## **RESIDENT'S CORNER**

# Inferior vena cava filter penetration into right proximal ureter

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Inferior vena cava (IVC) filter penetration into the renal collecting system is an infrequent event. We report a case

Introduction

Inferior vena cava (IVC) filters are commonly inserted in patients with thromboembolic disease who fail anticoagulation or have a contraindication to anticoagulation.<sup>1</sup> Symptomatic IVC filter penetration into adjacent structures is rare and has a reported incidence of less than 1%.<sup>2</sup> We report a case of IVC filter (Celect, Cook Medical, Bloomington, IN, USA) perforation into the right proximal ureter in a patient with protein S deficiency presenting as flank pain and gross hematuria. Protein S is a vitamin K–dependent anticoagulant protein, the deficiency of which is associated with thrombosis.

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of IVC filter penetration into the right proximal ureter resulting in gross hematuria, hydronephrosis and stone formation.

**Key Words:** inferior vena cava, inferior vena cava filter, complications, filter penetration

#### Case report

A 37-year-old morbidly obese female presented to the emergency department with a 1 year history of worsening right flank pain and gross hematuria with passage of clots. Her medical history was significant for protein S deficiency for which she had an IVC filter (Celect, Cook Medical, Bloomington, IN, USA) placed 2 years prior due to recurrent bilateral deep vein thrombosis (DVT) and pulmonary embolism (PE) on anticoagulation. She was on aspirin and Plavix with the filter in place. She had multiple other comorbidities including chronic obstructive pulmonary disease (COPD) on home oxygen, congestive heart failure and gastroesophageal reflux disease. A plain radiograph of the kidney-ureter-bladder area showed an IVC filter with no evidence of radiopaque stones noted in the renal collecting system. She had a serum creatinine of 1.0 mg/dL and a negative urine culture. Computerized tomography (CT) scan demonstrated two prongs of the

filter outside the IVC with one of the prongs perforating into the right proximal ureter with calcification, Figure 1. Cystoscopy showed no evidence of urethral or bladder pathology. A retrograde pyelogram showed a vague filling defect in the right proximal ureter. Semi-rigid ureteroscopy demonstrated stone formation over an IVC filter prong which had penetrated the right proximal ureter, Figure 2. Holmium laser lithotripsy was performed carefully leaving the IVC filter prong in place. No attempt was made to remove the IVC prong during ureteroscopy because of concerns that this would result in IVC injury. A Double J stent was placed and the procedure terminated.

Vascular surgery was consulted for removal of the filter. They performed an inferior vena cavogram but were unsuccessful in their attempt to remove the IVC filter under fluoroscopy. A decision was then made to perform an elective open removal of the IVC filter, along with repair of any injury to the right ureter from the perforated prong. Prior to exploratory laparotomy, a right retrograde pyelogram was performed which showed an area of narrowing of the proximal ureter with continued hydronephrosis. The Double J stent was exchanged for a new one. The abdomen was then explored via a midline incision. The right colon was mobilized and the inferior vena cava was exposed. The prongs that were extruding from the vena cava were removed individually with a wire cutter. The vena cava was opened, the filter itself removed and the cava closed primarily. There was significant fibrotic reaction around



**Figure 1.** Axial CT showing filter tine penetrating into right ureter with proximal hydronephrosis.



**Figure 2.** IVC filter prong seen in proximal right ureter on ureteroscopy.

the right ureter which was mobilized and inspected. No major injuries were noted. An omental wrap of the right ureter was then performed and the abdomen was closed.

The patient's drain was removed on the third postoperative day. Her postoperative stay was prolonged mainly due to underlying COPD and she was discharged home on day 7 on aspirin, Plavix and Coumadin. The vascular surgery plan is to place another IVC filter in a suprarenal position if the patient undergoes another major surgery. She will continue on anticoagulation. The patient will undergo stent removal on follow up along with a renal ultrasound to check for persistent right hydronephrosis.

### Discussion

Venous thromboembolism is a significant cause of morbidity and mortality in the United States. IVC filters have been recommended as prophylaxis for thromboembolic disease in patients who are not suitable for anticoagulation, fail anticoagulation or develop complications from anticoagulation.

Complications reported with IVC filters include problems from insertion, thrombosis at access site, filter migration, filter fracture, filter penetration and IVC obstruction.<sup>2</sup> The incidence of IVC filter perforation has been reported to range from 25% to 86% on CT imaging. However, organ injury due to this is a fairly rare occurrence, with reported rates of less than 1%.<sup>3</sup> Penetration of the IVC wall by the legs of a filter has been associated with perforation/erosion of the duodenum, ureter, small bowel, retroperitoneal hematomas and small-bowel obstruction, aortic perforation and formation of aorto-caval fistula.<sup>3</sup>

There are several cases of IVC filters penetrating into the genitourinary system. A Greenfield filter was reported to have penetrated the right ureter, causing right urinoma and renal failure.4 This was managed initially with a percutaneous nephrostomy tube and stent followed by open surgery with ureterolysis and repositioning with interposition of fat and Gerota's fascia. Another case report noted a Greenfield filter prong penetration through the right renal vein into the renal parenchyma and pelvis, causing symptomatic hydronephrosis.<sup>5</sup> This required open surgery and right renal vein repair after the prongs were removed. In both cases, the Greenfield filters were left in place. One case of a Bird's Nest IVC filter penetrating the right ureter has been reported, with resulting inflammation and hydronephrosis, which was managed conservatively with a ureteral stent.6 Another unknown IVC filter type was reported to penetrate the right renal vein into the lower pole calyx after being placed 14 years earlier.<sup>7</sup> However, due to minimal symptoms, this was treated conservatively and no attempt was made to remove the filter prongs from the collecting system.

More recently, a Cook Celect IVC filter was reported to have penetrated into the right periureteral region causing severe fibrotic reaction, ureteral narrowing and symptomatic hydronephrosis.<sup>8</sup> No luminal intrusion was noted on ureteroscopy. This required an open surgical procedure to excise the protruding strut of the filter, followed by ureteral mobilization and omental wrap around the ureter. However no attempt was made to remove the filter. This patient subsequently developed a ureteral stricture, with persistent right hydronephrosis.

To our knowledge, ours is the first case of Cook Celect IVC filter penetration into ureter resulting in hydronephrosis and stone formation over the prong. The Cook Celect IVC filter is a retrievable filter that can also be left permanently if desired. It is a modification of the Günther-Tulip filter and has secondary struts, which are separate and independent from the primary struts. This increases both retrievability and dwell times. However these same changes in design which increase retrieval rates are also associated with a high incidence of IVC wall penetration by the filter legs/struts as well as migration.<sup>2,9,10</sup> The degree of penetration appears to correlate with indwelling time. The retrieval rates with the Cook Celect filter are over 90%. Open filter retrieval tends to be reserved for patients who have findings of hollow viscus injury by a penetrating filter tine or who have abdominal pain or other suggestion of pericaval structure injury.

Symptomatic IVC filter penetration into the urinary tract is an exceedingly rare event, but is a complication that has been increasingly reported. There should be a high index of suspicion whenever a patient with an IVC filter develops symptoms related to the genitourinary tract, including flank pain, urinary tract infection, or hematuria. Close clinical follow up after filter insertion is recommended.

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