

Serpentine Inferior Vena Cava Thrombus with Direct Right Atrial Extension: A High-Risk Manifestation of Advanced Renal Cell Carcinoma

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ABSTRACT

Inferior vena cava (IVC) filling defects are commonly observed on computed tomography (CT) and Magnetic Resonance Imaging (MRI), requiring accurate differentiation among pseudo, bland, and malignant thrombi for effective clinical management. Extension of a thrombus from the IVC to the right atrium is a rare finding, typically associated with abdominal malignancies, particularly renal cell carcinoma (RCC), significantly worsening the patient's prognosis. Surgical thrombectomy remains a high-risk therapeutic option in these instances. Precision in diagnosis is paramount for selecting appropriate treatment and determining the pre-procedural level of vascular involvement. We report a unique case featuring a serpentine IVC thrombosis associated with RCC and right atrial extension.

Keywords

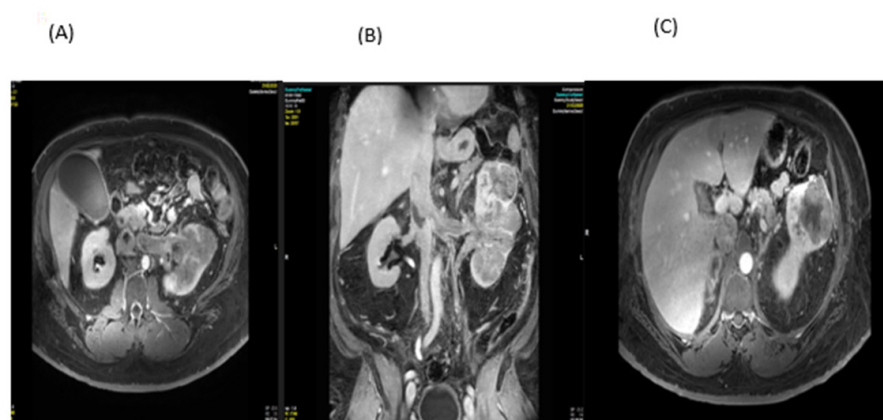
Inferior vena cava, Right atrium, Thrombosis, Renal cell cancer.

Introduction

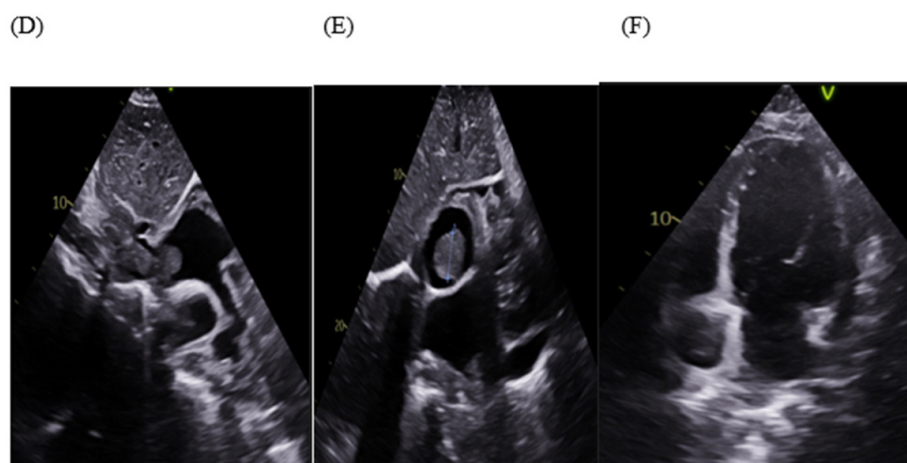
Inferior vena cava (IVC) filling defects are common findings on CT and MRI [1]. Nevertheless, pseudo-filling defects which arising from parallel laminar flow in the renal veins frequently complicate the diagnostic process. Assigning precise classification of an IVC filling defect—as pseudo, bland, or malignant—is critical for clinical management [2]. Renal cell carcinoma (RCC) frequently leads to the complication of inferior vena cava thrombus (IVCT) formation, or direct malignant invasion of the IVC. RCC-associated IVC extension occurs in 4%–10% of cases [1], with the venous tumor thrombus reaching the right atrium in a rare 1%–3% [3]. IVC involvement in RCC significantly influences disease staging and subsequent therapeutic decisions [4]. We present a rare case of RCC featuring IVCT extension into the right atrium. Written consent for publication of this case report and accompanying images was obtained from the legal representative of the deceased patient, and documentation is on file.

Case Report

A 65-year-old man with stage III chronic renal failure and type 2 diabetes was admitted for gross haematuria, cellulitis of the left foot and bilateral oedema of the lower limbs in the context of a deterioration of his general condition. Clinical examination revealed a left lumbar mass. Laboratory tests uncovered acute renal failure (creatinine clearance of 16.3 ml/min) with blood dyscrasia. To evaluate the left lumbar mass in the context of acute renal impairment, an MRI was performed, as CT scanning was contraindicated due to renal failure. The imaging revealed hypertrophy of the left kidney with mild dilation of the collecting system. The left renal vein was slightly enhanced, consistent with the presence of a clot (A,B,C). The echocardiogram revealed a hyperechoic mass at the junction between the inferior vena cava and the right atrium (D, E, F). A CT-guided renal biopsy was performed to minimize the risk of intra-abdominal dissemination. Pathological examination confirmed stage III clear cell renal carcinoma (T3b, NO, MO). In light of a major decline in clinical status and significant comorbidities, the initially approved cabozantinib therapy was deemed moot, prompting the introduction of palliative measures and preventive heparin calcium therapy instead.



(A) T1-weighted sequence with gadolinium (MRI) axial plan demonstrates a heterogeneous necrotic mass in the left kidney (left arrow) (B) T1-weighted sequence with gadolinium (MRI) frontal plan shows the left renal mass infiltrating involving left renal vein (vertical arrow) and inferior vena cava (horizontal arrow) (C) T1-weighted sequence with gadolinium (MRI) axial plan MRI shows thrombus occupying the inferior vena cava.



(D) Subxiphoid view shows a thrombus completely filling inferior vena cava and Prolapsing into right atrium. (E) Subxiphoid view demonstrates a thrombus completely prolapsing into right atrium. (F) Apical four-chamber view shows thrombus in the right atrium during ventricular systole.

Discussion

Inferior vena cava (IVC) filling defects identified on CT or MRI are common findings in patients with RCC, and distinguishing between pseudo-filling defects and true underlying disease is critical.

The nature of identified defects can be characterized as pseudo, benign, or malignant in nature [1]. CT imaging is often the initial imaging modality to identify an IVC filling defect coupled with MRI images to help investigate unclear CT findings.

Pseudo thrombosis is the most frequent IVC filling defect observed on computed tomography and can occur due to parallel laminar blood flow from the renal veins that can lead to an appearance resembling thrombosis [5]. The use of delayed imaging techniques is typically adequate to confirm pseudo-thrombosis and exclude the presence of a true thrombus.

Trans thoracic echocardiography can also be used in settings in

which the right atrium is involved in an IVC thrombus [3]. Bland thrombus is often associated with a hypercoagulable state due to causes such as oral contraceptive use, IVC filters, paraneoplastic syndromes, and vascular coagulopathies [6]. Malignant tumor thrombus is associated with an expanded anterior-posterior (AP) diameter of the renal vein ostium (RVo) and a complete level of occlusion of the IVC [6].

The incidence of IVCT is rare and is often correlated with significant morbidity and mortality. The etiology of IVCT includes nephrolithiasis, RCC, pulmonary embolism, and liver disease [7]. Categorizing IVCT as primary or secondary is essential. Primary IVCT results from metabolic syndrome or hypertension processes, whereas secondary IVCT formation results from malignancy, surgery, or infectious causes [3]. Assessment of the hepatic and renal systems can help elucidate the etiology of the thrombosis. Hematuria and flank pain suggest renal vein involvement, whereas ascites may indicate hepatic portal vein or supra-hepatic veins involvement [8].

Management of RCC with malignant IVC thrombus depends on the degree of occlusion, acuity, and extent of proximal vascular involvement. Denotation of a thrombus as malignant or cruoric is critical prior to engaging in treatment considerations. Enhancement patterns on imaging are critical to determine the nature of thrombus. A true bland thrombus does not show enhancement on MRI, while a malignant thrombus shows mixed signals and enhancement [5]. Standard initial treatment consists of anticoagulation, given the hypercoagulable state of the malignancy and the lack of a definitive diagnosis until further imaging and biopsy can be obtained. Catheter thrombolysis or thrombectomy may also be used in setting of an acute cruoric thrombus. In setting of a malignant thrombus, staging of RCC disease is highly dependent on the level of involvement. Surgical options are dependent on involvement and include IVC filter placement, stapling, and ligating the IVC inferior to the malignant thrombus, and segmental resection of the IVC [9].

Prognosis for patients who do not undergo caval thrombectomy and resection for RCC and IVCT is 5 months, whereas those who undergo surgical treatment have a 40%–60% 5-year survival rate [10]. Surgical considerations are dictated by the level of IVC involvement and often carry high risk, given that the true extent of the thrombus is usually determinable only intraoperatively. APD (anteroposterior diameter) at the renal vein opening from MRI or CT scans can help to determine IVC thrombus involvement preoperatively [6]. This highlights the importance of accurate recognition of the IVCT level of extension in diagnostic imaging modalities

Conclusion

IVC filling defects are common findings on CT and MRI, and accurate determination of pseudo, benign, or malignant thrombus is essential for clinical management. IVCT involvement extending into the right atrium is a rare presentation of RCC. The degree of IVC and right atrium involvement is critical in determining management and prognosis of patients. IVCT surgical thrombectomy is often a risky procedure due to intraoperative determination of IVCT involvement. CT and MRI images can be used to determine the AP diameter of the renal vein opening which helps determine the preoperative level of involvement. This case

features a unique presentation of IVCT in RCC with right atrial involvement that can help future clinicians better identify such involvement and its implications in regards to management.

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