

## CASE REPORT

## Duodenocaval Fistula from an Inferior Vena Cava Filter Perforation

Ulugbek Negmadjanov<sup>a</sup>, Michael Dedwylder<sup>a</sup>, Polina Gaisinskaya<sup>b</sup>, David Forcione<sup>b</sup>, W. Anthony Lee<sup>a,\*</sup><sup>a</sup> Department of Surgery, Charles E. Schmidt College of Medicine, Florida Atlantic University, Boca Raton, FL, USA<sup>b</sup> Department of Internal Medicine, Charles E. Schmidt College of Medicine, Florida Atlantic University, Boca Raton, FL, USA

**Background:** This article describes a rare case of inferior vena cava (IVC) filter perforation into the duodenum in a patient presenting with abdominal pain.

**Case report:** A 55 year old woman presented with abdominal pain four years after an IVC filter placement. Workup demonstrated an IVC filter strut perforating the duodenum. The filter was removed via laparotomy, the duodenum was closed primarily, and the IVC was repaired. The patient was discharged home on post-operative day five and is doing well.

**Conclusions:** Most extraluminal perforations of IVC filter struts are asymptomatic. Rare filter associated duodenal perforations may present with non-specific abdominal symptoms. If no other diagnosis can be attributed to the patient's presentation, direct removal of the filter and repair of the duodenum are indicated.

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## INTRODUCTION

Inferior vena cava (IVC) filters are indicated in patients at high risk of venous thromboembolism (VTE) when anticoagulation is contraindicated or fails. While guidelines are clear on the indications, IVC filters are increasingly used as prophylaxis in patients with fall risk, bariatric and trauma patients, and patients with VTE. Although significant improvements in the last decade in the design of retrievable filters have led to an increased use of filters, the actual removal rate is less than 25%. Overall, filter placement is considered to be a safe procedure; however, there is clear evidence that the insertion of filters may cause complications years after their placement. The most commonly described complications include access site complications, IVC filter migration, strut fracture, and IVC occlusion.<sup>1–3</sup>

A case of IVC filter strut perforation into the duodenum, causing severe dyspeptic symptoms and abdominal pain, is presented.

## CASE REPORT

A 55 year old woman with a history of peripheral arterial disease, chronic obstructive pulmonary disease, coronary artery disease, gastroesophageal reflux disease, hepatitis C, rheumatoid arthritis, appendectomy, and aortobi-iliac bypass graft for disabling short distance claudication

presented with several weeks' history of severe intermittent right upper quadrant pain, poor appetite, nausea, and emesis. She had a history of IVC filter placement four years prior to presentation for deep vein thrombosis at another hospital. The patient was on high dose proton pump inhibitor therapy prior to admission. The laboratory workup was unremarkable. Imaging workup demonstrated perforation of the IVC filter strut into the third part of the duodenum (Fig. 1A) and a dilated 9 mm common bile duct with an ampullary stricture. Esophagogastroduodenoscopy (EGD) revealed an IVC filter strut protruding into the third part of the duodenum with mucosal ulceration and thickening (Fig. 1B). Endoscopic ultrasound (EUS) and endoscopic retrograde cholangiopancreatography with brushings were performed to evaluate the ampullary stricture, followed by sphincterotomy and placement of a biliary stent. EUS was negative for a mass and cytology findings were benign.

Despite an extensive workup, the patient remained symptomatic with persistent abdominal pain and poor oral intake with no other identifiable causes, at which point retrieval was planned. A cavagram was performed, which demonstrated a patent IVC with the struts of the filter outside the lumen (Fig. 1C). Open surgical removal of the IVC filter with a duodenal repair was planned owing to the prolonged dwell time. Endovascular removal of the filter was not considered owing to potential complications of IVC rupture and duodenal injury.

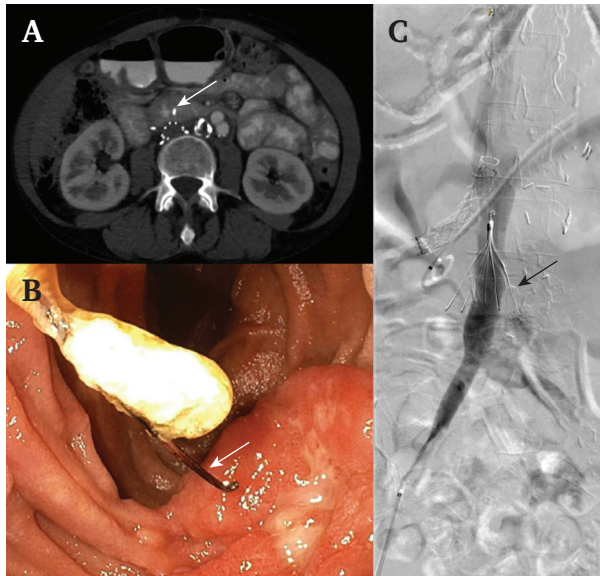
The operation was performed through a right transverse incision. A Cattell–Braasch manoeuvre was performed to expose the IVC from the renal vein confluence to the IVC bifurcation. Individual lumbar veins were clipped or

\* Corresponding author. 670 Glades Road, Suite 100, Boca Raton, FL 33431, USA.

E-mail address: [wlee@baptisthealth.net](mailto:wlee@baptisthealth.net) (W. Anthony Lee).

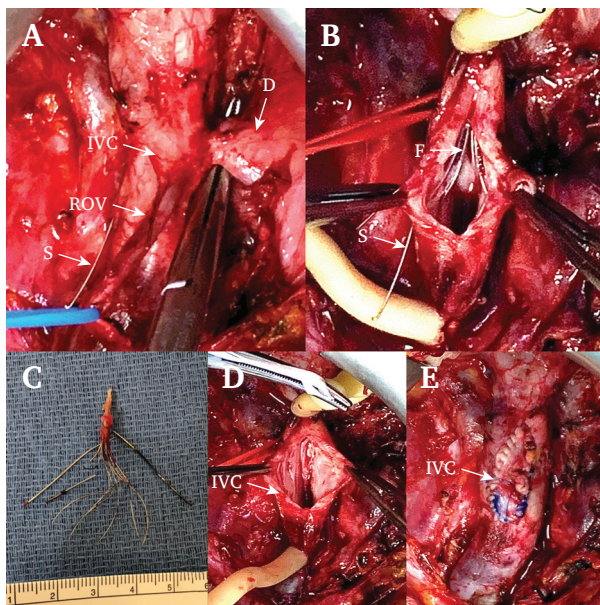
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**Figure 1.** (A) Perforation of the inferior vena cava (IVC) filter strut anteriorly into the duodenum on an abdominal computed tomography scan (white arrow) (B) Strut protruding into the lumen as seen on esophagogastroduodenoscopy (white arrow) (C) Inferior vena cavagram with the IVC struts outside of the IVC (black arrow).

controlled with silastic vessel loops. One of the struts was encased in a dense peri-ureteric tissue but was not penetrating the lumen of the right ureter. The strut was cut with wire cutters and pulled out. Next, the duodenocaval fistula (Fig. 2A) was completely exposed. The patient was



**Figure 2.** (A) Inferior vena cava (IVC) with duodenocaval fistula. D = duodenum; ROV = right ovarian vein; S = strut (B) Filter as seen through the longitudinal venotomy. F = IVC filter; S = strut (C) Completely removed IVC filter (D) IVC with the filter removed (E) Completed repair with the vein patch angioplasty.

heparinized and the IVC was occluded with the Rummel tourniquets. The IVC was opened through a longitudinal venotomy and the strut penetrating the duodenum was gently pulled out. The fistula was completely transected, and the duodenum was closed in two layers, and the area copiously irrigated with saline (Fig. 2B). The luminal segments of the filter legs, which were encased in dense fibro-intima, were sharply dissected out and the entire filter removed (Fig. 2C). To avoid narrowing, the IVC was repaired with a greater saphenous vein patch angioplasty (Fig. 2D and E). The patient recovered uneventfully and was discharged home on post-operative day five. She was doing well on her follow up visit six months after surgery, with complete resolution of abdominal pain and dyspepsia.

**DISCUSSION**

IVC filters have been used increasingly since the early 1970s for the prevention of VTE disease in patients that are unable to undergo systemic anticoagulation. With the introduction of retrievable IVC filters, there has been an increased use of these devices in prophylactic settings, despite lack of evidence and low retrieval rate. Due to lack of randomized data, there is no one filter that provides an improved safety profile over any other. Some of the more commonly reported complications of IVC filters include recurrent pulmonary embolism in 0.5%–6%, filter migration in 0%–11.8%,<sup>4</sup> caval thrombosis in 2.7%–13%,<sup>5</sup> filter fracture in 23%–40%,<sup>5</sup> and IVC perforation in 15%–70%.<sup>5</sup> These complications can be seen as early as six months after implantation,<sup>6</sup> and the rates are probably quite conservative due to underreporting, lack of routine surveillance, failure of diagnosis, and most complications being asymptomatic. As such, elective retrieval is indicated when filters are no longer needed. It is common to attempt to retrieve the filters within six months of their placement as attempts after one year often fail due to the fibro-intimal incorporation of the struts and hooks of the filter into the IVC wall.<sup>7</sup>

Duodenal perforation from an IVC filter strut perforation is a rare complication, whose true incidence is unknown. The majority of the patients with symptomatic duodenal perforations present with epigastric and right upper quadrant abdominal pain radiating to the back. As the pain is often non-specific, pain caused by an IVC filter is a diagnosis of exclusion. Pain can also be accompanied by dyspepsia and poor gastrointestinal (GI) tolerance. A high index of suspicion is also recommended for patients with a history of IVC filter placement presenting with a GI bleed.

The initial workup to identify the filter as the source of pain or GI bleed includes radiographs, followed by computed tomography and EGD. An upper GI series and adjunctive imaging studies are useful to rule out gastric outlet, small bowel, or biliary obstruction. A cavagram is often used to identify the patency of the IVC and evaluate for potential clot burden. As there are no formal guidelines on the removal of symptomatic late complications of IVC filters, the decision should consider the severity of the symptoms, risk vs. benefit, and the ability to rule out other potential etiologies of the patient’s presentation.

**Table 1.** Clinical presentation, filter characteristics, and treatment outcomes after inferior vena cava (IVC) filter retrieval.

Author (year)*	Age, sex	Clinical presentation	Interval from placement and diagnostic modality	Indications	Type of IVC filter and treatment modality	Complications and outcomes
Irvin (1972)	48, M	Fever, RUQ pain + right flank tenderness	7 days; AXR	Recurrent PE despite AC	Mobin-Uddin; ligation of the IVC just below renal veins	No complications; resolution of symptoms
Appleberg et al. (1990)	71, F	Diarrhoea + weight loss	6 y; AXR + EGD + cavagram + CT of the abdomen/pelvis	Massive iliofemoral DVT	Greenfield; repair of the duodenum and extraction of the filter (cavotomy)	No complications; resolution of symptoms
Taheri et al. (1992)	41, F	CP + SOB + RUQ pain	7 mo; AXR + cavagram	DVT + PE + GI bleed	Greenfield (suprarenal); repair of the duodenum and extraction of the filter (cavotomy)	No complications; resolution of symptoms
Tritsch et al. (1993)	66, F	Fever + weight loss + epigastric pain	4 y; AXR + EGD + CT of the abdomen/pelvis	DVT + PE	Kimray—Greenfield; strut cut flush with the IVC + repair of the duodenum (no cavotomy)	Small bowel obstruction; CVA during hospitalisation and death
Goldman et al. (1994)	58, F	RUQ abdominal + flank pain	10 y; EGD + BE + colonoscopy + abdominal US + cavagram + CT of the abdomen/pelvis	Intracranial bleed + DVT	Mobin—Uddin; extraction of filter found outside the IVC	No complications; resolution of symptoms
Al Zaharani et al. (1995)	55, M	Melaena + haematemesis	5 y; EGD + CT of the + abdomen/pelvis	Recurrent DVT + PE despite AC	Bird's nest; strut cut flush with the IVC repair of the duodenum (no cavotomy)	Post-operative DVT requiring AC; resolution of symptoms
Bianchini et al. (1996)	29, M	Heartburn + haematemesis	16 mo; AXR + EGD	DVT + PE despite full AC	Greenfield; repair of the duodenum + partial extraction of the filter (cavotomy)	No complications; resolution of symptoms
Sarkar et al. (1997)	68, F	Anaemia + GI bleed	11 y; EGD	DVT + PE post-operatively	Mobin—Uddin; repair of the duodenum + extraction of the filter (cavotomy)	No complications; resolution of symptoms
Dardik et al. (1997)	36, M	Nausea (SB obstruction)	2 y; AXR + UGI series +EGD + CT	DVT + GI bleed	Greenfield; repair of the duodenum + extraction of the filter (cavotomy)	No complications; resolution of symptoms

Guillem et al. (2001)	60, F	Abdominal + lumbar pain	10 y; abdominal US + EGD + CT of the abdomen/pelvis	Thrombophlebitis + recurrent PE	NR; repair of the duodenum + extraction of the filter (cavotomy)	Post-operative bleeding requiring ligation of a disrupted IVC branch; resolution of symptoms long term
Feezor et al. (2002)	40, M	Epigastric/RUQ pain + weight loss	NR; plain AXR + abdominal US + CT + EGD + cavogram	DVT + stroke	Bird's nest; strut cut flush with the IVC + repair of the duodenum (no cavotomy)	No complications; resolution of symptoms
Formentini et al. (2005)	23, F	Epigastric pain	5 y; AXR + EGD + CT of the abdomen/pelvis	Post-partum DVT + PE	NR; repair of the duodenum extraction of the filter (cavotomy)	No complications; resolution of symptoms
Mansour et al. (2005)	41, M	Haematochezia + abdominal pain	4 y; UGI series + EGD + CT of the abdomen/pelvis	PE + GI bleed	Bird's nest; strut cut flush with the IVC + repair of the duodenum (no cavotomy)	No complications; resolution of symptoms
Durairaj et al. (2006)	83, F	Epigastric discomfort	6 y, abdominal US + CT of the abdomen/pelvis + ERCP	Recurrent DVT + stroke + epistaxis/haematuria	Greenfield; non-operative management, long term antibiotic therapy	NR long term; resolution of symptoms for one mo
Botsios et al. (2006)	77, F	Epigastric pain + GI bleed	9 y, EGD + CT of the abdomen/pelvis	DVT + massive PE	Greenfield; repair of the duodenum extraction of the filter (cavotomy)	No complications; resolution of symptoms
Ibele et al. (2008)	48, F	RUQ pain	14 mo; CT of the abdomen/pelvis	Severe trauma + retroperitoneal bleed	Recovery; endovascular retrieval	No complications; resolution of symptoms
Veroux et al. (2008)	46, F	Diffuse oedema left lower extremity + mural thrombus in the aorta and IVC occlusion	2 y; DUS of the lower extremity + CT of the chest/abdomen/pelvis	Recurrent DVT + PE despite full AC	Recovery; repair of the duodenum + extraction of the filter (cavotomy) + aortic thrombectomy	No complications; residual IVC thrombus
Parkin et al. (2009)	21, M	Lower back pain + discitis	5 y; CT of the abdomen/pelvis	DVT + multiple PE despite AC	Günther tulip; extraction of the filter (cavotomy)	No complications; resolution of symptoms
Franz et al. (2009)	27, M	Abdominal + back pain	10 mo; CT of the abdomen/pelvis	DVT + irregular use of AC	Celect; strut cut flush with the IVC + repair of the duodenum (no cavotomy)	No complications; resolution of symptoms
Obman et al. (2010)	40, F	Upper abdominal pain	15 y; EGD + CT of the abdomen/pelvis	Severe trauma	Greenfield; repair of the duodenum + extraction of the filter (cavotomy)	No complications; resolution of symptoms

Continued

Table 1-continued

Author (year)*	Age, sex	Clinical presentation	Interval from placement and diagnostic modality	Indications	Type of IVC filter and treatment modality	Complications and outcomes
Becher et al. (2010)	42, M	Back pain	10 mo; CT of the abdomen/pelvis	Traumatic SAH + multi-organ injury	Celect; repair of the aortic pseudoaneurysm, extraction of the filter (cavotomy)	Right renal artery pseudoaneurysm requiring nephrectomy; resolution of symptoms
Bathla et al. (2011)	76, F	GI bleed	14 mo; EGD + CT of the abdomen/pelvis	Recurrent DVT despite full AC	Celect; repair of the duodenum + extraction of the filter (cavotomy)	No complications; resolution of symptoms
Shang et al. (2011)	58, M	Epigastric pain	10 y; EGD + CT of the abdomen/pelvis + UGI series	DVT + trauma	Bird's nest; repair of the duodenum + extraction of the filter (cavotomy)	No complications; resolution of symptoms
Widmer et al. (2011)	61, F	RUQ abdominal pain	1 y; EGD + CT of the abdomen/pelvis	DVT	NR; NR	NR
Conolly et al. (2012)	49, M; 50–58, F (3 patients)	Abdominal pain	5 mo–3 y, CT of the abdomen/pelvis	DVT + PE, surgical VTE, PE + hypercoagulable state	2 Bard Recovery filters, Bard G2, Celect; repair of the duodenum + extraction of the filter (cavotomy or sheath based open retrieval of the filter)	NR
Malgor et al. (2012)	61, F	Epigastric pain	3 y; EGD + CT of the abdomen/pelvis	DVT + PE	Bard G2; repair of the duodenum + extraction of the filter (cavotomy)	No complications; resolution of symptoms
Bae et al. (2012)	33, F	Epigastric pain + dyspepsia	8 mo; EGD + CT of the abdomen/pelvis	DVT during pregnancy	NR; strut cut flush with the IVC + repair of the duodenum (no cavotomy)	Post-operative ileus; resolution of symptoms
Caldwell et al. (2012)	47, F	Abdominal pain + GI bleed, CT of the abdomen/pelvis	3 y; CT of the abdomen/pelvis	DVT + obesity, pre-operatively before Roux-en-Y	Bard G2; endovascular extraction	No complications; resolution of symptoms
Antonoff et al. (2012)	62, M	Incidental CT scan findings	25 y; CT of the abdomen/pelvis + EGD	Protein C deficiency + prolonged hospitalisation after abdominal surgeries	Miles IVC clip; repair of the duodenum + clip extraction + IVC ligation	No complications; resolution of symptoms
Rondonotti et al. (2013)	57, F	GI bleed	4 y; EGD + capsule endoscopy + CT of the abdomen/pelvis	DVT + factor V mutation + multiple myeloma	NR; repair of the duodenum + extraction of the filter (cavotomy)	No complications; resolution of symptoms

Dat et al. (2014)	60, F	Epigastric pain + GI bleed	1 y; EGD + CT of the abdomen/pelvis	DVT + PE + bleeding	Celect; strut cut flush with the IVC + repair of the duodenum (no cavotomy)	Failed attempt during index surgery due to significant haemorrhage; patient required second surgery; resolution of symptoms
Ishida et al. (2014)	41, M	Routine EGD	18 mo; EGD + CT of the abdomen/pelvis	DVT + PE	ALN filter; strut cut flush with the IVC + repair of the duodenum (no cavotomy)	No complications; resolution of symptoms
Park et al. (2014)	46, M	Abdominal pain	6 y; EGD + CT of the abdomen/pelvis	DVT + paraplegia	NR; conservative management with abdominal pain attributed to urological causes	No complications; resolution of symptoms
Jehangir et al. (2015)	67, F	RUQ abdominal pain	NR; EGD + CT of the abdomen/pelvis	DVT	NR; repair of the duodenum + extraction of the filter (cavotomy)	No complications; resolution of symptoms
Genovese et al. (2015)	29–49, M (3 patients); 17–81 F (6 patients)	Abdominal pain + GI intolerance	2 mo–5 y; EGD + CT of the abdomen/pelvis	DVT/PE polytrauma, paraplegia	7 Celect, 2 Recovery; 2 patients had open repair of the duodenum + extraction of the filter (cavotomy); 6 patients had successful endovascular extraction; one patient had a failed endovascular extraction	One patient developed Gram negative bacteraemia after endovascular extraction managed with antibiotics; resolution of symptoms in all patients
Venturini et al. (2015)	45, M	Asymptomatic	5 y; CT of the abdomen/pelvis + cavagram	DVT + PE	ALN filter; endovascular extraction	No complications; resolution of symptoms
Pokharel et al. (2016)	67, F	RUQ abdominal pain + fevers	6 mo; CT of the abdomen/pelvis	PE + groin haematoma	NR; endovascular extraction	No complications; resolution of symptoms
Williams et al. (2016)	32, F	Epigastric abdominal pain	12 mo; CT of the abdomen/pelvis	DVT + contraindication to AC	Celect; endovascular extraction	No complications; resolution of symptoms
Fernandez-Moure et al. (2017)	67, M	Abdominal pain + GI bleed	1 y; EGD + CT of the abdomen/pelvis	DVT + craniotomy for brain tumour	Celect; endovascular extraction	No complications; resolution of symptoms

*Continued*

Table 1-continued

Author (year)*	Age, sex	Clinical presentation	Interval from placement and diagnostic modality	Indications	Type of IVC filter and treatment modality	Complications and outcomes
Kishor Jha et al. (2017)	47, F	Abdominal pain + dyspepsia	20 y; venography + CT of the abdomen/pelvis	DVT + contraindication to AC	NR; repair of the duodenum + extraction of the filter (cavotomy) + ligation of the IVC	MRSA bacteraemia; resolution of symptoms
McKelvie et al. (2017)	39, F	Asymptomatic, found during serial imaging	14 mo; EGD + CT of the abdomen/pelvis	DVT despite AC	Celect; unsuccessful endovascular extraction	NR
Lee et al. (2019)	63, F	Routine EGD	19 mo; EGD + AXR + CT of the abdomen/pelvis	DVT + iliac vein perforation	Celect; repair of the duodenum + extraction of the filter (cavotomy)	No complications; resolution of symptoms
Hongo et al. (2019)	43, M	GI bleed	12 y; EGD + CT of the abdomen/pelvis	DVT + trauma	NR; conservative management	No complications; resolution of GI bleed
Shimizu et al. (2019)	35, M	Epigastric pain	3 y; EGD + CT of the abdomen/pelvis	PE prevention after iatrogenic left iliac vein injury with DVT + malignancy	ALN filter; repair of the duodenum by EGD clipping + extraction of the filter (cavotomy)	No complications; resolution of symptoms
Halim et al. (2021)	28, F 55, M	Abdominal pain	NR; EGD + CT of the abdomen/pelvis	DVT	NR; repair of the duodenum + extraction of the filter (cavotomy)	No complications; resolution of symptoms
Parikh et al. (2021)	33, M	Epigastric abdominal pain	10 y; CT of the abdomen/pelvis	Recurrent DVT + paraplegia	Bird's nest; repair of the duodenum + strut cut flush with the IVC (no cavotomy)	No complications; resolution of symptoms
Khan et al. (2021)	33, F	Epigastric pain	13 y; EGD + CT of the abdomen/pelvis	DVT + paraplegia	Celect; repair of the duodenum + extraction of the filter (cavotomy)	No complications; resolution of symptoms
Tanabe et al. (2022)	26, M	GI bleed	8 y; EGD + CT of the abdomen/pelvis	IVC tumour embolisation	NR; repair of the duodenum + strut cut flush with the IVC + endovascular extraction	No complications; resolution of symptoms

M = male; RUQ = right upper quadrant; AXR = abdominal Xray; PE = pulmonary embolism; NR = not reported; AC = anticoagulation; F = female; EGD = oesophagogastroduodenoscopy; CT = computed tomography; DVT = deep vein thrombosis; CP = chest pain; SOB = shortness of breath; GI = gastrointestinal; CVA = cerebrovascular accident; BE = barium enema; US = ultrasound; SB = small bowel; UGI = upper gastrointestinal; ERCP = endoscopic retrograde cholangiopancreatography; DUS = duplex ultrasound; SAH = subarachnoid haemorrhage; VTE = venous thrombo-embolism; MRSA = methicillin resistant *Staphylococcus aureus*.

\* See [Supplementary Appendix S1](#) for the full references.

Symptomatic penetrations of IVC filters can be managed with both endovascular techniques and surgical interventions. In the current literature there are a total of 49 case reports and case series describing cases with duodenal perforation (Table 1). Laparotomy, venotomy with extraction of the filter, and direct repair of the duodenum was described in 25 patients. In situations when the IVC was thrombosed, *en bloc* segmental resection of the IVC with the filter *in situ* was performed. In 10 patients who had a significant inflammatory reaction around the filter the struts were cut flush with the IVC and the duodenum was repaired, leaving the remaining portion of the filter in the IVC. Complications after an abdominal approach were described in two patients, which included significant bleeding requiring a second operation for haemorrhage control and IVC filter strut removal. One patient developed right renal artery pseudo-aneurysm requiring nephrectomy secondary to the IVC filter strut penetrating the aortic wall. Two patients had delayed return of GI function secondary to post-operative ileus and small bowel obstruction, and one patient died after a prolonged stay in hospital. Several authors<sup>8</sup> have described endovascular retrieval in symptomatic patients who had duodenal, aortic, or vertebral penetration by an IVC filter. The filter was retrieved in 12 patients, and two patients had a failed attempt. All patients were maintained on broad spectrum antibiotics peri-operatively, to prevent intra-abdominal sepsis. In cases of aortic wall penetration, femoral artery access was maintained intra-operatively for potential haemorrhage control. Table 1 provides a detailed workup list and treatment.

In the current era of minimally invasive surgery there are also several reports of laparoscopic assisted, retroperitoneal laparoscopic, and even robotic assisted retrievals of an IVC filter. These approaches did not demonstrate decreased duration of hospital stay vs. open techniques, and several patients experienced post-operative fever and haematuria.

The conventional endovascular approach to remove an IVC filter revolves around retrieving the filter using a snare with a co-axial sheath. Several adjunctive manoeuvres, such as stiff wire displacement, loop snare realignment, wire loop and snare sling techniques, angioplasty balloon displacement, parallel wire and snare flossing, and dissection with endobronchial forceps, can aid the process. Another alternative is endovascular IVC filter retrieval using an excimer laser sheath, which has been described as safe and effective in extracting embedded filters.<sup>9</sup>

Despite advances in techniques, endovascular attempts at retrieval have their own set of complications. There have been cases of strut bending with non-collapsibility into the jugular sheath, which requires urgent open surgery. There is also potential for strut fracture with migration to the right ventricle and pulmonary artery. The complication rate for endovascular retrieval that requires adjuncts beyond standard snare and sheath varies from 5.3% to 20.6% between series.<sup>10</sup>

In conclusion, an IVC filter causing duodenal perforation is a rare complication with non-specific symptoms. Multi-modal imaging and diagnostic studies should be used to

rule out other more likely causes of a patient's symptoms. Consultation with gastroenterology should be considered. When all other reasonable causes have been excluded, direct filter removal can be performed safely using established endovascular or open surgical techniques. As the present case demonstrates, safe removal of the filter can be performed in the context of previous abdominal surgery.

#### CONFLICTS OF INTEREST

None.

#### FUNDING

None.

#### APPENDIX A. SUPPLEMENTARY DATA

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.ejvsf.2022.06.001>.

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