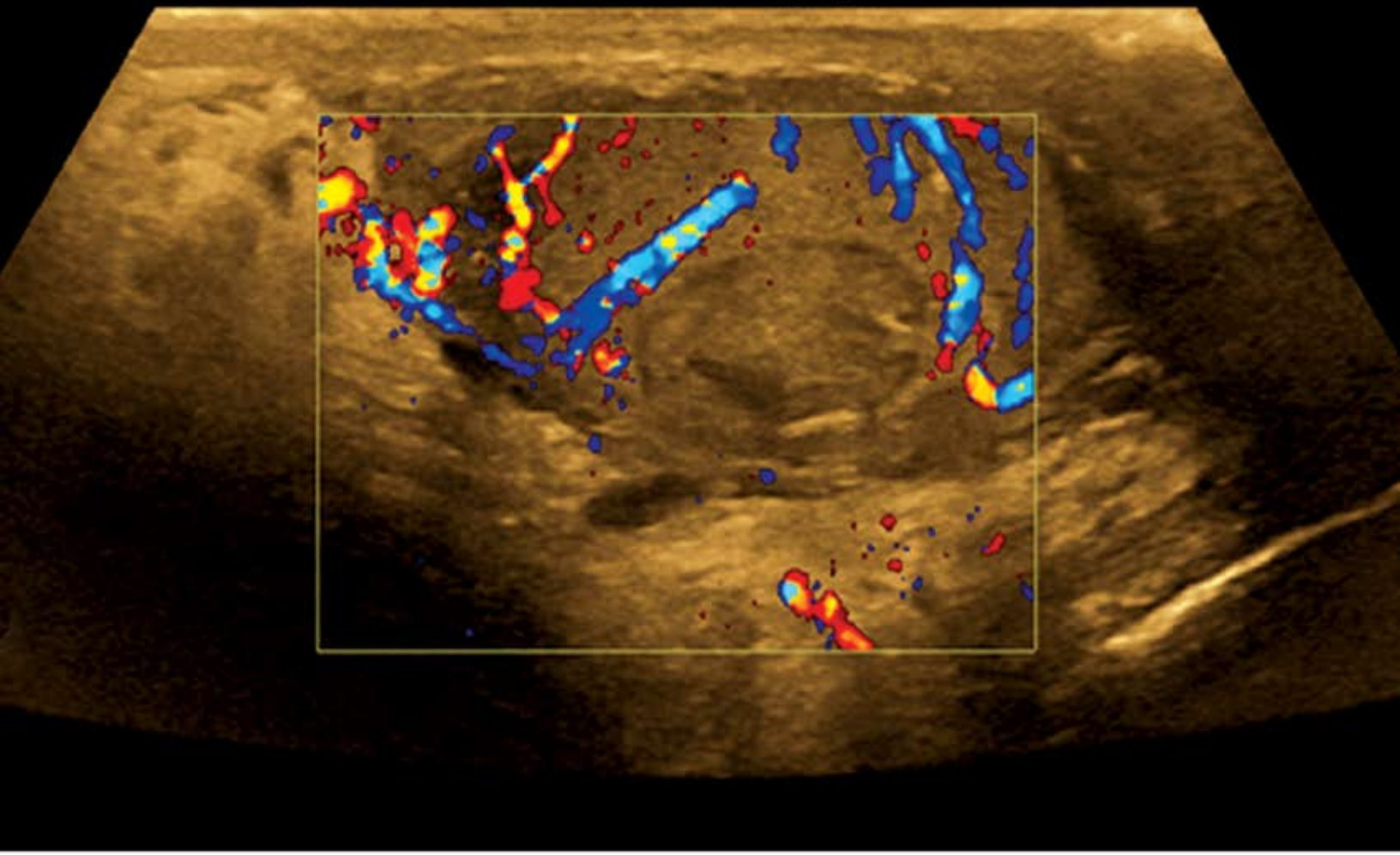
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Clinical Ultrasound

A Case-based Approach



Corinne Deurdulian
Mark E Lockhart

Foreword
Edward G Grant

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CLINICAL ULTRASOUND
A Case-based Approach

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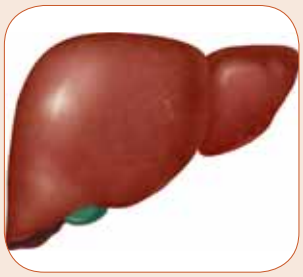
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CASE 20

Corinne Deurdulian



CLINICAL HISTORY

A 58-year-old male with portal hypertension of uncertain etiology presents with vague right-sided abdominal pain.

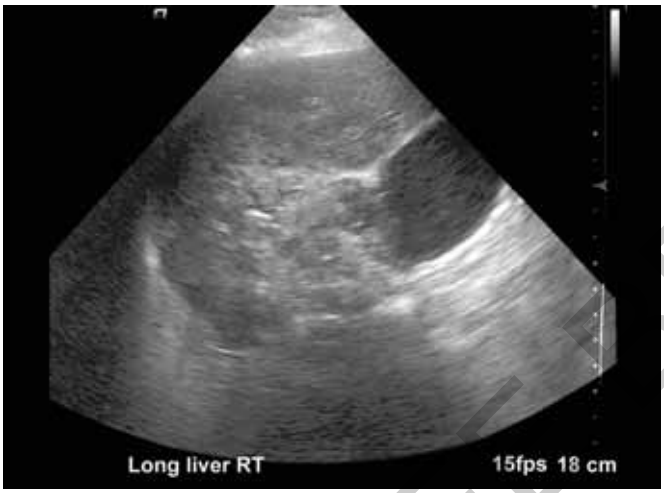


Fig. 1: Longitudinal grayscale image of the right hepatic lobe.



Fig. 2: Longitudinal grayscale image of the right hepatic lobe.



Fig. 3: Color Doppler image of the liver in the region of the main portal vein (MPV).

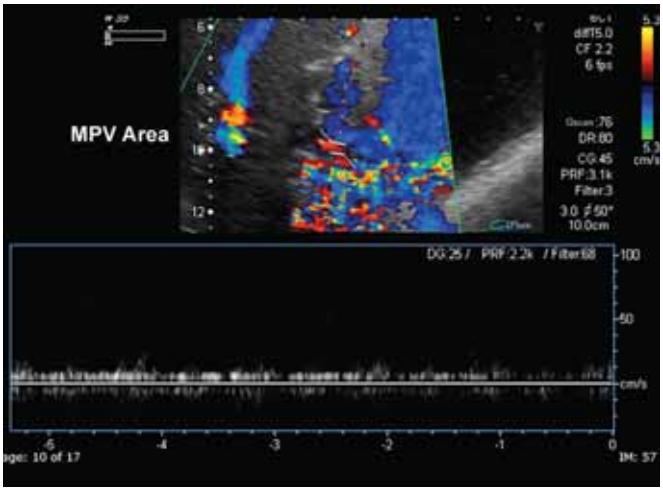


Fig. 4: Spectral Doppler image of the liver in the region of the main portal vein.

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DIAGNOSIS

Cavernous transformation of the portal vein (portal vein cavernoma) mimicking cholangiocarcinoma.

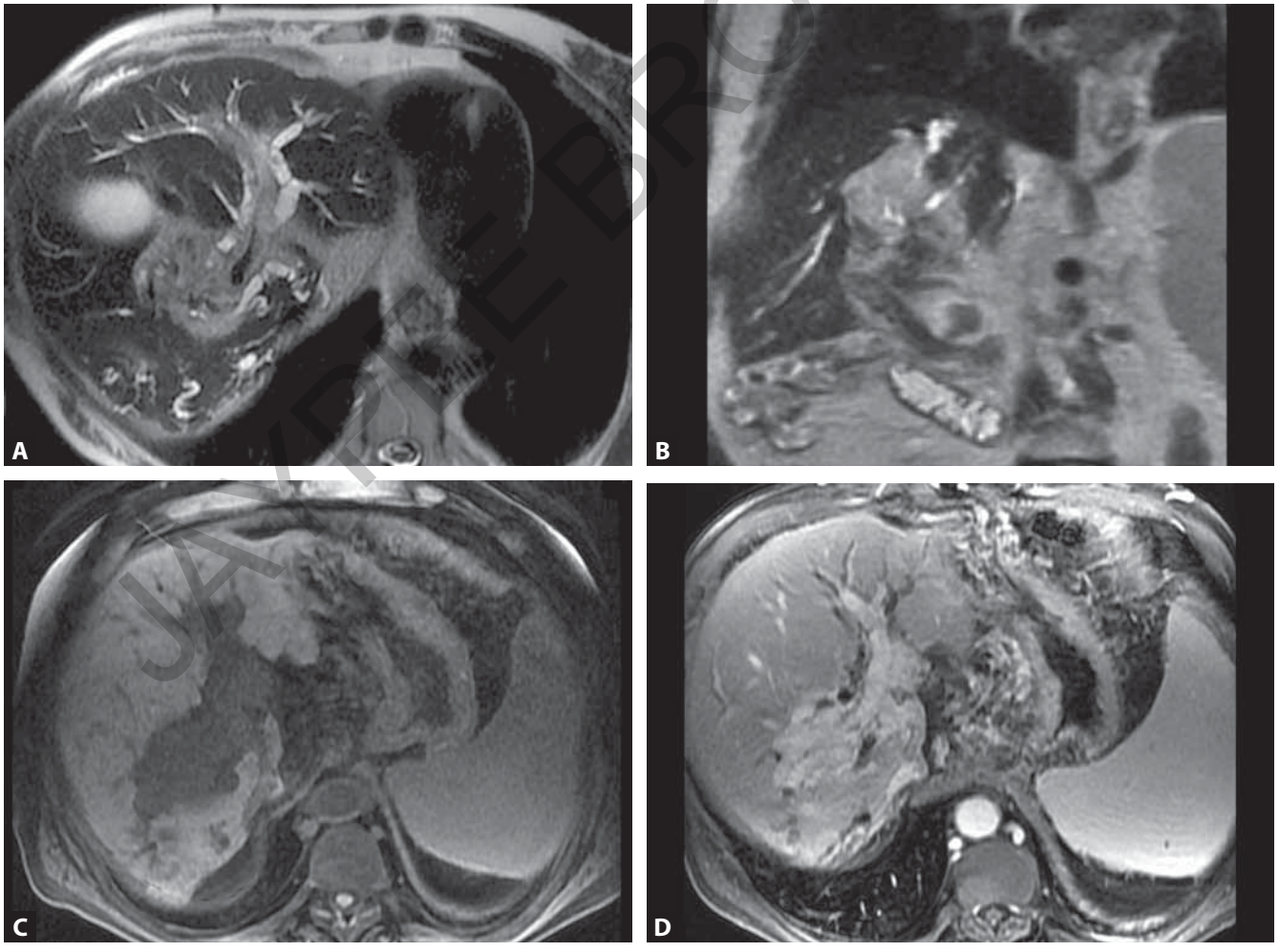
Differential Diagnosis

- Cholangiocarcinoma
- Hepatocellular carcinoma
- Hemangioma
- Arteriovenous malformation

CLINICAL PRESENTATION

Chronic portal vein thrombosis can result in cavernous transformation where multiple small collateral vessels develop in the porta hepatis to bypass the occluded portal vein.[1] Flow within these collaterals is typically hepatopetal and continuous without significant cardiac or respiratory variation.[2] Patients with cavernous transformation typically have additional findings of portal hypertension including hepatic cirrhosis, ascites, splenomegaly, and collaterals elsewhere in the abdomen. Chronic portal vein thrombus is most commonly related to cirrhosis and malignancy.[3] However, chronic inflammatory and infectious conditions, as well as various coagulopathies, are additional contributing causes.

Sometimes, the collateral vessels extend into the liver and form a tumor-like mass, or portal vein cavernoma, which can be mistaken for malignancy.[4] Spectral Doppler evaluation is critical in these patients as collateral venous blood flow can be mistaken for tumoral hypervascularity based on color Doppler evaluation alone. Cross-sectional imaging such as MRI and CT may not be helpful as the



Figs. 5A to D: Axial (A) and coronal (B) T2-weighted MR images of the abdomen with focus on the liver. Axial 3D spoiled gradient echo sequences without (C) and with (D) contrast in the portal venous phase.

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"mass" will tend to enhance more in the portal venous phase (compared with the late arterial phase) and can appear as an infiltrating process, similar to cholangiocarcinoma. This is likely related to periportal fibrosis which can appear as high signal on T2-weighted MR images and demonstrate progressive enhancement postcontrast.

IMAGING FINDINGS

The US images above demonstrate a 9 cm mass in the right hepatic lobe (Figs. 1 and 2). Color and spectral Doppler images demonstrate blood flow in the mass, but the main portal vein is not identified (Figs. 3 and 4). Venous blood flow is detected within the mass which does not demonstrate phasicity.

MRI performed after the US demonstrates a high T2 signal process involving both the right and left hepatic lobes with associated biliary dilatation (Figs. 5A and B). Precontrast images demonstrate abnormal signal with the morphology of a mass, while the postcontrast image demonstrate enhancement of the mass in the portal venous phase (Figs. 5C and D).

Although the imaging findings are highly suggestive of cholangiocarcinoma, the absence of a normal, patent portal vein and the presence of venous flow in multiple collateral vessels suggests the diagnosis. The lack of arterial blood flow, or tumor neovascularity, also points to a diagnosis of cavernoma rather than a neoplastic process. The absence of the typical enhancement pattern of hemangioma and the infiltrating appearance of the existing process render hemangioma unlikely. Similarly, an arteriovenous malformation is excluded due to the absence of a communication between a feeding and draining vessel. PET-CT scan may also be performed if the diagnosis remains equivocal. Most cholangiocarcinomas are FDG avid while portal vein cavernomas are not.[4]

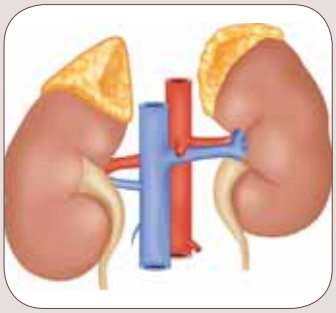
MANAGEMENT

Treatment of cavernous transformation/portal vein cavernoma is largely based on managing symptoms and sequela of portal hypertension.[3] A transjugular intrahepatic portosystemic shunt (TIPS) cannot be performed in the absence of an identifiable portal vein.

REFERENCES

1. Kauzlaric D, Petrovic M, Barmeir E. Sonography of cavernous transformation of the portal vein. Am J Roentgenol. 1984;142(2):383-4.
2. De gaetano AM, Lafortune M, Patriquin H, et al. Cavernous transformation of the portal vein: patterns of intrahepatic and splanchnic collateral circulation detected with Doppler sonography. Am J Roentgenol. 1995;165(5):1151-5.
3. Ponziani FR, Zocco MA, Campanale C, et al. Portal vein thrombosis: insight into physiopathology, diagnosis, and treatment. World Journal of Gastroenterology. 2010; 16(2):143-55.
4. Saberi B, Deurdulian C, Pandya H, Kahn JA. Education and imaging: hepatology: portal vein cavernoma imitating cholangiocarcinoma in a patient with erythropoietic protoporphyria. J Gastroenterol Hepatol. 2014;29(10):1755.

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CASE 53

Argha Chatterjee, Mark E Lockhart

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CLINICAL HISTORY

A 32-year-old male with a renal lesion detected incidentally during workup for abdominal pain.

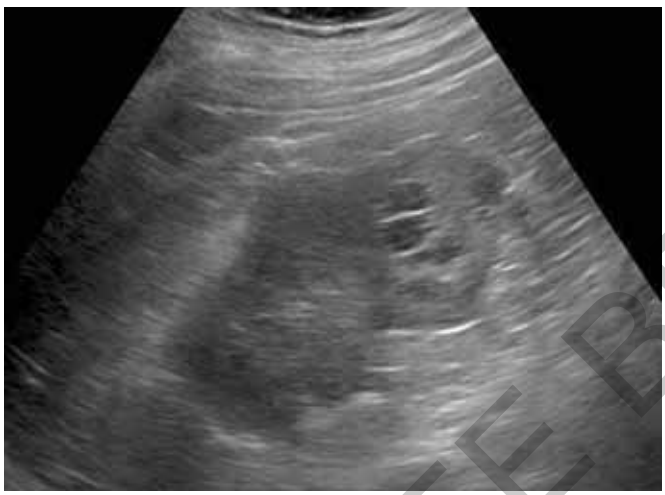


Fig. 1: Grayscale ultrasound image of the interpolar region of left kidney.

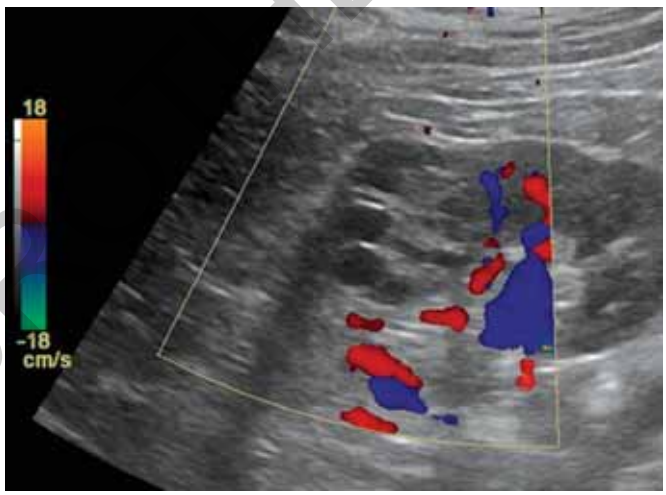


Fig. 2: Color Doppler image of the interpolar region of the left kidney.



Fig. 3: Contrast-enhanced ultrasound of the left kidney at 28 seconds post-injection.

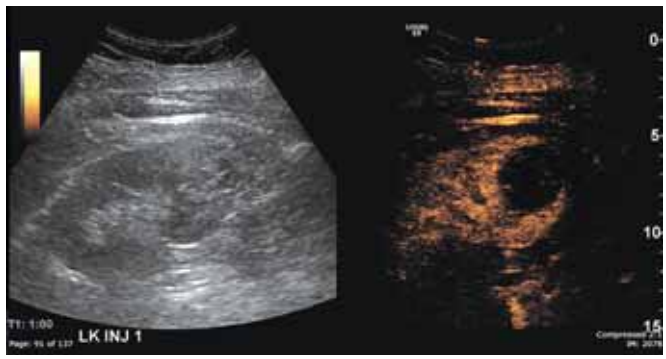


Fig. 4: Contrast-enhanced ultrasound of the left kidney at 60 seconds post-injection.

DIAGNOSIS

Multilocular cystic renal tumor (MCRT)

Differential Diagnosis

- Cystic renal cell carcinoma
- Benign renal cyst
- Focal cystic disease of the kidney

CLINICAL PRESENTATION

Multilocular cystic renal tumor includes two histologically distinct entities: cystic partially differentiated nephroblastoma (CPDN) and multilocular cystic nephroma (MCN). CPDN occurs more commonly in males between the age of 3 months and 4 years,[1] and MCN occurs more commonly in females in the age group of 40–60 years. Both lesions appear as well-circumscribed renal mass containing noncommunicating cysts of variable sizes (from microscopic to 4 cm in diameter). The only solid component in these lesions is the fibrous septa between the cysts. These two tumors are indistinguishable in gross and radiologic appearance, but can be differentiated in histology by presence of blastemal cells in CPDN.[2]

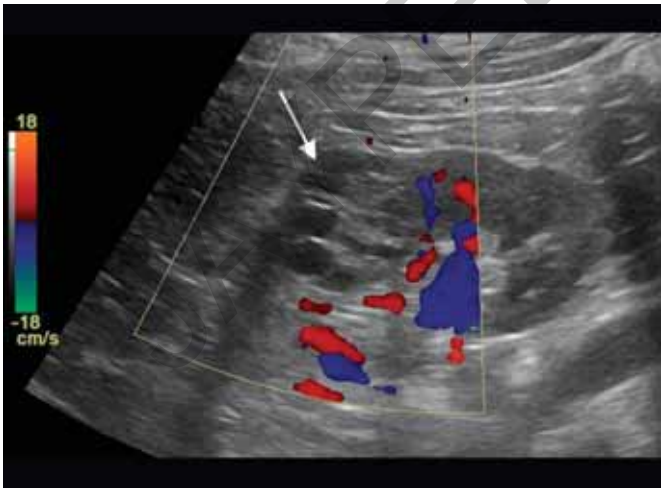


Fig. 2 (annotated): Focal renal lesion (arrow) has solid and cystic components and distorts the renal margin. There is no definite Doppler flow in the lesion, but Doppler may miss small amounts of flow.

MCN is a benign lesion, and it is grouped under mixed mesenchymal and epithelial tumors in the WHO classification of renal neoplasms.[3] CPDN is considered a rare cystic variant of Wilms, tumor (1%).[4]

Multilocular cystic renal tumor usually presents as an abdominal lump in children. In adults, abdominal pain, hematuria and urinary tract infection may be the presenting features.[5]

IMAGING FINDINGS

Figures 1 and 2 demonstrate a multiloculated cystic lesion in the left kidney with increased through transmission and no internal flow by color Doppler. Contrast-enhanced ultrasound images of the left renal lesion demonstrated trace enhancement of the septations at 28 seconds (Fig. 3) and no internal enhancement at 60 seconds (Fig. 4). CT images demonstrate a nonenhancing, water-attenuation left renal mass (Figs. 5 and 6).

Ultrasound is the initial imaging modality for evaluation of these MCRTs and most commonly shows a large well-defined multicystic mass, often involving the lower pole of the kidney. The lesion is usually solitary and unilateral, although bilateral lesions have been reported. A "beak" or "claw" of compressed normal renal parenchyma may be seen around the mass that indicates renal origin. Areas containing microscopic cysts may appear solid and echogenic on ultrasound. Septal calcification is uncommon.[2] Extension into the renal pelvis and features of urinary tract obstruction may be present.[5]

Contrast-enhanced CT and MRI show similar appearances. Variable degrees of enhancement are seen in the septa. Cysts may show variable intensity in T1-weighted images, but appear hyperintense on T2-weighted images. Usually no associated lymphadenopathy is seen. No contrast accumulation occurs in the cystic spaces due to lack of communication with the collecting system. Solid components other than the septa are characteristically absent. Presence of solid components should discourage the diagnosis of MCRT.

In children, differential diagnosis of CPDN include Wilms' tumor with pseudocystic change, clear cell sarcoma, and segmental multicystic dysplastic kidney (MCDK). Presence of a duplicated collecting system

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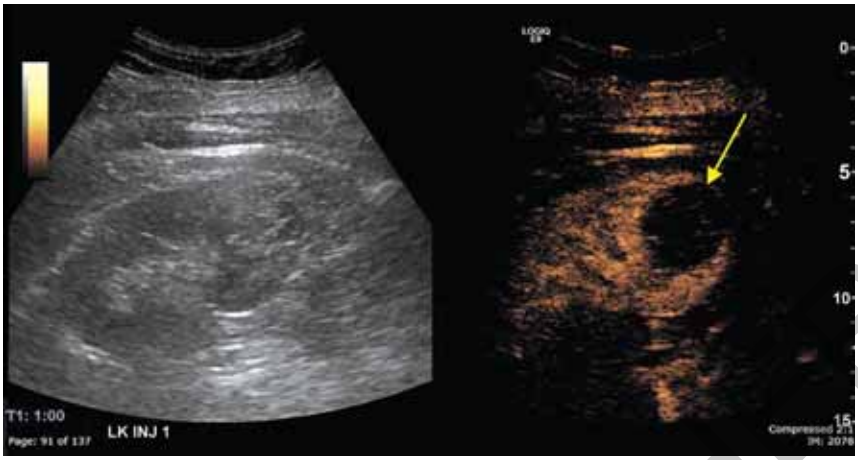


Fig. 4 (annotated): Contrast-enhanced ultrasound shows thin vascularized septations within the cystic renal lesion.

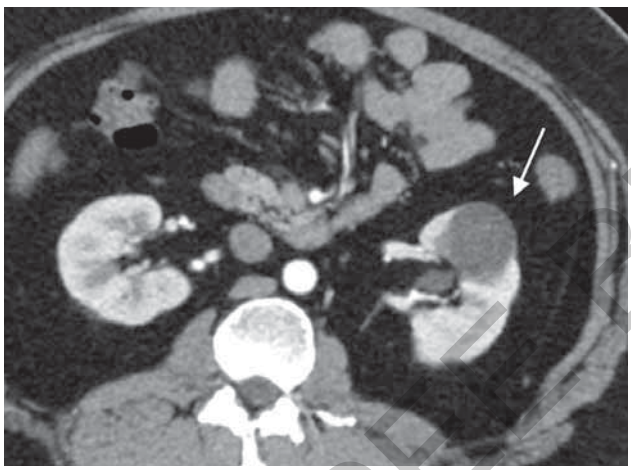


Fig. 5: Axial contrast-enhanced CT image at the level of the kidneys shows relative homogeneous hypodense mass with subtle heterogeneity suggesting septations.

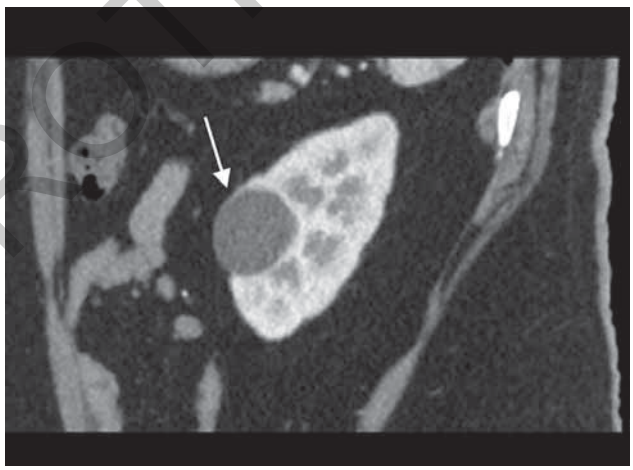
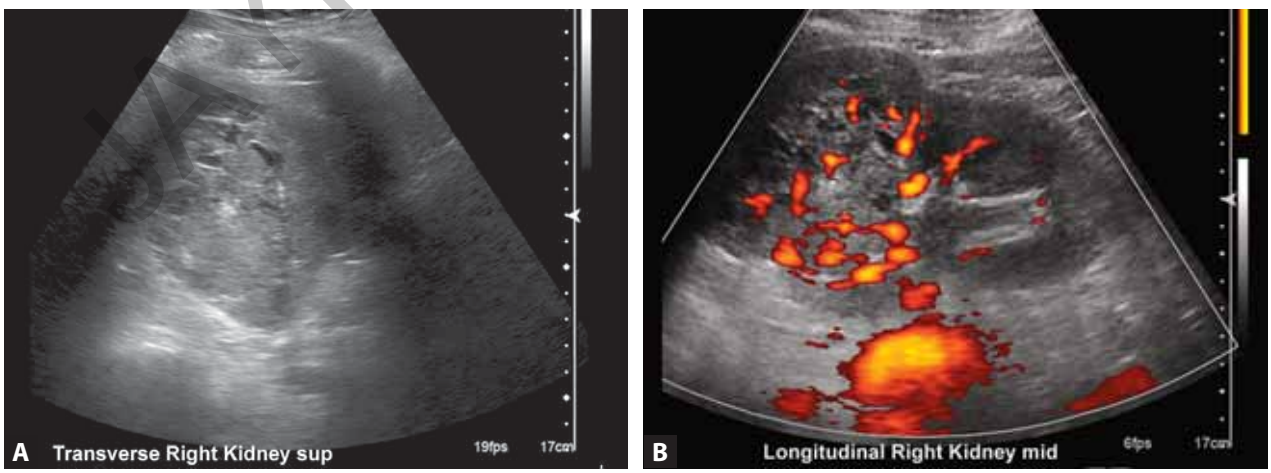
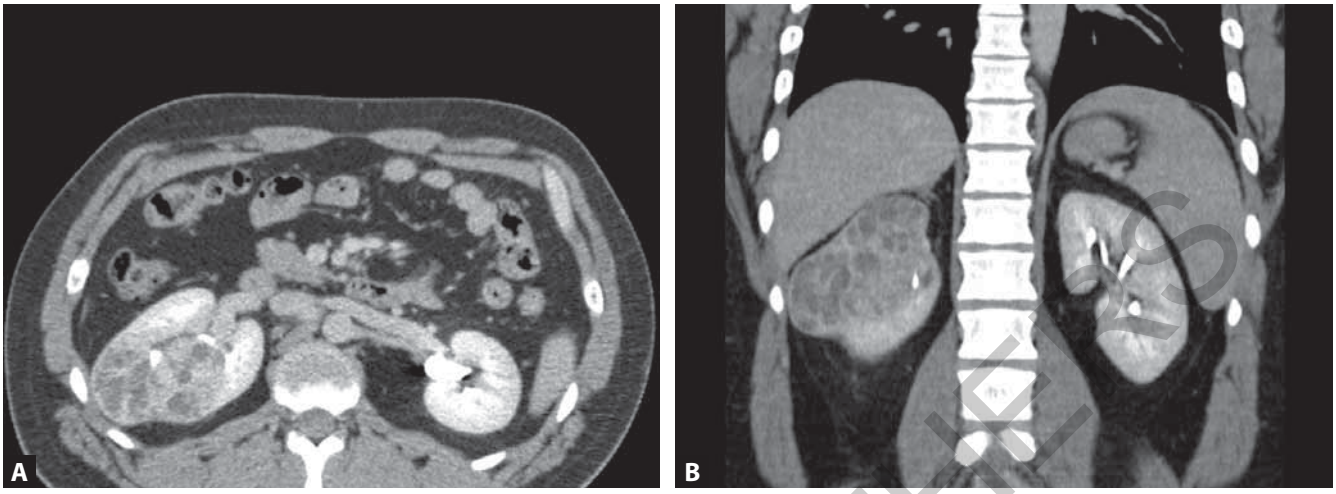


Fig. 6: Sagittal CT image of the left kidney shows similar appearance. There is mild distortion of the renal margin at this level.



Figs. 7A and B: (A) Transverse grayscale and (B) longitudinal ultrasound images of the right kidney of a 34-year-old male demonstrate a mass with multiple cystic components and blood flow within the presumed solid portions of the mass. This was initially thought to represent renal cell carcinoma.

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Figs. 8A and B: (A) Axial and (B) coronal contrast-enhanced CT images demonstrate the multicystic right renal mass. Pathology was consistent with a multilocular cystic renal tumor, or multilocular cystic nephroma. The presumed solid components on US were likely thickened fibrous septations.

or ureterocele or a contralateral pelviureteric junction obstruction suggests diagnosis of segmental MCDK.

In adults, MCN resembles cystic RCC and focal cystic disease of kidney (Figs. 7 and 8). In focal cystic disease, the presence of a few cysts outside the main conglomerated mass suggests the diagnosis.

Clinical-radiological differentiation of MCRT from a malignant renal tumor is difficult. The key feature predicting malignancy is the presence of obvious solid components.

MANAGEMENT

A biopsy is not helpful, as a negative biopsy may not rule out malignancy. Due to difficulty in confident pre-operative diagnosis, MCRT usually requires surgical resection. Surgery is curative in MCN. CPDN also has excellent prognosis with surgery, although recurrences are rarely reported.

REFERENCES

1. Lowe LH, Isuani BH, Heller RM, et al. Pediatric renal masses: Wilms tumor and beyond. Radiographics. 2000;20(6):1585-603.
2. Agrons GA, Wagner BJ, Davidson AJ, Suarez ES. Multilocular cystic renal tumor in children: radiologic-pathologic correlation. Radiographics. 1995;15(3):653-69.
3. Eble JN, Sauter G, Epstein JI, Sesterhenn IA (Eds.): World Health Organization Classification of Tumours. Pathology and Genetics of Tumours of the Urinary System and Male Genital Organs. Lyon: IARC Press; 2004. p. 76.
4. PDQ Pediatric Treatment Editorial Board. Wilms Tumor and Other Childhood Kidney Tumors Treatment (PDQ®): Health Professional Version. 2015 Sep 28. In: PDQ Cancer Information Summaries [Internet]. Bethesda (MD): National Cancer Institute (US); 2002.
5. Wilkinson C, Palit V, Bardapure M, et al. Adult multilocular cystic nephroma: Report of 1six cases with clinical, radio-pathologic correlation and review of literature. Urol Ann. 2013;5(1):13-7.

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- Each case includes a thorough discussion of ultrasound findings, many including cross-sectional correlation.
- Differential diagnoses are presented along with diagnostic pearls and management options.

Corinne Deurdulian MD grew up in Texas, where she attended the University of Texas at Austin, the University of Texas Medical School at Houston (UT-Houston), and subsequently stayed at UT-Houston and MD Anderson Cancer Center for Radiology Residency. Drawn to a greener state, she headed to Chapel Hill for her Abdominal Imaging Fellowship at the University of North Carolina. She worked in North Carolina for 7 more years as the Chief of Imaging at the Veterans Affairs Medical Center (VAMC) in Salisbury, North Carolina. During her time at the VAMC, she built a multispecialty radiology department and started the body intervention service as well as several cancer screening and treatment programs. In 2012, She joined the dynamic faculty at the University of Southern California (USC) as part of the Ultrasound Section and Body Division, and was heavily focused on contrast-enhanced ultrasound, gastrointestinal and genitourinary imaging, ultrasound elastography, and body interventions. She remains active on the local and national fronts with multiple radiology organizations in leadership roles and as faculty. She has worked with the American College of Radiology (ACR) as a subject-matter expert on ultrasound contrast and elastography. She is currently a Radiologist at the Veterans Affairs Medical Center in Los Angeles and is committed to improving radiology care for veterans.

Mark E Lockhart MD MPH graduated from the University of Mississippi with a BA in Chemistry in 1991, moved to Emory University for medical school, then completed his Diagnostic Radiology Residency and Abdominal Imaging Fellowship at the University of Alabama at Birmingham School of Medicine, Alabama, USA. He obtained an MPH in outcomes research to improve his research skills in 2002. As a member of the Abdominal Imaging Faculty, he developed research interests in ultrasound and MRI. He has served in many different roles within the Department of Radiology, including Chief of the Abdominal Imaging Section since 2012 and current Chair of the Departmental Promotion Committee. Within the University of Alabama at Birmingham, he has been an active member of the UAB Faculty Senate, and served as Chair of the Faculty in 2009–2010. Nationally, he has been a Proctor of the National Radiology Boards, a member of the American Board of Radiology (ABR) Ultrasound Certifying Committee, member of the American College of Radiology (ACR) Commission on Ultrasound, and currently serves as Chair of the ACR Appropriateness Committee. In his clinical service and research, he has focused on vascular ultrasound, contrast-enhanced ultrasound, genitourinary and pelvic imaging, as well as body interventions.

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