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Seminars in
ROENTGENOLOGY

Cross-Sectional Imaging of Renal Masses: Image Interpretation–Related Potential Pitfalls and Possible Solutions

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Introduction

After identifying and correcting pitfalls related to image acquisition, radiologists should focus their attention on the potential errors that can occur during image interpretation. Among them, the first and most important one is inappropriate characterization of a focus of normal renal tissue, congenital variant, or a benign infectious or inflammatory condition as a renal neoplasm on imaging studies.[1] Secondly, identification of fat within a solid renal mass can create problems in distinguishing benign angiomyolipoma (AML) from malignant entities such as renal cell carcinoma (RCC) and liposarcoma.[2] Thirdly, inappropriate assessment of contrast enhancement in solid or cystic masses, especially in hyperattenuating and heavily calcified renal masses, may pose significant problems that result in a faulty interpretation of a benign neoplasm as a malignant one and vice versa.[2]

In this article, we would review potential errors that radiologists may encounter during interpretation of ultrasound (US), multiple detector computed tomography (MDCT), and magnetic resonance imaging (MRI) studies in patients with renal masses and provide possible solutions to overcome these pitfalls.

Renal Pseudotumors

Renal lesions that are composed of either normal or benign renal tissue but mimic neoplasms on imaging are known as "renal pseudotumors."[1] Although less common after the advent of MDCT and MRI, adjacent normal structures such as spleen, colon, and pancreatic tissue may mimic a primary renal neoplasm if the imaging study is inadequately performed.[3] Renal pseudotumors may simulate both solid and cystic neoplasms of the kidneys. Failure to identify them correctly may lead to unnecessary surgery in patients. Selected renal pseudotumors are presented below with tips to differentiate them from "true" renal neoplasms.

Hypertrophied or prominent column of Bertin is a developmental variant characterized by the presence of cortical tissue extending between the pyramids that project into the renal sinus.[4] Hypertrophied cortical tissue may appear as an isohyperechoic to mildly hyperechoic "mass" on US that is usually perpendicular to the renal capsule with a smooth margin mimicking a renal neoplasm (Fig. 1).[5] Although this US appearance is characteristic, some lesions are predominantly hyperechoic secondary to anisotropic effect and are more suspicious for tumors and require further evaluation with MDCT or MRI.[6] Additionally, hypertrophied normal renal tissue adjacent to renal scars from prior reflux nephropathy or infarcts may mimic a mass on US or in the nephrographic phase of the contrast-enhanced computed tomography (CT) or MRI (Fig. 2). These 2 pseudotumors can be correctly diagnosed by recognizing that the attenuation or signal intensity and contrast enhancement of the "masses" are identical to the adjacent cortical tissue on CT and MRI, especially on the corticomedullary phase of the examination; coronal and sagittal reconstructions are very useful for accurate evaluation (Figs. 1 and 2).[1]

During fetal life, the kidneys consist of multiple lobules separated by grooves that typically fuse by the end of the fetal period; incomplete fusion of fetal lobules may result in the persistence of 1 or more interlobar grooves mimicking a renal neoplasm or scar tissue in adults.[1] Although, indentations produced by persistent fetal lobulations lie between renal pyramids and are surrounded on either side by normal cortical tissue, renal scars secondary to reflux or prior infection lie directly over the calyces, are more common in the poles, are less sharply defined, and are associated with atrophy of adjacent cortical tissue.[6] Junctional parenchymal defect and

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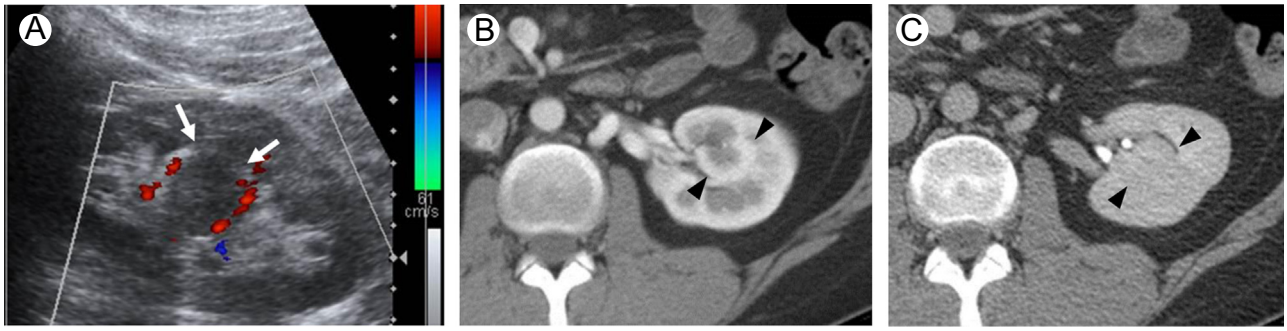

Figure 1 Prominent column of Bertin mimicking a renal mass. (A) Longitudinal color Doppler image of the left kidney shows a central hypoechoic "mass" (arrows), concerning for a neoplasm. (B and C) Axial contrast-enhanced CT images during the corticomedullary (B) and excretory phase (C) demonstrate normal corticomedullary differentiation without any identifiable mass (arrows). These CT findings are consistent with a renal pseudotumor secondary to a prominent column of Bertin. (Color version of the figure is available online.)

renal hilar lip are other anatomical variants closely related to persistent fetal lobulations. Incorporation of perirenal fat into a prominent indentation on the renal surface causing invagination of the anterior surface of the upper third of the kidney toward the hilum results in the formation of junctional parenchymal defect.[7] This lesion appears as a triangular echogenic focus or mass on sagittal US images and is commonly identified in the anterosuperior or posteroinferior margins of the kidney. This can mimic a small AML given its hyperechoic appearance; however, the echogenic defect can be traced medially and inferiorly into the renal sinus (Fig. 3). On CT, renal hilar lip presents as a pedunculated "mass" or a prominent bulge projecting from medial border of the left kidney just above the renal hilum; this may simulate a renal tumor. However, hilar lip contains normal-appearing cortex and medulla and administration of contrast shows enhancement similar to adjacent renal parenchyma that differentiates it from a neoplasm; coronal and sagittal reconstructions are helpful in accurate diagnosis.[8]

Focal acute pyelonephritis may mimic a solid renal neoplasm especially in patients in whom clinical signs of infection are minimal or absent, often because of incomplete courses of antibiotic therapy. A focal hypoechoic or hyperechoic cortical lesion extending into the medulla is seen on US. CT may show an ill-defined low-attenuation "mass" without a well-defined capsule (Fig. 4) [1,9] and ill-defined margins. Edematous appearance of the surrounding renal parenchyma, striated nephrogram, associated renal or perinephric fluid, asymmetric perinephric fat stranding, and thickening or enhancement of the urothelium are some of the imaging findings that, if present, help to differentiate focal infection from a neoplasm.[1] In patients with suspicious lesions for acute pyelonephritis, abscess, and infarct, it is prudent to recommend short-term follow-up imaging as these lesions evolve or resolve very rapidly whereas a renal neoplasm would not show significant change in a short time period.[9]

The presence of clinical signs of infection such as fever and elevated white count are helpful in making a diagnosis. At CT, renal abscess appears as an avascular, hypodense mass with enhancing rim mimicking a cystic or necrotic RCC (Fig. 5). The presence of perinephric fat stranding and thickening of the Gerota fascia favors the diagnosis of abscess; correlation with clinical history for urinary tract infection and supportive laboratory findings would be beneficial. Imaging-guided drainage may be indicated in suspicious cases; aspiration of pus would prove the diagnosis and may be treated with percutaneous drainage. If blood or necrotic debris is aspirated to indicate a tumor, patient may then undergo surgical resection.[2]

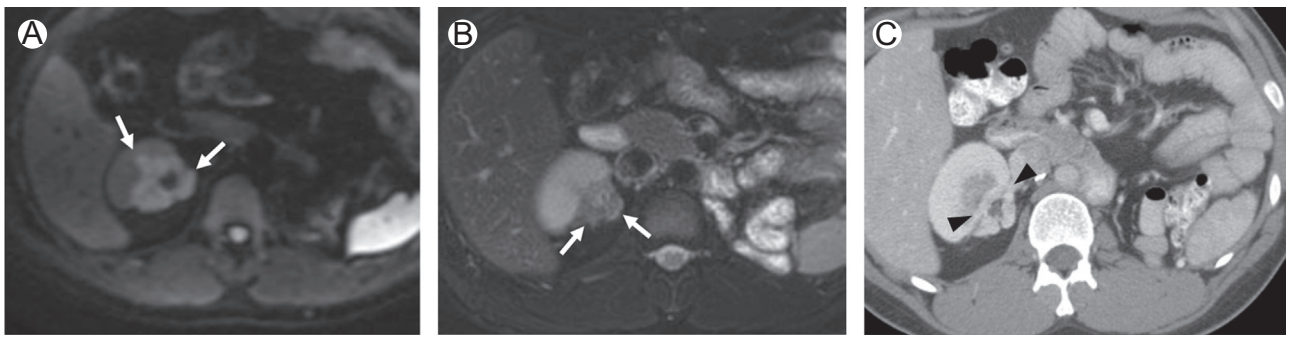

Figure 2 Focal cortical scarring simulates a renal mass on MRI. (A and B) Axial diffusion-weighted (DW) and T2-W images of the right kidney demonstrate an ill-defined focal lesion in the upper pole, which is hyperintense on DW image and hypointense on T2-weighted image (arrows), concerning for a renal mass. (C) Axial contrast-enhanced CT image during corticomedullary phase confirms that the renal "mass" in question represents focal scarring (arrowheads). (Color version of the figure is available online.)