow-up venography another 7 months later revealed filter struts protruding outside the IVC into the duodenum and posteriorly, abutting a vertebral body (figure 1). Three other struts were located within the right renal vein (figure 2). One of these struts had detached from the filter and was embedded within the right kidney, protruding through the anterior cortex and into the adjoining hepatic parenchyma (figure 3). Despite the migration of the filter components, the patient remained asymptomatic and a decision was made to not attempt surgical removal of the filter but to treat conservatively with anticoagulation and compression hosiery and follow-up with regular imaging.

DISCUSSION

IVC filters are effective in treating venous thromboembolic disease and their use is on the rise. Studies show use of IVC filters has dramatically increased in recent times with the frequency of IVC filter placement more than doubling (an increase of 111.5%) within a decade in one US population.² This may reflect a growing experience in the use of such devices along with an increasingly ageing population in whom anticoagulation is contraindicated.³

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Figure 1 Axial CT section through the abdomen. Filter struts located in the inferior vena cava (IVC) (short arrow) with a single filter strut protruding into the lumen of the duodenum (long arrow).

In one prospective randomised study (PREPIC Study), the risk reduction of developing pulmonary embolism (PE) in those patients with a permanent IVC filter and anticoagulation versus anticoagulation alone was 78%.⁴ In another study, the cumulative incidence of PE at 3 years was significantly lower for those patients with an IVC filter (1.7%) versus those without (5.3%).⁵

These devices are not without risk, however. One notable increased risk of IVC filter placement is that of DVT: the PREPIC Study found that the incidence of DVT after 2 years was 20.8% in the filter group and 11.6% in the anticoagulation-only group. At 8 years, this incidence increased to 37% in the filter group and 27.5% in the anticoagulation-only group.⁴ Multiple case studies have reported perforation, embolisation and fracture of IVC filters with migration of filter components to the supraceliac IVC, heart, pericardium, thoracic cavity, liver, duodenum and aorta.^{6–8} In a systematic review of 37 studies, the incidence of significant migration of the filter was 1.3%.⁹ Another study has reported a fracture rate of less than 1%.¹⁰ Specifically to Celect filters, however, Zhou *et al* reported a 13% penetration rate.¹¹ Despite these low risks, the consequences of filter migration can be catastrophic with reported effects including cardiac tamponade, haemorrhage and sudden death.^{7,8}

One systematic review revealed on average only 7% of perforations, migrations and fractures occurred within the first 30

Figure 2 Three struts are located in the right renal vein (arrow).

Figure 3 One of the filter struts appear to have detached from the filter and is embedded within the anterior renal parenchyma, protruding through the anterior renal cortex into the adjoining hepatic parenchyma (arrow).

days.⁹ The review also revealed low retrieval rates for retrievable filters. Of all filters inserted there was a 34% retrieval rate with the overall retrieval failure rate at 5.5%.⁹ The significance of the 30-day window was apparent from another study which showed a 99% successful retrieval rate at up to 30 days, decreasing to 37% at 12 months.¹²

No study has evaluated the risks associated with filter removal, although the Society for Interventional Radiology, the Food and Drug Administration and The National Institute for Health and Care Excellence have published guidelines to help inform clinical decision-making in this regard, recommending retrieval of the filter as soon as its risks outweigh the benefits.¹³ There is no formal guidance in the literature on the removal of symptomatic, complicated filters and we would recommend clinicians undertake a careful decision-making process with the patient, taking into account the potential benefits and risks of undergoing an endovascular or open procedure to remove filter components. This would take into account the severity of the symptoms attributed to the filter, the desire for the patient to have a further procedure and the experience of the operating clinician.

This extreme case appears to be the first in which a single standard IVC filter has penetrated three separate organs. In the current location, the risk versus benefit favours the migrated filter to be managed conservatively. Surveillance may show if the filter moves into a location where it may be considered to be more risky, for example towards a high-risk organ such as the aorta, cardiopulmonary vessels, heart or spinal cord. In such a circumstance, we would recommend a push towards intervention, even if asymptomatic, due to the risk of sudden and catastrophic bleeding or significant morbidity. The same would apply if the patient becomes symptomatic, for example, with pain, gastrointestinal bleeding or infection. Despite the increasing number of filters that are deemed irretrievable, there is little literature and guidance regarding regular surveillance of these patients. In a young patient of 39 years, yearly CT scanning would inflict an unacceptably high cumulative radiation load. Instead, the authors recommend the use of regular abdominal plain film radiography to monitor filter migration. If a complicated retrieval is warranted, this should be performed in a tertiary vascular centre.

While it is possible that manipulation of the filter during the attempted retrieval could have theoretically contributed to the

fracture and embolisation, this is not certain. While caution is required when managing the complicated filter, the decision to remove—and the degree to which one pushes removal of—a dislodged, tilted or old filter should still follow the same principles of removal of any filter as discussed above, taking into account the benefits versus risks of retrieval in the context of symptoms, whether there is migration towards high-risk organs and operator experience. Clearly, given a growing trend to using filters and a growing recognition of many filter-related complications there is a great need to ensure that patients are fully consented prior to filter placement, with an emphasis on discussing potential complications, plans for follow-up and filter retrieval. Concerns do remain as to the most appropriate way in which to manage patients with irretrievable filters and further research is required to provide better information about

the risks and benefits of retrievable filters to guide us in the future.

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Learning points

- Complications related to inferior vena caval (IVC) filters are uncommon but can be serious and can include IVC rupture and penetration into pericaval tissues.
- Several national guidelines exist to assist in the timing of removal of IVC filters when the risk-benefit ratio favours removal.
- In this case where surveillance is indicated, we recommend the use of plain film radiography as an alternative to CT while we await further research regarding management of irretrievable filters.
- While caution is required when managing the complicated filter, the decision to remove—and the degree to which one pushes removal of—a dislodged, tilted or old filter should still follow the same principles of removal of any filter as discussed above, taking into account the benefits versus risks of retrieval in the context of symptoms, whether there is migration towards high-risk organs and operator experience.

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