Spontaneous rupture of the inferior vena cava (IVC) in the setting of IVC filter thrombosis: case report

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Radiology Case. 2019 Mar; 13(3):19-27 :: DOI: 10.3941/jrcr.v13i3.3499

ABSTRACT

Spontaneous rupture of the inferior vena cava (IVC) is a rare entity. We report a case of a spontaneous IVC rupture associated with IVC filter thrombosis in a patient presenting with severe atraumatic back pain. Computed tomography (CT) identified a retroperitoneal hematoma and suggested IVC thrombosis. Magnetic resonance (MR) imaging confirmed the presence of IVC filter thrombosis and demonstrated a large defect in the infrarenal IVC, with the vessel lumen in free communication with the adjacent hematoma. The patient was managed conservatively and discharged in stable condition. MR imaging played an important role in characterizing the CT findings, which were unclear.

CASE REPORT

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A 61-year-old man with a history of recurrent deep venous thrombosis (DVT) underwent placement of an inferior vena cava (IVC) filter (TrapEase, Cordis) three and a half years prior to presenting to the emergency department (ED) with severe atraumatic back pain and hematuria. His medical comorbidities included obesity (body mass index of 48 kg/m^2) and bilateral knee osteoarthritis status-post total knee replacements approximately four years prior to presentation. His initial DVT occurred in the post-operative period for his first knee replacement. He subsequently developed a second DVT in the ipsilateral lower extremity despite therapeutic anticoagulation with warfarin (Coumadin), prompting IVC filter placement. Limited hypercoagulability work-up included prothrombin gene G20210A mutation testing, which was negative, and testing of plasma protein C and S activities, both of which were low. However, these labs were drawn while he was on warfarin but not repeated later. He continued warfarin for three months after IVC filter placement and was subsequently transitioned to aspirin 81 mg daily. His additional medications included pantoprazole (Protonix) and tamsulosin (Flomax). His family history was significant for a daughter with pulmonary embolism in the setting of an atrial ablation, presumably performed for an arrhythmia.

On presentation to the ED, vital signs were within normal limits. Basic metabolic panel, liver function testing, and complete blood counts were normal. Specifically, creatinine was 0.9 mg/dL and hemoglobin was 13.4 g/dL. Urinalysis was significant for 3+ blood on dipstick and 21-50 red blood cells per high power field. Due to suspected ureterolithiasis, he underwent non-contrast abdomen/pelvis computed tomographic (CT), which was negative for acute abnormalities (Figure 1). His back pain was presumed to be secondary to lumbar spondylosis, and he was discharged from the ED with instructions to follow-up with his primary care doctor.

Two days later, he returned to the ED with worsening back pain and lower extremity edema. Repeat laboratory testing revealed acute kidney injury (creatinine 1.6 mg/dL) and a new leukocytosis (15,000 white blood cells/mm^3). His hemoglobin remained normal at 14.3 g/dL. He underwent a contrast-enhanced abdomen/pelvis CT, which showed a new

retroperitoneal hematoma (Figure 2), prompting transfer to our tertiary care hospital. Subsequently, he underwent further evaluation with a contrast-enhanced CT of the abdomen and pelvis with both an arterial phase and a delayed phase (150 seconds) to optimize opacification of the inferior vena cava, and findings were suggestive of IVC thrombosis (Figure 3). Finally, because the etiology of the hematoma remained unclear, he underwent magnetic resonance (MR) imaging of the abdomen and pelvis without and with intravenous contrast, including angiography and venography (Figure 4). This study showed a large defect in the left lateral wall of the infrarenal IVC, with a direct communication between the IVC lumen and the retroperitoneal hematoma. There was thrombosis of the IVC at the level of the IVC filter, extending inferiorly with associated thrombosis of the common and external iliac veins bilaterally and bilateral common, superficial, and deep femoral veins. Venous duplex imaging (not shown) confirmed thrombosis of the femoral veins, extending distally into both popliteal and posterior tibial veins, as well as the left soleal sinus and gastrocnemius veins.

His hemoglobin trended downward over the next week, reaching a minimum of 9.5 g/dL, but he did not require transfusion. His renal function improved over the next several days and subsequently normalized. Aspirin was withheld on presentation due to the retroperitoneal hemorrhage and was not restarted. He was evaluated by the vascular surgery and interventional radiology services, both of which felt that the patient would not benefit from operative intervention or thrombolysis due to the significant risk of re-bleeding. He was not placed on systemic anticoagulation; however, vascular surgery planned to restart it at the time of follow-up, giving the IVC tear a chance to heal. He remained hemodynamically stable during his ten-day hospital admission, and he was subsequently discharged to a skilled nursing facility. Following discharge, his lower extremity edema progressed, but improved following initiation of furosemide. He otherwise remained clinically well. Follow-up CT without contrast three weeks later demonstrated decrease in the size of the retroperitoneal hematoma (Figure 5). Subsequent CT without contrast four months after discharge showed further decrease in the size of the retroperitoneal hematoma (not shown); the patient was restarted on systemic anticoagulation at that time.

DISCUSSION

Etiology & Demographics:

Rupture of the IVC is a rare entity that occurs almost exclusively in the setting of trauma [1, 2]. Spontaneous rupture has been reported in only a handful of cases, generally in the context of systemic anticoagulation [3], Ehlers-Danlos syndrome [4], or retroperitoneal vascular malformations [5]. Occasionally, no precipitating etiology can be identified [6-9]. In contradistinction, there are at least 30 reported cases of spontaneous iliac vein rupture in the setting of iliac vein thrombosis, most commonly in the setting of May-Thurner syndrome [10, 11]. Additionally, there is a prior case report of a retroperitoneal hematoma secondary to spontaneous lumbar vein rupture in the setting of IVC filter thrombosis, successfully treated with catheter embolization [12]. However, to our knowledge, our case is the first in the English literature of a frank IVC rupture in the setting of extensive deep venous thrombosis associated with an IVC filter.

The etiology of IVC rupture in our patient remains unclear. While possible that spontaneous rupture occurred first and IVC thrombosis followed, it is more likely that IVC filter thrombosis occurred first, resulting in increased intraluminal pressure in the distal IVC and subsequent rupture. In support of this notion, prior cases of spontaneous iliac vein rupture in the setting of May-Thurner syndrome suggest that the venous compression and associated thrombosis is the precipitating etiology [10, 11]. Additionally, acute thrombophlebitis was seen in cases where pathology was available, suggesting that loss of vessel wall integrity due to inflammation is a contributing factor [11, 13]. Accordingly, chronic transmural inflammation is a ubiquitous feature of abdominal aortic aneurysms, and generally considered a prerequisite to spontaneous rupture [14, 15]. IVC rupture after thrombosis also explains the fact that the hematoma was limited in our patient. The etiology for our patient's hematuria remains unclear, as the renal veins were not involved by the thrombosis, though one possibility is that the retroperitoneal hemorrhage caused ureteral irritation resulting in hematuria.

Clinical & Imaging Findings:

Our patient with spontaneous IVC rupture associated with IVC filter thrombosis presented with severe atraumatic back pain. CT identified a retroperitoneal hematoma and suggested the presence of IVC thrombosis. MR imaging confirmed the presence of IVC filter thrombosis and demonstrated a large defect in the infrarenal IVC, with the vessel lumen in free communication with the adjacent hematoma. Table 1 summarizes the clinical features and imaging features of spontaneous IVC rupture.

MR imaging played an important role in elucidating the etiology of the retroperitoneal hemorrhage and making a definitive diagnosis of IVC filter thrombosis, both of which were not clear on CT. Indeed, MR has superior contrast resolution, allows for dynamic imaging, and does not utilize ionizing radiation [16, 17]. MR imaging including angiography and venography, by providing a comprehensive assessment of the intra-abdominal vasculature using a single dose of intravenous gadolinium contrast in a single imaging session, should be considered in stable patients with ambiguous or equivocal vascular findings on contrast-enhanced CT.

Treatment & Prognosis:

Spontaneous rupture of the IVC is associated with high rates of morbidity and mortality, and most patients require open surgery to control the bleeding and repair the perforation [3-9]. Furthermore, survival to hospital discharge is rare unless the rupture is contained, as was the case in our patient. Table 1 summarizes the treatment and prognosis of spontaneous IVC rupture.

IVC filter thrombosis is a known complication of IVC filter placement, occurring in 7-30% of patients, with various complications including venous insufficiency and collateral vessel formation resulting in alternate pathways for thromboembolism [18, 19]. Although there is no clear evidence to support concurrent anticoagulation therapy in patients with IVC filters, there is retrospective data demonstrating an association between a lower rate of filter-related complications and treatment with systemic anticoagulation, in patients with metastatic carcinoma [20]. In patients that develop IVC thrombosis, catheter directed thrombolysis is a safe and effective approach for symptomatic management [21]. However, our patient had a significant risk of re-bleeding with catheter-directed thrombolysis; given his hemodynamic stability, conservative management was appropriate.

Differential Diagnoses:

The differential diagnosis for spontaneous retroperitoneal hematoma broadly includes idiopathic retroperitoneal hematoma, aortic rupture, and IVC rupture [22, 23]. Retroperitoneal fibrosis has the potential to mimic retroperitoneal hematoma, and thus should be included in the differential diagnosis [24]. Table 2 shows the imaging features of each of these diagnoses.

Idiopathic retroperitoneal hematoma

This entity is defined by a lack of alternative explanation for the retroperitoneal hematoma, and the most common risk factors is anticoagulation [22]. Idiopathic retroperitoneal hematoma on CT manifests as high attenuation retroperitoneal fluid, often tracking into the pelvis, without internal contrast enhancement. On MR imaging, it appears as retroperitoneal fluid with a variable appearance on T1- and T2-weighted images depending on the age of blood products. No explanatory factor is identified on imaging, a requirement to make this diagnosis.

Aortic Rupture

Retroperitoneal hematoma associated with aortic rupture almost exclusively requires the presence of an abdominal aortic aneurysm or pseudoaneurysm [23], neither of which was present in our patient. On CT, retroperitoneal hematoma associated with aortic rupture manifests as high attenuation retroperitoneal fluid associated with an abdominal aortic aneurysm or pseudoanerysm. On MR imaging, this condition manifests as retroperitoneal fluid with a variable appearance on T1- and T2-weighted images depending on the age of blood products, again with an associated abdominal aortic aneurysm or pseudoanerysm.

Retroperitoneal fibrosis

This entity is characterized by fibroinflammatory soft tissue which encases the aorta, IVC, and/or iliac vessels [24]. Commonly, this condition presents with ureteric obstruction and hydronephrosis, neither of which was present in our patient. This entity is can be distinguished from retroperitoneal hematoma on CT and MR imaging by the presence of enhancing retroperitoneal soft tissue.

TEACHING POINT

Spontaneous rupture of the IVC is an extremely rare entity, and in the presented case, IVC filter thrombosis with extensive associated DVT was presumably the etiology. MR imaging, which played an important role in elucidating the etiology of the hemorrhage by means of direct visualization of an IVC mural defect, can be helpful as a problem solving tool in cases of unexplained retroperitoneal hematomas.

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FIGURES

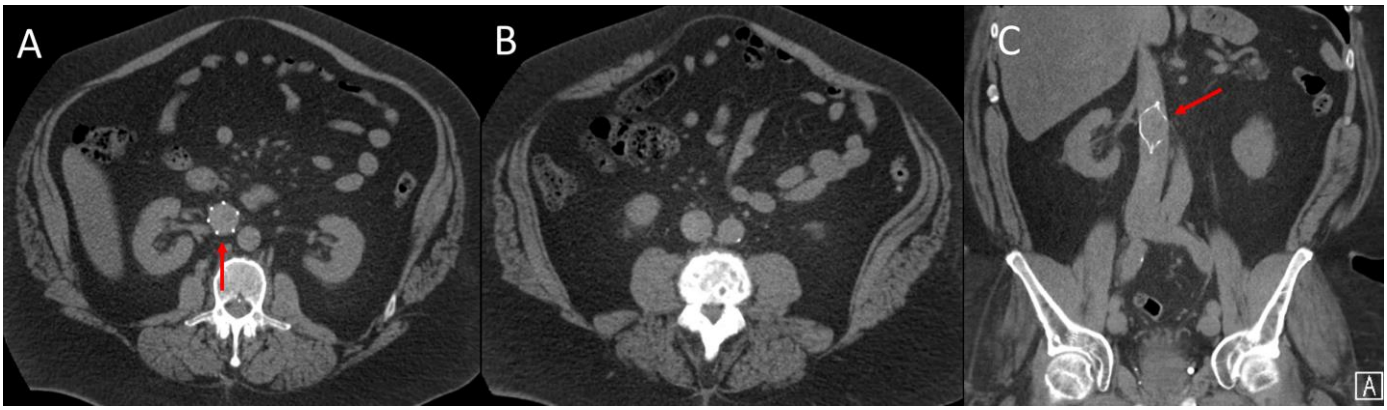

Figure 1: 61-year-old man with no acute findings on initial unenhanced CT.
Findings: Initial unenhanced transaxial CT images at the level of the inferior vena cava filter (A) and lower pole of the right kidney (B) demonstrated no acute abnormality. Specifically, the inferior vena cava, abdominal aorta, and retroperitoneum appeared normal. Transaxial and coronal images (C) showed a TrapEase filter (arrows) in expected location.
Technique: CT: 417 mAs (140 mAs reference), 140 kV, 5 mm slice thickness, no intravenous contrast.

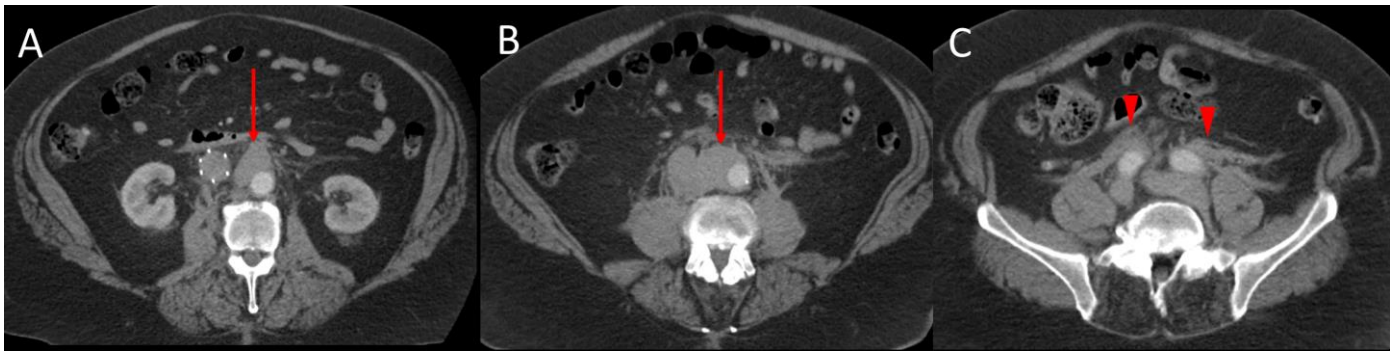

Figure 2: 61-year-old man with spontaneous retroperitoneal hematoma.
Findings: Subsequent contrast-enhanced CT in the portal venous phase performed two days after initial presentation demonstrated a new retroperitoneal hematoma surrounding the aorta and the inferior vena cava (arrows), below the level of the inferior vena cava filter (A and B). Hematoma tracked into the pelvis along the common iliac arteries (C, arrowheads). There was no contour abnormality of the aorta or the common iliac arteries to suggest an arterial abnormality.
Technique: CT: 417 mAs (140 mAs reference), 140 kV, 5 mm slice thickness, 100 mL Optiray 320, portal venous phase.

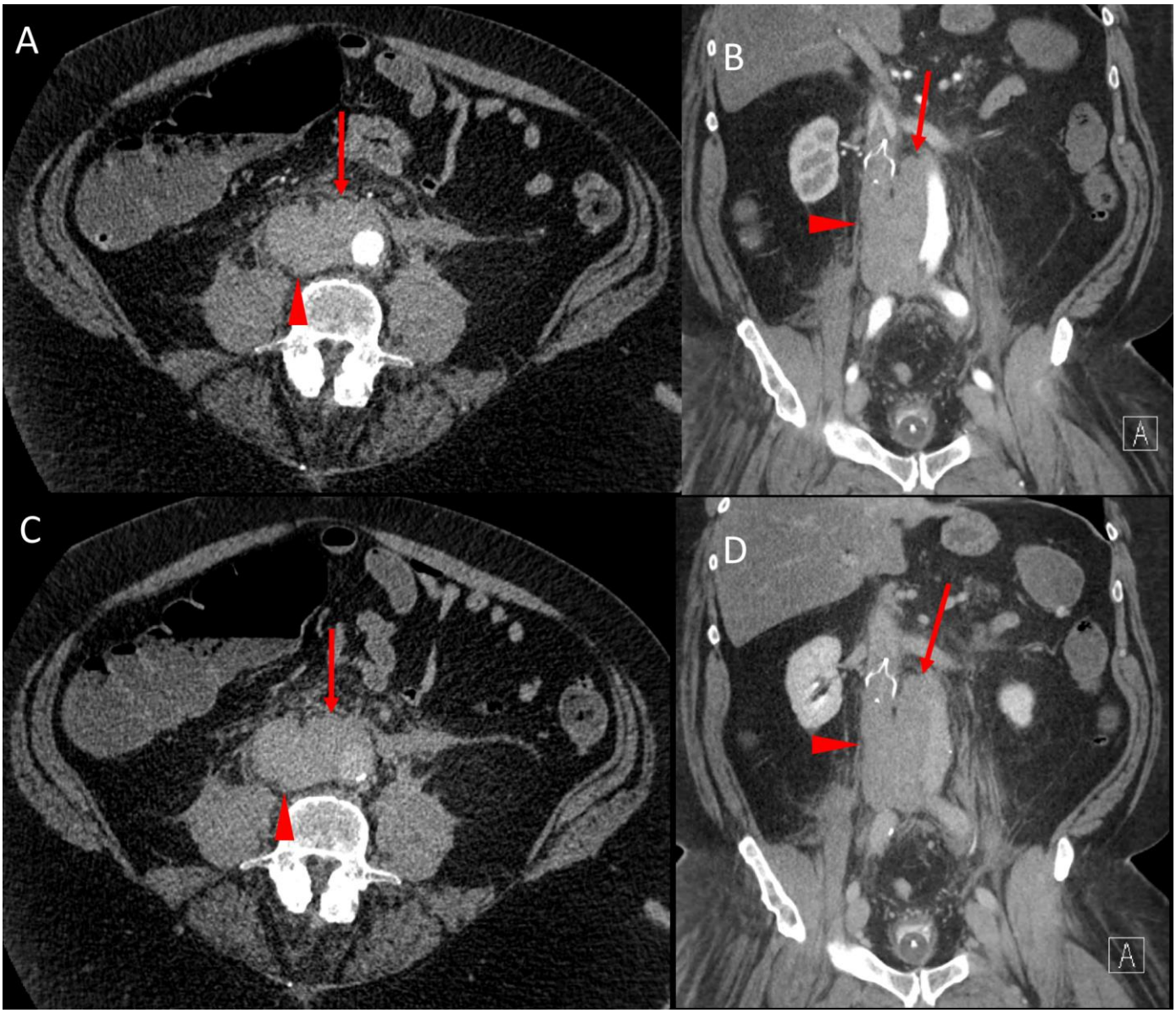

Figure 3: 61-year-old man with spontaneous retroperitoneal hematoma and possible IVC thrombosis.
Findings: Multiphase contrast-enhanced CT was performed for further evaluation in the arterial phase (A and B) and at a delayed phase (150 seconds) for optimal opacification of the inferior vena cava (C and D). The attenuation characteristics of the inferior vena cava (arrowheads) did not change between the arterial and delayed phases, suggesting IVC thrombosis. However, no clear etiology of the hematoma was identified. The retroperitoneal hematoma was unchanged in size and configuration (arrows), and there was no evidence of active extravasation.
Technique: CT: 556 mAs (180 mAs reference) and 561 mAs (180 mAs reference) for acquisition 1 (A and B) and 2 (C and D), respectively, 120 kV, 1 mm slice thickness, 125 mL Optiray 350, arterial phase and a delayed phase (150 seconds) for acquisition 1 and 2, respectively.

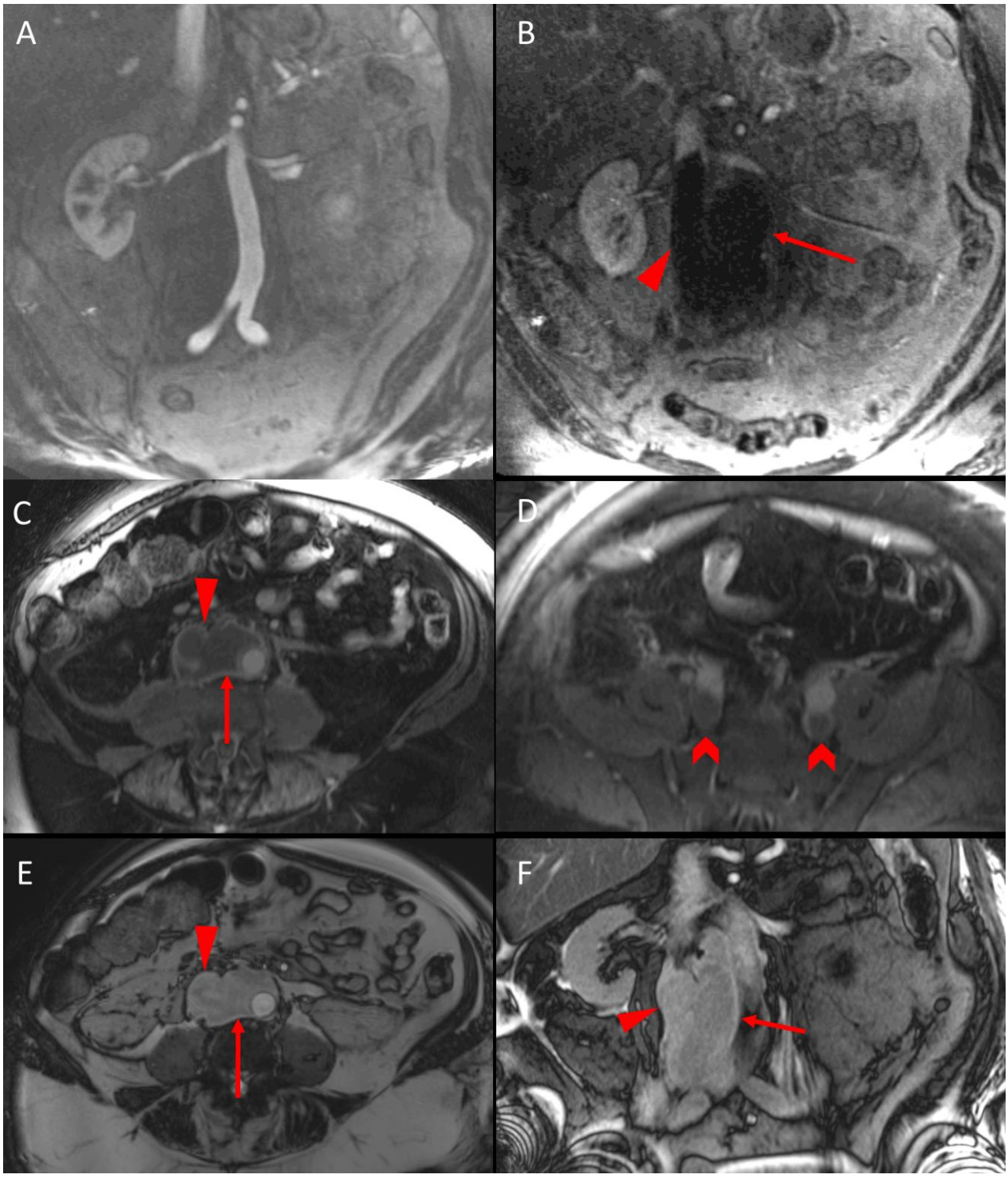

Figure 4: 61-year-old man with spontaneous retroperitoneal hematoma, IVC and extensive deep venous thrombosis, and large tear in the IVC.

Findings: MR imaging of the abdomen and pelvis. MR angiographic images demonstrated a normal appearance of the abdominal aorta and proximal common iliac arteries (A). MR venographic images revealed a lack of signal within the inferior vena cava (arrowhead), consistent with IVC filter thrombosis (B). The adjacent retroperitoneal hematoma had similarly low signal intensity (arrow). Post-contrast transaxial images obtained after a 5 minute delay showed a large mural defect in the left aspect of the inferior vena cava, consistent with IVC rupture (C, arrowhead). Post-contrast transaxial images of the pelvis after a 5-minute delay show thrombosis of both common iliac veins (D, chevrons). Axial (E) and coronal (F) balanced steady-state free-precession images (True FISP, Siemens) demonstrate similar signal characteristics within the IVC (arrowheads) and the adjacent hematoma (arrows).

Technique: MR imaging: 1.5 Tesla, 20 mL multihance. A: 3D MR Angiogram (TR: 3.06 ms, TE: 1.1 ms), coronal, arterial phase; B: 3D MR Venogram (TR: 3.06 ms, TE: 1.1 ms), coronal, venous phase; C/D: Volumetric interpolated breath-hold examination (VIBE) (TR: 4.48 ms, TE 2.25 ms), transaxial, delayed phase; E: Steady state free precession (True FISP, Siemens) (TR: 4.17 ms, TE: 2.09 ms), transaxial, noncontrast; F: Steady state free precession (True FISP, Siemens) (TR: 3.87 ms, TE: 1.94 ms), coronal, noncontrast.

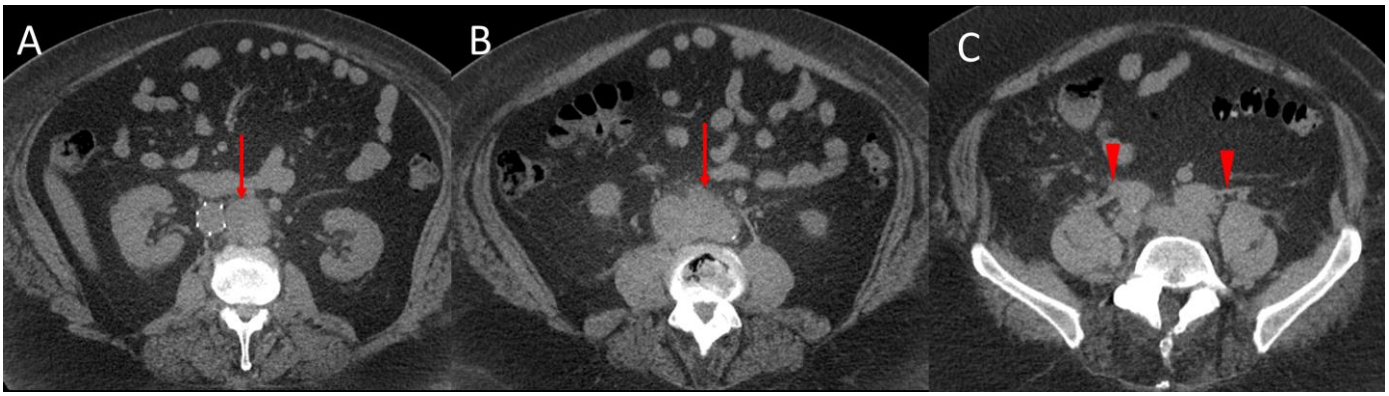

Figure 5: 61-year-old man with spontaneous rupture of the IVC in the setting of IVC filter thrombosis undergoing follow-up evaluation.
Findings: Follow-up CT without contrast three weeks after discharge later demonstrated slight decrease in size of the retroperitoneal hematoma (A and B, arrows) and an associated decrease in the amount of blood tracking along the iliac vessels into the pelvis (C, arrowheads).
Technique: CT: 596 mAs (180 mAs reference), 120 kV, 3 mm slice thickness, no intravenous contrast.

Etiology	Idiopathic, systemic anticoagulation, connective tissue disease, retroperitoneal vascular malformations, inferior vena cava thrombosis
Incidence	Unknown; less than 10 reported cases
Gender ratio	No known gender predilection reported in the literature
Age predilection	No known age predilection reported in the literature
Risk factors	Anticoagulation, connective tissue disease, retroperitoneal vascular malformation, inferior vena cava filter
Treatment	Surgery or endovascular therapy if hemodynamically unstable; conservative management if stable
Prognosis	Generally poor; most reported cases resulted in mortality
Findings on Imaging	• CT - high attenuation retroperitoneal fluid, often tracking into the pelvis, no internal contrast enhancement, hematoma associated with the IVC, possible defect in the wall of the IVC and/or IVC thrombosis • MR imaging - retroperitoneal fluid with a variable appearance on T1- and T2-weighted images depending on the age of blood products, no internal contrast enhancement, possible defect in the wall of the IVC and/or IVC thrombosis

Table 1: Summary table of spontaneous inferior vena cava rupture.

Diagnosis	CT	MR Imaging
Idiopathic retroperitoneal hematoma	High attenuation retroperitoneal fluid, often tracking into the pelvis, no internal contrast enhancement	Retroperitoneal fluid with a variable appearance on T1- and T2-weighted images depending on the age of blood products, no internal contrast enhancement
Aortic rupture	Retroperitoneal hematoma associated with the aorta, with associated abdominal aortic aneurysm or pseudoaneurysm	Retroperitoneal hematoma associated with the aorta, with associated abdominal aortic aneurysm or pseudoaneurysm; variable appearance on T1- and T2-weighted images depending on the age of blood products
IVC rupture	Retroperitoneal hematoma associated with the IVC, possible defect in the wall of the IVC and/or IVC thrombosis	Retroperitoneal hematoma associated with the IVC, possible defect in the wall of the IVC and/or IVC thrombosis; variable appearance on T1- and T2-weighted images depending on the age of blood products
Retroperitoneal fibrosis	Enhancing retroperitoneal soft tissue surrounding the aorta, IVC, and/or iliac vessels, commonly resulting in ureteric obstruction and hydronephrosis	Enhancing retroperitoneal soft tissue surrounding the aorta, IVC, and/or iliac vessels, commonly resulting in ureteric obstruction and hydronephrosis

Table 2: Differential diagnoses table for spontaneous retroperitoneal hematoma.

ABBREVIATIONS

CT = Computed tomography
DVT = Deep venous thrombosis
ED = Emergency department
IVC = Inferior vena cava
MR = Magnetic resonance

KEYWORDS

Retroperitoneal hematoma; spontaneous; inferior vena cava rupture; inferior vena cava filter; inferior vena cava thrombosis; case report

ACKNOWLEDGEMENTS

Dr. Ludwig receives salary support from the Training OPportunities in Translational Imaging Education and Research (TOP-TIER) Holden Thorp grant at Washington University.