Filter-Associated Inferior Vena Cava Thrombosis with Duodenal Perforation: Case Report and Literature Review

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Background: The aim of this article is to report a case of filter-associated inferior vena cava (IVC) thrombosis with perforation of the duodenum and penetration of a vertebral body by the filter struts.

Case report: A 37-year-old woman with a medical history of Behcet's disease treated with corticosteroids underwent placement of a retrievable IVC filter because of recurrent iliofemoral venous thrombosis regardless of therapeutic levels of anticoagulation. Despite a correct positioning of the filter, the second follow-up computed tomography scan, performed at 1 year, showed a complete thrombosis of the infrarenal IVC segment, with perforation of the vessel wall by the filter struts and penetration in the duodenum. The patient remained asymptomatic. Open surgical removal of the filter with resection of the affected vena cava without vascular reconstruction was planned. The operation was performed under general anesthesia, surgical exposure was performed through a small midline laparotomy, and a duodenal Kocher maneuver was then performed to expose the IVC. The filter struts were found to have completely passed the cava wall in multiple directions. 2 struts penetrated through the duodenal serosa and 1 strut was embedded in the L3 periosteum. The IVC filter was successfully removed en bloc with the segment of the thrombosed and retracted IVC. The stumps were closed with 3-0 running polypropylene sutures and the duodenal lesions were closed with vicryl seromuscular sutures. No vascular reconstruction was necessary due to the marked development of collateral venous circulation. The patient was discharged home on postoperative day 6 and is doing well 6 months after surgery.

Conclusions: Patients with IVC penetration of filter struts are usually asymptomatic, as was our patient. However, a high level of clinical suspicion for perforation should be maintained when facing nonspecific abdominal or back pain, and in episodes of gastrointestinal bleeding in patients with an IVC filter. We recommend that patients with implanted IVC filters, even those who are asymptomatic, should receive regular imaging follow-up, and retrievable filters should be removed as soon as they are no longer needed.

Venous thromboembolism (VTE) is a significant cause of morbidity and mortality with an estimated annual incidence of 184 per 100,000 population, which corresponds to an estimated annual 119,670 events in France.[1]

Inferior vena cava (IVC) filter is indicated in patients where anticoagulation is contraindicated because of the risk of bleeding and in those who develop pulmonary embolism (PE) despite therapeutic levels of anticoagulation.[2] Insertion of IVC filters may result in complications such as IVC perforation (0-41%),[3] IVC occlusion (2-30%),[3] access

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site thrombosis (0-25%),[3] insertion complication (5-23%),[3] IVC migration (0-18%),[3] IVC fracture (2-10%),[3] IVC filter deployment outside the target region (1-9%),[3] recurrent PE (0.5-6%),[3] filter embolization (<1%),[3] and death (0.12%).[3] The vena cava perforation by the filter can cause injury to the duodenum, aorta, vertebral bodies, or other adjacent retroperitoneal structures.

Duodenal perforation by IVC filter is rare, and data on diagnosis and treatment have been sporadically published. We report a case of IVC filter's hooks penetrating the vein wall of a completed thrombosed vena cava toward the duodenum and a vertebral body.

CASE REPORT

A 37-year-old woman with a medical history of Behcet's disease treated with corticosteroids underwent placement of an ALN filter (ALN Implants Chirurgicaux, Ghisonaccia, France) because of recurrent iliofemoral deep venous thrombosis (DVT) regardless of therapeutic levels of anticoagulation. The retrievable filter was inserted by an interventional radiologist via the right internal jugular vein and was positioned below the renal veins at the inferior limit of the second lumbar vertebra (L2). Both the cavagram and computed tomography (CT) scan showed that the filter was correctly deployed inside the vena cava at the level of the inferior border of L2 (Fig. 1). Anticoagulation with coumadin was continued.

The patient remained asymptomatic except for the swelling and discoloration of the legs due to the postthrombotic syndrome. Regular follow-up examinations were performed with a CT scan. The CT scan performed at 12 months revealed a complete thrombosis of the vena cava at the level of the filter, with perforation of the vein wall by the struts, which appeared to be in close contact with the second portion of the duodenum. Furthermore, 2 struts were embedded in the third lumbar vertebra (L3) (Fig. 2). There was no retroperitoneal hematoma or pneumoperitoneum. Given these radiographics findings, she was transferred to our unit where we planned an open retrieval of the IVC filter with excision of the compromised segment of the IVC.

The operation was performed under general anesthesia, surgical exposure was performed through a small midline laparotomy, and a duodenal Kocher maneuver was then performed to expose the IVC (Fig. 3); the filter struts were found to have completely penetrated the cava wall in multiple directions, 2 struts penetrated through the duodenal serosa, and 1 strut was embedded in the L3 periosteum. Care was taken to dissect the struts free and away from adjacent viscera and surrounding structures. Vascular control was obtained proximal and distal to the filter. The division of the IVC was first performed at the apex of the filter (Fig. 4). The IVC stumps were closed with 3-0 running polypropylene sutures and the duodenal lesions were closed with vicryl seromuscular sutures. The IVC filter was successfully removed en bloc with the segment of the IVC (Fig. 5). The patient was discharged home on postoperative day 6 and is doing well 6 months after surgery.

DISCUSSION

The treatment of choice for VTE is anticoagulation, but in some specific cases, it may be ineffective or contraindicated. Our patient was diagnosed and treated for Behcet's disease and suffered from recurrent DVT despite her good compliance and constant maintenance of a therapeutic dose of oral anticoagulation therapy. In similar circumstances, IVC filters have been used as safe and efficacious devices to prevent PE[4] since the early 1970s.[5] The choice of the filter depends on the indication. Retrievable devices are preferable when the reason for insertion is temporary with a technical success of early percutaneous retrieval, ranging around 85-99%.[6,7] However, although most retrievable filters are inserted with the primary intention to remove them as soon as possible, only 50% of these filters are retrieved.[8] Permanent devices are used when long-term need is anticipated.

Although the procedure is considered safe overall, filters are prone to complications over time. IVC filter thrombosis is a complex problem that is not only related to filter design and characteristics but also to the patient's comorbid conditions such as hypercoagulable states, the presence of malignancy, or any of the underlying reasons that contraindicate anticoagulation itself. Thrombus burden within an IVC filter may range from asymptomatic small thrombus fragments to complete IVC occlusion with potentially serious consequences. The mechanism of IVC thrombosis may be due to entrapment of emboli within the filter decreasing filter patency, extension of DVT from the lower extremities and the iliac vein, or in situ thrombosis due to the intrinsic thrombogenicity of the device. In the PREPIC study,[8] symptomatic IVC thrombosis was seen in 13% of filter recipients after 8 years of follow-up. Ahmad[9] reported filter thrombosis rates by evaluating 1,718 patients with IVC filters; 18.6% of all patients had some degree of IVC filter thrombosis, whereas total occlusion of the filter-bearing IVC was seen only in 2% of this subset, that is, less than 0.4% of all patients. It is clear therefore that complete thrombosis of the filter-bearing IVC such as in our patient is a very infrequent problem.

The other major IVC filter—related complication observed in our case is the perforation of the vena cava wall by the struts. This complication was first

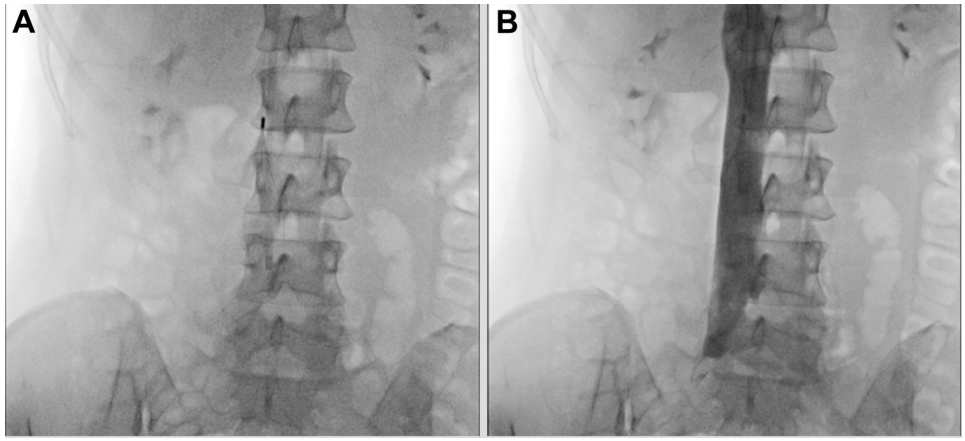

Fig. 1. Cavagram confirms the correct position after deployment of the ALN filter inside the vena cava at the level of the inferior border of L2. **(A)** IVC filter without tilt. **(B)** Patent Inferior vena cava after filter deployment.

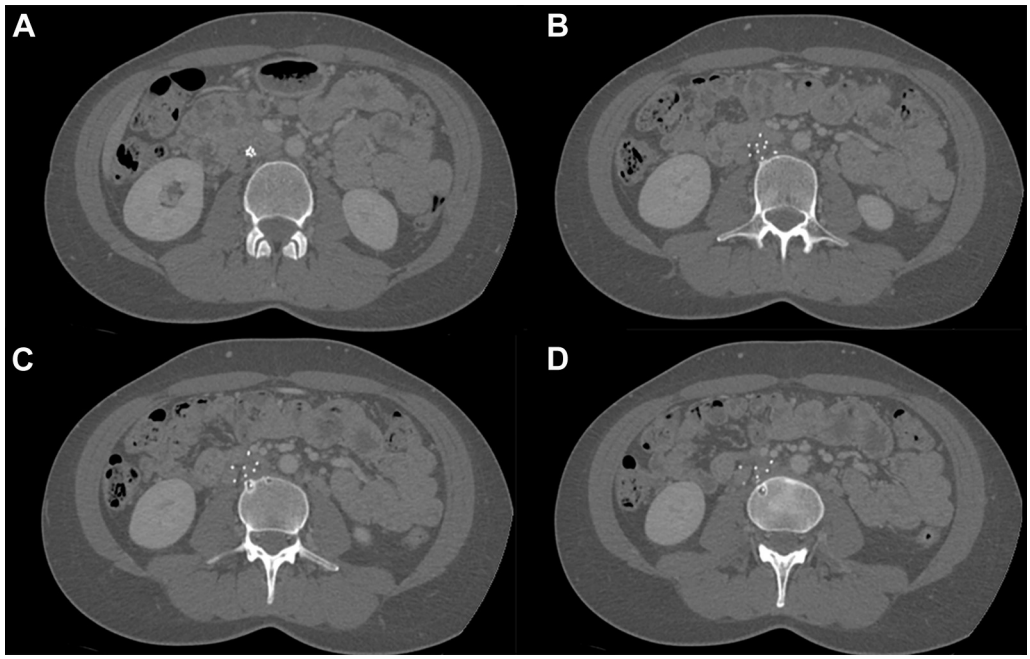

Fig. 2. CT scan showing IVC filter with struts perforating the IVC wall and extending into the retroperitoneum. **(A)** IVC filter inside a completely thrombosed inferior vena cava. **(B)** IVC filter struts outside the lumen of the inferior vena cava. **(C)** IVC filter struts in close contact with the duodenum and body of third lumbar vertebra. **(D)** IVC filter strut embedded in the body of third lumbar vertebra.

described in 1978 by Wingered,[10] since then, a variety of severe complications related to penetration have been well documented, including retroperitoneal hemorrhage, aortocaval fistula formation, duodenal perforation, upper and lower gastrointestinal bleeding, and hydronephrosis. Limited IVC wall penetration is required to anchor the IVC filter in its intended target location within the IVC to prevent migration. The ALN filter utilized in our patient is cone-shaped, made of stainless steel with 2 levels, for anchoring and for centering. The upper level provides an active anchorage through 6 struts whose distal extremities are curved into hooks, and the lower level consists of 3 long struts for centering.

The Society of Interventional Radiology (SIR) defined IVC penetration as the penetration of the vein wall by a filter strut or anchor device with

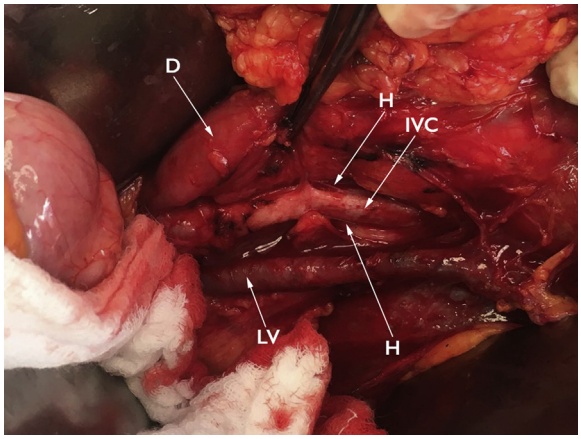

Fig. 3. Kocher maneuver exposing the inferior vena cava that is fibrotic and shrunk. D, duodenum; LV, right lumbar vein; IVC, inferior vena cava; H, filter hooks.

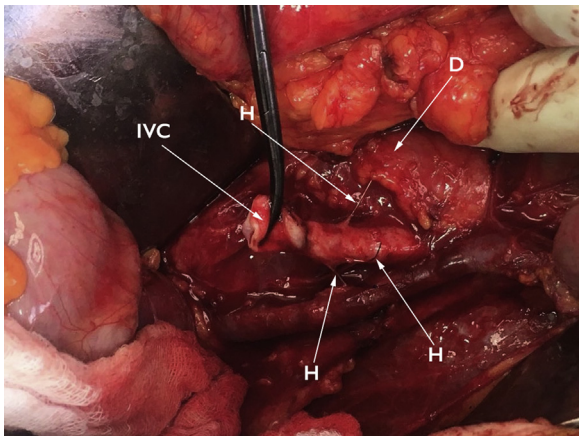

Fig. 4. Transection of the cava vein was performed first at the apex of the IVC filter. Struts penetrating through the vena cava wall. One of the struts is penetrating the duodenum. D, duodenum; H, struts.

transmural incorporation, extending more than 3 mm outside the wall of the IVC as demonstrated by CT or venography or at autopsy.[11] A systematic review, including 9,002 patients, identified IVC penetration to be present in 19% of patients, and of these patients, 19% showed evidence of organ/other structure involvement.[12] Although filter strut penetration of vena cava occurs frequently, the evolution of this complication is not well understood. It has been suggested that aorta pulsation, respiratory motion, and that interaction of the IVC filter and vessel wall could lead to penetration over time, which could result in a more stable filter position. In addition, multiple factors can affect likelihood of filter penetration, including cava vein diameter less than 24.2 mm.[13] The diameter of the vena

Fig. 5. Complete excision of the IVC filter and of the involved segment of vena cava.

cava in our patient in the initial cavography was 18.8 mm below the renal veins at the time of filter placement. Another factor associated to wall penetration is the type of filter and its design.[14] Cone-shaped and retrievable filters have been found to have higher rates of penetration than the permanent ones,[15] particularly when the retrievable filter is left in place longer than anticipated.[16] Filter tilt $>15°$ is another predictor of IVC penetration.[17] In our patient, we observed that the presence of complete IVC thrombosis caused a retraction of the vein (Fig. 6). This mechanism undoubtedly favored the perforation of the venous wall by the filter struts, enabling them to extend into the surrounding tissues and organs.

Patients with IVC penetration of filter struts are usually asymptomatic, as in our patient. However, when adjacent structures are perforated by the filter, potentially severe clinical consequences may occur. A high level of clinical suspicion for perforation should be maintained when facing nonspecific abdominal or back pain, and in episodes of gastrointestinal bleeding in patients with an IVC filter.

Currently there is no clear diagnostic or treatment strategy available in literature for this rare but potentially severe complication. We base our strategy for treatment in our patient on the experience of previous reports published by other groups. Conservative management with close follow-up for complications or evolution of the degree of penetration may be appropriate for asymptomatic patients.[14] Management of symptomatic patients can be a challenge, requiring exposure of the IVC surrounded by an inflammatory reaction. Most groups prefer a surgical approach through laparotomy with or without venotomy,[18–21] and closure of the duodenal lesion with seromuscular vicryl sutures. Other groups report endovascular retrieval without major complications, although 10.9% of attempts

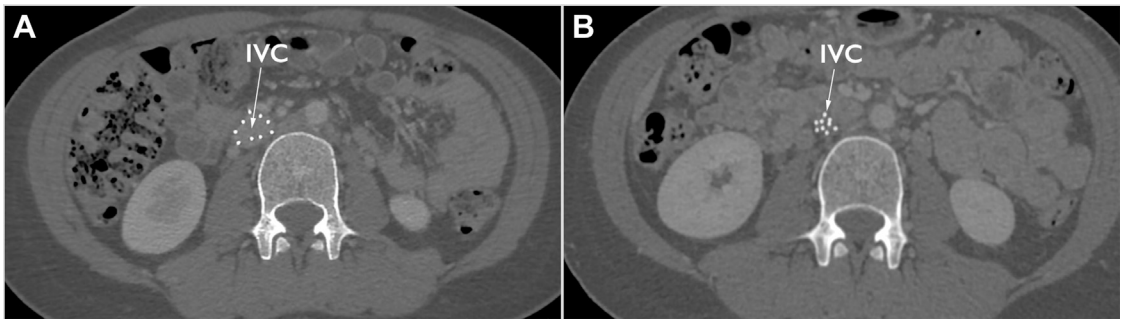

Fig. 6. Portal sequence of CT at the level of L3 vertebral body. **(A)** CT control at one week after filter deployment, the inferior vena cava (IVC) is patent and the filter hooks are perfectly adhered to the wall of the vein. **(B)** CT scan performed at 1 year from the procedure, complete thrombosis of the inferior vena cava is observed, with retraction of the walls, leaving the filter hooks tightened, exerting an increased pressure against the wall of the vena cava.

are unsuccessful[22] due to severe angulation of the filter and/or imbedding of the filter cap/hook within the cava wall. Others utilize a hybrid approach that consists of laparotomy, Kocher maneuver to expose the IVC, venotomy over the filter cap or hook, and a 9 French short sheath which is advanced and used to retrieve the filter. There are anecdotal reports of total laparoscopic filter removal but only in the absence of involvement of the duodenum.[23,24]

All these reports do not directly address the issue of feasibility or safety in removing these filters. The endovascular, open surgical or hybrid retrieval can be performed depending on patient's and physician's preferences. In our patient, due to the presence of well-developed venous collaterals through the pelvic, gonadal, internal iliac and paravertebral veins, we decided to perform an open surgical retrieval with resection of the thrombosed vena cava segment without venous reconstruction.

In conclusion, the diagnosis of duodenal perforation by an IVC filter may be challenging, especially in a patient with a nonspecific presentation. Open surgical removal is feasible for the extraction of complex cases not amenable to an endovenous approach, with minimal morbidity and excellent outcomes. We recommend that patients with implanted IVC filters, even those who are asymptomatic, should receive regular imaging follow-up, and retrievable filters should be removed as soon as they are no longer needed.

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