CASE REPORT

Chest pain from excluded inferior vena cava filter after stent placement

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A 52-year-old patient presented with chronic substernal chest pain 18 months following exclusion of an inferior vena cava (IVC) filter with a self-expanding IVC stent. After a thorough work-up revealed no other possible cause of chest pain, the filter and stent were removed with subsequent resolution of chest pain. Intraoperatively, filter struts were found to have penetrated the posteromedial wall of the IVC and were abutting the periaortic neural plexus. Referred chest pain due to strut penetration of the caval wall is a novel complication of both IVC filters and IVC stents, demonstrating a need for continued surveillance. (J Vasc Surg: Venous and Lym Dis 2014;2:70-3.)

Retrievable inferior vena cava (IVC) filters are an increasingly popular method for short-term prevention of pulmonary emboli from proximal lower extremity deep venous thrombosis (DVT). However, 10% to 15% of filters are unable to be endovascularly retrieved, most commonly due to fibrous attachments between filter struts and the IVC wall or significant thrombus in the filter. Unretrievable filters increase risks of delayed complications from prolonged dwell time, including device fracture or migration, recurrent DVT, filter thrombosis, guidewire entrapment, and IVC penetration. Although IVC penetration is common, clinically significant caval penetration is rare and usually presents with symptoms of back or abdominal pain. The present case highlights a novel complication of IVC filter penetration resulting in unrelenting chest pain.

OPERATIVE DETAILS

In the operating room, the IVC was exposed from the right renal vein to the iliac veins via a midline laparotomy with mobilization of the duodenum. The IVC was freed from the vessel wall, but the filter and stent removal. Preoperative CT angiography demonstrated a patent stent with filter struts displaced posteromedially toward the aorta and vertebral column (Fig 2, A and B).

The patient did well following filter exclusion with IVC stent placement until substernal chest pain developed 18 months afterward. The chest pain was severe and radiated to the abdomen, groin, and thighs. Given a history of recurrent thromboembolic, hypertensive, and hyperlipidemic, the patient underwent extensive cardiac and pulmonary evaluations that included multiple echocardiograms, a cardiac stress test, cardiac catheterization, computed tomography (CT) pulmonary angiograms, and pulmonary function tests. The workup revealed no cardiac or pulmonary pathology. With no other potential source of persistent chest pain, the excluded IVC filter was considered a potential cause, and the patient was evaluated for filter and stent removal. Preoperative CT angiography demonstrated a patent stent with filter struts displaced posteromedially toward the aorta and vertebral column (Fig 2, A and B).

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Following anticoagulation, a vascular clamp was placed distally below the stent across the terminal IVC, and a proximal clamp was placed across the IVC above the right renal vein. Through an anterior venotomy, the filter was carefully dissected, and the struts were exposed. The filter struts had penetrated the posterior and medial wall of the IVC in two places and were abutting the aorta. The struts were divided with wire cutters, and the two venotomies were repaired with polypropylene sutures. The stent and filter were carefully removed (Fig 2, D), and the longitudinal anterior venotomy was primarily repaired (Fig 2, E). The clamps were removed, and the retroperitoneum and abdominal wall were closed in standard fashion.

Postoperatively, the patient did well with resolution of chest pain and was discharged on postoperative day 5. A CT scan performed 4 months following IVC stent and filter removal demonstrated complete removal of the stent and filter (Fig 2, F) with patency of the IVC.

**DISCUSSION**

The present case highlights two novel points. First, stenting the IVC to exclude an IVC filter has a risk of caval penetration and carries a risk of complication that is not mentioned in previous studies of IVC stenting for filter exclusion. Second, chest pain from IVC filter penetration has not been previously reported and represents a very unusual complication of IVC filter placement. Penetration of the IVC wall by the filter struts occurs in 4% to 38% of patients with filters, but clinically significant penetration of the duodenum, aorta, and ureter account for less than 1% of IVC filter penetrations.7

![Figure 1](image-url)

**Fig 1.** Venography demonstrating tilted inferior vena cava (IVC) filter (A) that significantly deformed following attempted removal (B) and was treated with stent exclusion (C). Final venogram demonstrated patent IVC with exclusion of the IVC filter (D).
Chest pain has been reported with IVC filter migration to the right atrium but not related to caval penetration. In the present case, the filter remained in the infrarenal IVC and was radially displaced by the stent. Immediately after stent placement, the filter likely remained intraluminal since there was no contrast extravasation following stent placement or new complaints of pain. However, over time, filter struts penetrated the caval wall to irritate periaortic nerves, leading to referred chest pain. Referred chest pain from the abdominal aorta has been similarly reported as the chief presenting symptom in patients with isolated abdominal aortic dissections. The aortic adventitia contains bundles of nerve fibers called *nervi vascularis*. These nerves are distinct from the baroreceptors and chemoreceptors present in the aortic wall and arise from the thoracic and lumbar sympathetic ganglia. The *nervi vascularis* carry afferent pain signals through the aortic neural plexus to the sympathetic trunk, which then lead to the central nervous system. The aortic pain fibers are stimulated by distention and conduct impulses to the same nerves that transmit afferent signals from the heart. In the present case, the penetrating struts likely stimulated the *nervi vascularis*, presenting as unrelenting chest pain. Following removal of the penetrating IVC filter, the patient experienced resolution of chest pain.

Filter exclusion with an IVC stent prevented the risk of filter migration and thrombosis, but likely led to increased pressure of the filter struts on the IVC wall. Stenting of the IVC has been frequently described for treating vena caval obstruction secondary to benign and malignant causes. Stent placement in patients with IVC filters is less common and is technically demanding due to the risk of wire entrapment and disruption or displacement of the filter structure while advancing the stent. Stenting is accomplished by

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**Fig 2.** A, Sagittal view of computed tomography (CT) demonstrating an inferior vena cava (IVC) stent with posteriorly displaced IVC filter (*red arrows*). B, CT reconstruction showing stent and crushed filter with overlying accessory right renal vein (*large white arrow*). C, Intraoperative view of the infrarenal IVC with vessel loop around the accessory right renal artery (*large white arrow*) (E). D, Removal of the stent and filter with primary closure of longitudinal anterior venotomy (*small white arrows*) (E). F, Follow-up CT scan demonstrates removal of the stent and filter with patency of the IVC (insert).
damaging the filter with aggressive balloon angioplasty followed by stent placement though the displaced or fractured filter.\textsuperscript{14,16} Neglen et al have reported no complications following high-pressure angioplasty and stent placement to recanalize 25 venous occlusions involving IVC filters.\textsuperscript{17} They conclude that the use of endovascular stents to exclude IVC filters and thrombus is a safe option with less morbidity than open surgical exploitation. However, the present case demonstrates that excluded IVC filters still represent a risk of complication from IVC penetrations. CavaI penetration may have been more likely the present case since the filter was dislodged distally from the area of scar formation from chronic apposition of filter struts to the cava wall.

The OptEase IVC filter is approved for temporary implantation of 23 days with successful retrieval reported out to 48 days.\textsuperscript{17} The patient was within this period at the time of attempted removal. While freeing the filter from the IVC wall, the filter folded on itself and could not be retracted into a sheath for safe removal. Since the filter was free from the vessel wall, it was at risk for fracture and embolization and was therefore excluded with a self-expanding uncovered stent. If the filter remained attached to the IVC wall, stent exclusion would not be required so long as there was not significant thrombus.

Guidelines recommend placement of IVC filters in patients with acute proximal DVTs or acute pulmonary emboli who cannot tolerate anticoagulation.\textsuperscript{18,19} Although not meeting the guidelines, the present patient was deemed high-risk for further pulmonary embolization given the proximal nature of the DVT with recurrent pulmonary emboli. Approximately 25\% to 50\% of IVC filters are placed outside of the guidelines and further standardization of the indications for filter insertion is needed.\textsuperscript{20} Although IVC filter placement is frequently benign, complications occur in 1\% to 3\% of patients and may limit enthusiasm for prophylactic insertion.\textsuperscript{21}

CONCLUSIONS

With an increase in IVC filter deployment, novel complications should be expected, and filter-related complications must be considered in the differential diagnosis of patients with filters that present with incongruent symptoms not fully explained by initial diagnostic evaluation. To our knowledge, this is the first report of chronic chest pain secondary to IVC penetration from a filter and the first report of a complication following IVC filter exclusion with stent placement. In patients with IVC filters having prolonged dwell times, diligent surveillance is required to monitor for delayed complications from IVC penetration.

REFERENCES