

# Open retrieval management of inferior vena cava filter erosion resulting in symptomatic hydronephrosis

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## ABSTRACT

Inferior vena cava filters are effective for the management of thromboembolic disease but can erode into adjacent organ systems in rare instances. Endovascular retrieval of eroded filters has been the preferred management for this complication. We present a case for which endovascular retrieval was not appropriate because of filter orientation and erosion into the ureter and describe successful management using open retrieval of a permanent filter with erosion into the renal collecting system requiring reconstruction. Although minimally invasive retrieval is preferred over open repair, this approach should be considered when filter erosion is not amenable to endovascular retrieval. (*J Vasc Surg Cases Innov Tech* 2023;9:101188.)

**Keywords:** Case study; IVC filter; Penetration; Retrieval; Ureteral injury

Venous thromboembolic disease is a significant source of morbidity and mortality,<sup>1</sup> and the cornerstone of management is anticoagulant pharmacotherapy.<sup>2</sup> When anticoagulation is contraindicated, placement of an inferior vena cava (IVC) filter is a viable option for the prevention of pulmonary embolism.<sup>3</sup> However, filter complications can occur.<sup>4</sup> Caval filter erosion is a well-described complication of filter placement; however, symptomatic penetration into adjacent organ systems occurs in a minority of cases.<sup>5</sup> Furthermore, a limited number of case studies have described symptomatic erosion into the adjacent renal collecting system. We present a rare case of IVC filter strut penetration into the renal collecting system with open filter retrieval and renal collecting system reconstruction. The patient provided written informed consent for the report of her case details and imaging studies.

## CASE REPORT

A 72-year-old white woman presented with a 2-week history of right flank pain, oliguria, and dysuria. The next day, she had

worsening symptoms and new-onset hematuria despite antibiotic initiation. Abdominal computed tomography revealed new-onset, right-sided grade 2 hydronephrosis. Identification of a transversely oriented IVC filter with multiple prongs perforating the lateral aspect of the IVC at the ureteropelvic junction raised suspicion for symptomatic filter erosion (*Fig 1*). No renal calculi were noted on imaging. The patient had had a permanent Greenfield IVC filter (Boston Scientific, Marlborough, MA) placed in 2002 after a diagnosis of deep vein thrombosis and a history of factor V Leiden. In 2017, she had imaging findings showing migration of her IVC filter. On patient request, filter migration was managed conservatively without retrieval. A comparison with the present imaging studies showed worsening IVC filter caval penetration and mild ureterectasis. Following consultation, it was determined that a multidisciplinary approach with urology, vascular surgery, and interventional radiology was required for surgical management of her pyelonephritis, hydronephrosis, and retrieval of the eroded IVC filter.

**Operative procedure.** The first step was decompression of the hydronephrosis and drainage of infected urine. Interventional radiology placed a right percutaneous nephrostomy tube and evaluated the filter retrieval options with vascular surgery. Because the filter was a permanent Greenfield filter type, the tilted orientation, and erosion, endovascular retrieval did not seem appropriate. After resolution of the acute pyelonephritis 1 week later, the patient was brought to the operating room for open filter retrieval and ureter reconstruction.

Urology began the procedure with cystoscopy and placed bilateral ureteral stents to aid with ureter identification. Vascular surgery then exposed the retroperitoneum and IVC. Two IVC filter struts were confirmed to have perforated the IVC lateral wall into the proximal ureter, and the top of the filter had eroded the IVC wall medially into the right gonadal vein (*Fig 2, A*). There was abrupt tapering of the ureter caliber where the struts were perforating into it, along with significant inflammatory changes. Next, the patient was systemically heparinized,

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The present study was supported by the National Institute of General Medical Sciences (grant 5U54GM104942 to S.D.M.) and the National Institute of Diabetes and Digestive and Kidney Diseases (grant K23DK128569 to S.D.M.).

Author conflict of interest: none.

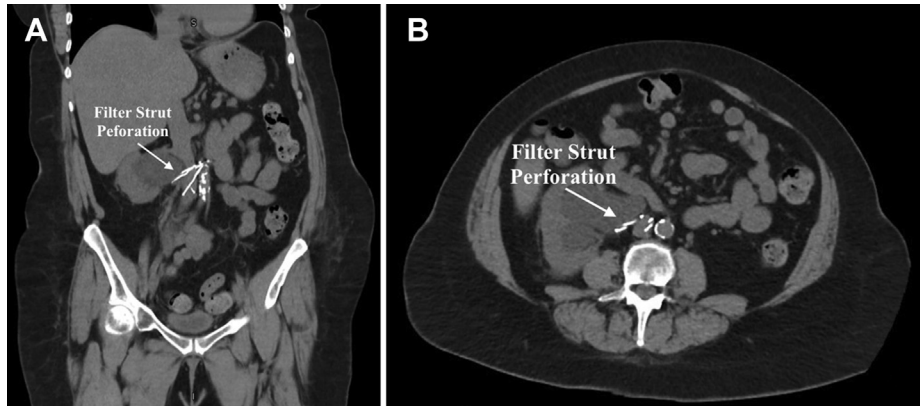
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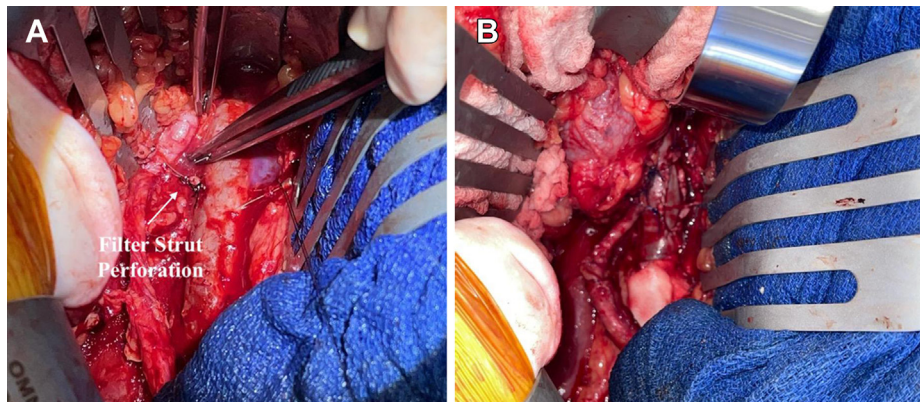
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<https://doi.org/10.1016/j.jvscit.2023.101188>



**Fig 1.** Preoperative noncontrast-enhanced abdominal coronal (A) and axial (B) computed tomography scans exhibiting inferior vena cava (IVC) filter struts perforating (arrow) through the lateral IVC wall, with resulting obstruction at the right ureteropelvic junction. The top of the filter also perforated the medial IVC wall, but no bowel involvement was found at surgery.



**Fig 2.** A, Inferior vena cava (IVC) filter struts shown intraoperatively perforating the lateral wall of the IVC into the right proximal ureter at the level of the ureteropelvic junction. B, Intraoperative reconstruction of the involved right renal collecting system and patch closure of the IVC.

and clamps were placed proximally and distally to the involved vena cava. A longitudinal venotomy was performed, and the filter was removed. The two struts that involved the ureter were unable to be removed. These struts were cut with wire cutters and left in place until the urology team was able to remove them during ureter reconstruction. The involved gonadal vein was ligated. The anterior venotomy was repaired with a bovine pericardial patch as a part of the IVC was removed with the filter owing to filter fibrosis into the wall of the IVC.

Dissection of the right renal pelvis and proximal ureter was performed, and the remaining two eroded IVC filter struts causing obstruction were removed. An antegrade pyelogram was performed, which showed persistence of hydronephrosis without adequate drainage. The decision was made to proceed with formal reconstruction with right Anderson-Heinz dismembered pyeloplasty. The involved proximal ureter and ureteropelvic junction were excised (Fig 2, B). The proximal ureter was spatulated laterally and anastomosed to the renal pelvis. A double-J ureteral stent was placed across the

anastomosis in an antegrade fashion before completing the anastomosis. A funnel-shaped, dependent, water-tight anastomosis was confirmed by negative leak test via the nephrostomy tube. A Foley catheter was used to maintain the renal collecting system empty.

**Postoperative follow-up.** The Foley catheter was removed on postoperative day 2 with adequate urine production. The patient had acute blood loss anemia on postoperative day 1 requiring 1 week of observation in the hospital. During this time, the patient's flank pain and urinary voiding symptoms subsided, her hemoglobin status stabilized, and the patient was discharged. During urologic follow-up 1 month later, the patient confirmed continued cessation of her urinary symptoms. An antegrade nephrostogram confirmed the lack of hydronephrosis, and the right ureter stent was removed. The patient was monitored overnight, follow-up ultrasound confirmed the absence of new-onset hydronephrosis, and her nephrostomy tube was removed the next day. Renal ultrasound 10 months

**Table.** Review of previously reported cases of urinary collecting system penetration by eroded inferior vena cava (IVC) filters

Report	Reference	Patient age and sex	Country	Symptoms	Intervention	Outcome
Case – endoscopic and endovascular management of inferior vena cava filter erosion into the right proximal ureter	6	47; F	Canada	Right flank pain	Transjugular filter retrieval with endobronchial forceps	Persistent mild right flank pain of decreased intensity compared with preoperative status
Misplaced inferior vena caval filter in right renal vein with erosion into renal collecting system	7	50; M	USA	Asymptomatic; erosion found on imaging after microscopic hematuria	Followed up conservatively with no surgical intervention	Follow-up not specified
Idroureteronefrosi secondaria a perforazione della parete della vena cava inferiore da parte di filtro cavale [Hydronephrosis caused by inferior vena cava penetration by a Mobin-Uddin filter]	8	63; F	Italy	Asymptomatic; right hydronephrosis found on periodic ultrasound scans after IVC filter placement	Followed up conservatively with no surgical intervention	Follow-up not specified
Inferior vena cava filter penetration following Whipple surgical procedure causing ureteral injury	9	80; M	USA	Asymptomatic; erosion found on routine follow-up imaging after placement	Transjugular filter retrieval with snare system and nephrostomy catheter placement	Indwelling nephrostomy catheter exchanged every 8 weeks with no further symptoms at last follow-up
Inferior vena cava filter erosion causing symptomatic obstructive hydronephrosis	10	59; F	USA	Abdominal and right flank pain	Transjugular filter retrieval with snare system and nephroureteral stent placement	Persistent minor narrowing of right ureter on imaging but no clinical symptoms at last follow-up
Gross haematuria associated with penetration of an inferior vena cava filter into the right renal collecting system	11	63; F	USA	Gross hematuria	Right ureteral stent placement and endovascular filter retrieval	Remained asymptomatic at last follow-up
Open retrieval of an inferior vena cava filter penetrating into a horseshoe kidney	12	48; F	New Zealand	Gross hematuria	Open filter retrieval after failed endovascular retrieval	Resolution of hematuria at 2 months of follow-up
Late erosion of a prophylactic Celect IVC filter into the aorta, right renal artery, and duodenal wall	13	42; M	USA	Back pain	Open filter retrieval after failed endovascular retrieval	Right renal artery pseudoaneurysm 1 month after procedure requiring right nephrectomy but normal renal function maintained
Delayed transcaval renal penetration of a Greenfield filter presenting as symptomatic hydronephrosis	14	53; F	USA	Right flank pain and hematuria	Open filter retrieval	No reported symptoms at 1 year of follow-up
Unfriendly filter: an unusual cause of hydronephrosis and hematuria	15	67; F	USA	Abdominal pain and gross hematuria	Right ureteral stent placement and open filter retrieval	Uneventful postoperative course with follow-up not specified

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Table. Continued.

Report	Reference	Patient age and sex	Country	Symptoms	Intervention	Outcome
Inferior vena cava filter penetration into right proximal ureter	16	37; F	USA	Right flank pain and gross hematuria	Open filter retrieval after failed endovascular retrieval with right ureter omental wrap	Uneventful postoperative course with follow-up not specified
Erosion of inferior vena caval filter noted during robotic assisted laparoscopic partial nephrectomy	17	67; F	USA	Stress type urinary incontinence	Robotic-assisted laparoscopic partial right nephrectomy	Uneventful postoperative course with follow-up not specified
Surgical management of inferior vena cava strut penetration causing hydronephrosis: case report	18	43; F	USA	Upper abdominal pain and right flank pain	Right ureterolysis, mobilization of ureter, excision of filter strut, and omental wrap around ureter with filter left in situ	Postoperative imaging findings months later consistent with residual right hydronephrosis and possible right ureter stricture
Inferior vena cava filter strut perforation discovered during right robotic-assisted laparoscopic partial nephrectomy	19	67; M	USA	Asymptomatic; erosion found during unrelated surgical intervention	Filter wire was bent, 2 hemostatic clips placed, and right partial nephrectomy	Uneventful postoperative course with follow-up not specified
Bird's nest filter causing symptomatic hydronephrosis following transmural penetration of the inferior vena cava	20	25; M	UK	Right groin pain and dysuria	Right ureteral stent placement with filter left in situ	Ureteral stent replacement every 3 months but remained asymptomatic at last follow-up
Symptomatic hydronephrosis caused by inferior vena cava penetration by a Greenfield filter	21	82; F	USA	Right flank pain	Right ureteral stent placement and right ureterolysis and ureteral repositioning with filter left in situ	Resolution of hydronephrosis on ultrasound 2 months after procedure

F, Female; M, male.

after her surgery confirmed the durability of the reconstruction with only minimal dilation of the renal pelvis, an expected finding given the renal pelvis redundancy from the previous hydronephrosis.

## DISCUSSION

Although proved to be an effective management option for venous thromboembolic disease, IVC filters can erode through the vena cava due to the outward force exerted by the filter struts on the IVC wall.<sup>6</sup> Filter erosion rates increase with longer indwelling filter times,<sup>3</sup> as evidenced by our case.

Filter erosion resulting in symptomatic organ involvement occurs in <0.5% of filter placements,<sup>4</sup> and only 16 cases of ureteropelvic junction perforation have been reported before the present case (Table).<sup>6-21</sup> Although rare, our case highlights the possibility of symptomatic urinary collecting system penetration by IVC filters. Symptoms consistent with urinary tract infections or obstruction in

patients with an indwelling IVC filter should be considered a possible consequence of filter erosion because of the close anatomic nature between the IVC and urologic structures. Abdominal computed tomography should be considered to observe the status of the patient's filter.

Of the 16 reported cases of urinary collecting system penetration by eroded filters, management ranged from no intervention required<sup>7,8</sup> to life-long nephrostomy tube dependence after failed stent placement.<sup>9</sup> However, the most common intervention has been endovascular<sup>6,9-11</sup> or open<sup>12-16</sup> retrieval of the filter. To the best of our knowledge, we describe a novel combined open retrieval of a permanent filter type and renal collecting system reconstruction for the management of IVC filter urinary collecting system penetration. The successful outcome of filter removal and urinary function in the present patient highlights the importance of the use of surgical multidisciplinary teams for patients

presenting with complex problems. Owing to the possibility of significant morbidity with symptomatic urinary collecting system penetration by IVC filters, further studies are needed to describe successful management of this complication. Currently, the PRESERVE (predicting the safety and effectiveness of inferior vena cava filters) trial is underway to describe the long-term safety of IVC filters as incidents of filter complications continue to be reported.<sup>22</sup>

## CONCLUSIONS

The details of our unique case emphasize key learning points regarding the safety and management of IVC filters and their complications. First, IVC filters should only be placed if indicated, and retrieval should be performed as soon as feasible. Second, patients with a history of long-term indwelling filters and urologic symptoms should be evaluated for filter migration. Finally, we have provided a novel multidisciplinary management strategy for IVC filter erosion into the renal collecting system that should be considered for patients for whom open retrieval is necessary.

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Submitted Jan 18, 2023; accepted Mar 28, 2023.