Late erosion of a prophylactic Celect IVC filter into the aorta, right renal artery, and duodenal wall

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We present the case of a patient with retrievable inferior vena cava (IVC) filter-related pseudoaneurysms of the infrarenal aorta and right renal artery, with associated erosion into the duodenal wall. The patient was seen 10 months following multiorgan trauma and placement of a prophylactic retrievable IVC filter (R-IVCF). Management required autogenous aortic reconstruction, caval repair, and subsequent right nephrectomy. This case demonstrates that R-IVCFs may be associated with significant risks, which is concerning, as a majority of prophylactic R-IVCFs placed after multisystem trauma are not removed. (J Vasc Surg 2010;52:1041-4.)

Prophylactic insertion of inferior vena cava (IVC) filters accounts for more than half of all IVC filters placed into multisystem trauma patients with contraindications to anticoagulation.[1] There has been an increase in the use of prophylactic IVC filters associated with the introduction of retrievable IVC filters (R-IVCFs), the majority of which are not removed.[2] In this case, we describe a patient with R-IVCF-related pseudoaneurysms of the infrarenal aorta and right renal artery who presented 10 months following multiorgan trauma and prophylactic R-IVCF placement. Management consisted of autogenous aortic reconstruction, caval repair, and subsequent right nephrectomy. To date, the patient has recovered uneventfully.

CASE REPORT

The patient is a 42-year-old gentleman who was involved in a motor vehicle collision (MVC) with associated multiorgan injuries. These included a closed head injury with subarachnoid hemorrhage that precluded prophylactic anticoagulation. With his expected prolonged hospitalization, a prophylactic retrievable inferior vena cava filter (Celect R-IVCF, Cook Medical, Bloomington, IN) was placed on hospital day 7 for pulmonary embolus (PE) prophylaxis in the absence of documented deep vein thrombosis (DVT); the patient had no active infection at the time. During filter placement, one strut was slightly angulated into the right renal vein, and the device positioned cephalad to the typical infrarenal caval location. We were called to evaluate, and attempts at repositioning were unsuccessful. Ultimately, it was felt to be in satisfactory position to prevent PE; subsequent imaging demonstrated no change in location.

At the completion of his trauma hospitalization 3 months later, an additional unsuccessful attempt was made to retrieve the filter endovascularly. Multiple attempts to snare the hook of the filter failed; it was thought that the filter's retrieval hook was embedded in the anterior wall of the IVC, and manipulation did not change the angle of the filter to facilitate retrieval. The R-IVCF was left in place as a permanent device.

Ten months after his MVC, the patient presented with left upper extremity edema and was diagnosed with left arm thrombophlebitis. During inpatient hospitalization, the patient underwent a computed tomography (CT) scan of the abdomen and pelvis as part of an evaluation of back pain. The CT demonstrated the superior aspect of the IVC filter in a retrohepatic caval position. The struts protruded outside the vena cava lumen and were associated with significant phlegmon, fluid collections, an infrarenal aortic pseudoaneurysm, and penetration into the duodenal wall (Figs 1, 2).

A follow-up CT scan 3 days later demonstrated increased pericaval fluid collections and new presumed septic emboli to the lungs, based on their rapid evolution and typical imaging appearance. There was concern that the aortic pseudoaneurysm associated with the IVC filter was infected, potentially seeded from his infected thrombophlebitis, prior instrumentation of the filter, his duodenum, or his abuse of illicit drugs. Operative intervention was indicated.

A 2-day staged operative strategy was planned. Further attempt to remove the filter percutaneously was done to minimize the magnitude of the required open reconstruction, particularly given the patient's history of prior open Graham Patch for perforated peptic ulcer. On day 1, endovascular retrieval of the filter was attempted but proved unsuccessful. A host of combined instrumentation techniques were employed from the right internal jugular, right cephalic, and right femoral vein approach. We utilized balloons from two directions, a snare, and a snared wire looped around the filter struts. Strong force was successfully applied but did not successfully disengage the filter or change the position.

On day 2, we proceeded with open repair of the aortic pseudoaneurysm and open removal of the R-IVCF. Upon entering the abdomen through a midline incision, no frank pus or abnormal fluid was encountered. A right-sided visceral mobilization was

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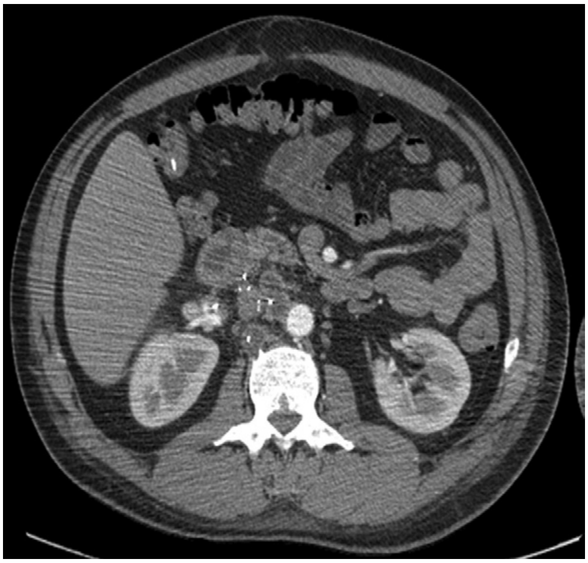

Fig 1. Extraluminal struts from a retrievable IVC filter with associated phlegmon and pericaval fluid collections, anterior strut abutting the duodenal wall, posterior strut with associated periosteal reaction, and strut adjacent to right renal artery.

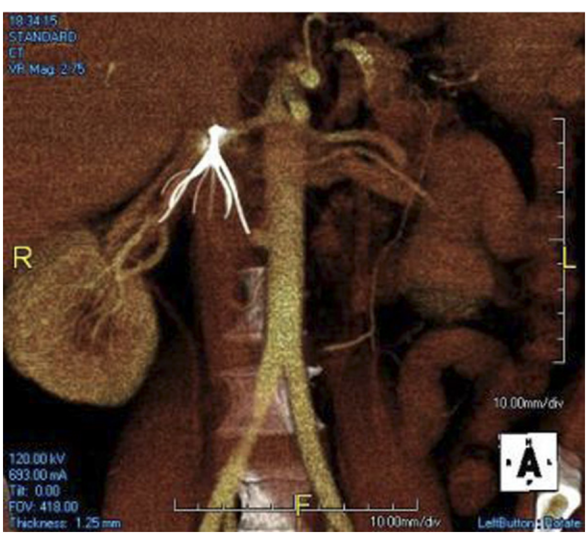

Fig 2. Reformatted 3D CT scan image of the retrievable IVC filter showing extraluminal struts and aortic pseudoaneurysm.

performed, including mobilization of the right colon, duodenum, head of the pancreas, and base of the mesentery from the cecum to the duodenojujunal junction. The extraluminal filter strut imbedded in the duodenal wall was encountered and detached from the wall. No leak was noted from the duodenum, and therefore, no formal repair was performed. The falciform, right triangular, and coronary ligaments around the liver were divided in order to mobilize the liver and facilitate control of the inferior vena cava superior to the filter. The exposure provided visualization of the aorta from the bifurcation to the superior mesenteric artery as well as the

Fig 3. Reformatted 3D CT scan image of the right renal artery pseudoaneurysm.

vena cava from the bifurcation to the retrohepatic portion. Significant phlegmon was encountered surrounding the aorta and inferior vena cava. After proximal and distal aortic control, a 4-cm segment of aorta containing the pseudoaneurysm was excised. Reversed, proximal, 4-cm left femoropopliteal vein was placed as an aortic interposition graft and found to be an appropriate size match.

We then turned out attention to the filter extraction, which required retrohepatic caval control, bilateral renal vein control, and infrarenal caval control. A 6-cm anterior venotomy was made for good visualization, and the entire filter was then removed in one piece, with considerable effort required, using a Kelly clamp, as the filter was densely incorporated into the wall of the IVC. Within the caval lumen, there was reactive change of the wall, but there was no loose material, no thrombus, and the lumen was adequate. Therefore no cava was resected, and the cavotomy was repaired primarily. Due to bowel swelling, the patient's abdomen was dressed with a negative-pressure dressing; his fascia was closed on postoperative day 5. The patient was discharged home on postoperative day 20.

One month later, follow-up contrast CT demonstrated a right renal artery pseudoaneurysm (Fig 3), which was not appreciated on the prior preoperative CT or intraoperatively during his aortic repair. Arteriography demonstrated a pseudoaneurysm arising from the right main renal artery bifurcation at the previous location of one of the filter struts. Although the strut had been in this location, we cannot exclude the possibility that the pseudoaneurysm was the result of surgical dissection during his prior operation. The patient was not considered a reasonable candidate for renal salvage given the concern for associated infection. Right nephrectomy was performed utilizing preoperative transcatheter embolization of the renal artery. We chose to embolize the renal artery preoperatively due to the marked inflammatory change noted in the same region one month prior, the large luminal defect in the renal artery hilar pseudoaneurysm by imaging, and recent aortic repair in the area of potential arterial control.

Table I. Published removal rates of FDA-approved retrievable IVC filters

Author, year	*Filters used*	*Number inserted*	*Attempted removal No. (%)*	*Successful removal No. (%)*
Antevil et al, 2005	Recovery, Günther-Tulip, OptEase	161	43 (27%)	33 (20%)
Ray et al, 2006	Recovery, Günther-Tulip	197	94 (48%)	80 (41%)
Van Ha et al, 2007	Recovery, Günther-Tulip	97	29 (30%)	28 (29%)
Karmay-Jones et al, 2007	Recovery, Günther-Tulip, OptEase	446	115 (26%)	90 (20%)
Seshadri et al, 2008	Günther-Tulip	42	19 (45%)	11 (26%)
Yunus et al, 2008	Günther-Tulip, OptEase	167	5 (3%)	4 (2%)
Hermsen et al, 2008	Recovery, G2 Filter System	92	39 (42%)	30 (33%)
Helling et al, 2009	Recovery, Günther-Tulip, G2 Filter System	125	40 (32%)	32 (26%)
Ko et al, 2009	Günther-Tulip	94 (preprotocol); 61 (postprotocol)	32 (34% preprotocol); 35 (57% postprotocol)	28 (30% preprotocol); 31 (51% postprotocol)
Johnson et al, 2009	Recovery, Günther-Tulip, OptEase	72	15 (21%)	13 (18%)

IVC, Inferior vena cava.

Table II. Reports of complications with FDA-approved retrievable IVC filters

Author, year	*Filter type*	*Complications*	*Major complication rate*
Antevil et al, 2005	Recovery, Günther-Tulip, OptEase	Filter infection; IVC thrombotic occlusion; migration; PE	3%
Ray et al, 2006	Recovery, Günther-Tulip	Breakthrough PE; IVC thrombosis; IVC wall penetration; thrombosis in filter	6%
Sadaf et al, 2007	Celect	Penetration of IVC; migration	Case report
Karmay-Jones et al, 2007	Recovery, Günther-Tulip, OptEase	Migration; tilt; breakthrough PE; symptomatic caval occlusion	2%
Veroux et al, 2008	Recovery	Perforation of IVC, duodenum, aortic wall with mural thrombus; complete thrombosis of IVC, left iliac vein	Case report
Helling et al, 2009	Recovery, Günther-Tulip, G2 Filter System	IVC thrombosis; tilt	6%
Gupta et al, 2009	G2 Filter System	Perforation of IVC and aorta with mural thrombus; lumbar body penetration; migration	Case report
Ko et al, 2009	Günther-Tulip	Breakthrough PE; tilt; IVC thrombosis; IVC wall penetration; thrombosis in filter	5%
Johnson et al, 2009	Recovery, Günther-Tulip, OptEase	No reported complications	0%
Parkin et al, 2009	Günther-Tulip	Perforation of IVC; vertebral osteomyelitis	Case report

IVC, Inferior vena cava; *PE,* pulmonary embolus.

To date, the patient continues to do well with normal renal function. He is asymptomatic with evidence of patency of his inferior vena cava and aortic repair. He has normal ankle-brachial indices.

DISCUSSION

The use of IVC filters has evolved significantly since their inception in the late 1960s and early 1970s, created with the singular purpose of preventing PE. Since Greenfield's IVC filter was released in 1973,[3] studies have indicated low mortality for these devices and improved safety.[4] However, multiple potential complications exist, both in the short and long term, for both permanent and retrievable devices.[5,6]

Our case report adds to the expanding body of literature documenting sequela and low retrieval rates from R-IVCFs (Tables I, II). In our review of the medical and surgical literature, no previous reports of right renal artery pseudoaneurysm with infrarenal aortic pseudoaneurysm from a retrievable IVC filter have been published.

Caval penetration is a well-known complication of various types of IVC filters, and while it occurs in up to 40% of cases, it is thought to be largely asymptomatic.[7] However, multiple case reports highlight the range of potential complications once the integrity of the cava has been breeched.[8,9] There are also reports of early caval penetration with Celect filters, within 9 days of placement.[10] Caval penetration is both a short-and long-term complication, and as this case report highlights, the longer the duration of penetration, the potentially more severe the complications (Table II).

This is troubling, as less than half of all R-IVCFs are removed,[2] most often due to lack of patient follow-up (Table I). However, there are cases when mechanical factors such as strut penetration, filter migration, tilt, or residual thrombus preclude removal of these "retrievable" devices even with appropriate follow-up.

The trend toward retrievable filters began in 2003, when permanent IVC filters were formally approved for percutaneous removal by the FDA.[11] Since then, dedicated retrievable filters have come onto the market, such as the Celect model placed into our patient. The prophylactic indication for IVC filter placement now accounts for more than half of all IVC filters inserted, a trend that began in the 1990s.[12]

Since FDA approval, retrievable devices have become increasingly popular.[1] The largest recipient group for R-IVCFs is multisystem trauma patients, a high-risk group for developing venous thromboembolism (VTE). These patients have an incidence of DVT from 40% to 80%; of the patients that get PE, roughly 50% will occur within 8 days of the accident, and 89% within 21 days.[13-15] With such extraordinary risks for VTE, those major trauma patients with contraindications for anticoagulation would seem to theoretically benefit from prophylactic R-IVCF insertion.

This theoretical benefit, however, has been argued against in the trauma literature[12] and has not been demonstrated prospectively.[16] Formal guidelines for the use of R-IVCFs do exist but are based primarily on expert opinion, given the lack of clinical evidence.[13,17,18] Furthermore, while the risks of VTE are highest within 3 weeks of an accident, the vast majority of R-IVCFs are not removed (Table I).[2] Considering the expansion in the use of R-IVCFs since their introduction in the absence of demonstrated benefits to patient outcomes, a recently convened multidisciplinary research consensus panel agreed that the highest priority for all IVC-filter research is their prophylactic use in trauma.[19] Several authors have questioned the rationale and safety of expanding use of prophylactic R-IVCFs in surgical or trauma populations,[6,20] and a consensus statement from the American College of Chest Physicians recommended avoidance of prophylactic IVC filters in trauma patients.[13]

CONCLUSIONS

This case report demonstrates that prophylactic R-IVCFs may be associated with significant risks, although their use after multisystem trauma is increasing, and most are not removed. Prophylactic R-IVCF-supporters site decreased PE and a theoretic mortality benefit, while detractors highlight the lack of evidence, poor retrieval rates, and rare but significant complications such as those documented here. We urge caution in the prophylactic use of R-IVCFs in the trauma population until there are data demonstrating benefit of such a management strategy.

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