Pediatr Radiol (2009) 39:172–175
DOI 10.1007/s00247-008-1046-z

CASE REPORT

Bilateral renal masses in a 10-year-old girl with renal failure and urinary tract infection: the importance of functional imaging

Thomas H. Urbania · Bamidele F. Kammen · Paul A. Nancarrow · Rose Ellen Morrell

Received: 31 July 2008 / Revised: 15 September 2008 / Accepted: 10 October 2008 / Published online: 11 November 2008

Abstract Renal sonography is a routine step in the evaluation of new onset renal failure. When renal masses are discovered in this setting, functional imaging may be critical. We report a case of bilateral renal masses in a girl with urinary tract infection and renal insufficiency found to have vesicoureteral reflux. Renal scintigraphy revealed these masses to be the only remaining functional renal tissue, preventing potentially harmful resection.

Keywords Renal failure · Renal scintigraphy · Renal mass · Vesicoureteral reflux

Introduction

Though characteristic imaging features of benign and malignant renal masses have been described for multiple modalities [1–3], anatomic imaging may remain nonspecific. When renal masses are discovered in the setting of renal failure, urinary tract infection and vesicoureteral reflux, functional imaging may be crucial to guide further diagnosis and treatment.

We report a case of bilateral renal masses in a 10-year-old girl with urinary tract infection and renal insufficiency found to have vesicoureteral reflux. In this case, renal scintigraphy revealed the masses to be the only remaining functional renal tissue, guiding biopsy and avoiding potentially harmful surgery.

Case report

A 10-year-old girl presented with 4 months of intermittent headache, nausea and nonbilious emesis. Physical examination revealed an elevated blood pressure of 207/138 mmHg, trace periorbital edema, and papilledema without focal neurological signs. She had a history of two urinary tract infections before age 3 years treated with antibiotics. She was not seen by a physician over the subsequent 7 years. Her family history was significant for a maternal cousin with Wilms tumor and a paternal grandfather with renal cell carcinoma as an adult.

Initial laboratory studies revealed a creatinine of 3.1 mg/dl and a BUN of 46 mg/dl. Urinalysis showed proteinuria and elevated white blood cells. The child was admitted for treatment of her urinary tract infection and evaluation of her hypertension and renal insufficiency.

Renal sonography demonstrated small kidneys for age and bilateral renal masses. A hyperechoic right renal mass measured 5 cm and a hyperechoic left renal mass measured 3 cm. Both masses demonstrated increased blood flow on color Doppler imaging. There was mild right pelvicaliectasis (Fig. 1). A CT scan of the abdomen and pelvis obtained without intravenous contrast due to the patient's renal insufficiency was performed to confirm the presence of and

T. H. Urbania (✉)
Department of Radiology and Biomedical Imaging,
University of California, San Francisco,
505 Parnassus Ave., Box 0628, San Francisco, CA 94143, USA
e-mail: thomas.urbania@radiology.ucsf.edu

B. F. Kammen · P. A. Nancarrow
Department of Diagnostic Imaging,
Children's Hospital and Research Center Oakland,
Oakland, CA, USA

R. E. Morrell
Department of Nephrology,
Children's Hospital and Research Center Oakland,
Oakland, CA, USA

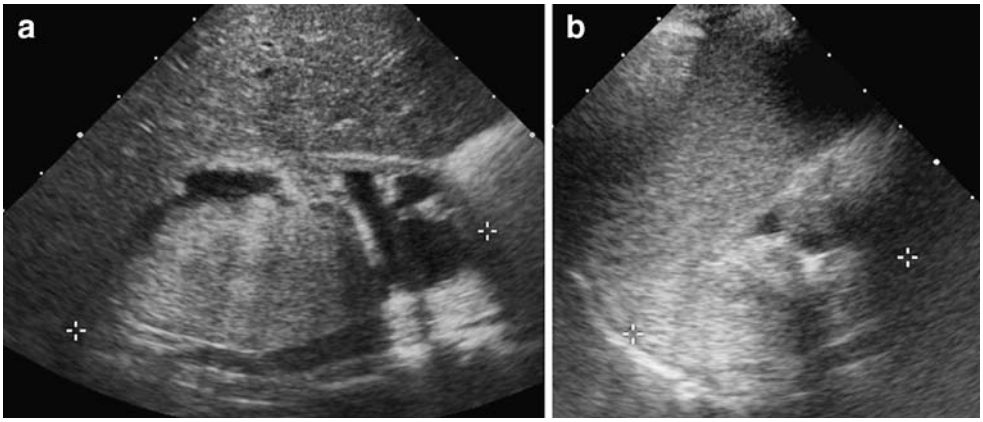

Fig. 1 Initial renal sonography. **a** Sagittal image of the right kidney demonstrates a small kidney for age with a 5-cm hyperechoic mid and upper pole mass. There is also pelvicaliectasis. **b** Sagittal image of the left kidney demonstrates a small kidney for age with a 3-cm hyperechoic renal mass. Both masses showed increased blood flow on color Doppler sonography

better characterize the renal masses. This study confirmed a predominantly low attenuation dominant mass in the interpolar region of the right kidney and several low attenuation left renal masses (Fig. 2). On a non-contrast MR examination performed the same day, these masses were slightly hyperintense to renal cortex on both T1- and T2-weighted images. There was marked thinning of the right renal cortex and near-complete replacement of the left renal cortex by multiple masses (Fig. 3).

The child underwent assessment of renal function with a Tc-99m-DMSA renal scan to determine the functional contribution of each kidney and to better guide surgical management. There was pronounced uptake of the radiopharmaceutical within the dominant right renal mass and left upper pole renal mass, with a small focus of uptake in the lower pole of the left kidney. Uptake within the remainder of the kidneys was negligible (Fig. 4).

Open biopsy of the right renal mass was performed, revealing the mass to be tubulointerstitial nephritis presumably related to chronic pyelonephritis. No neoplastic tissue was identified. The left kidney was not biopsied because the lesions in both kidneys were presumed to have the same histology given their similar imaging characteristics.

A voiding cystourethrogram following completion of antibiotic treatment for urinary tract infection demonstrated bilateral grade 5 vesicoureteral reflux (Fig. 5). The child underwent bilateral ureteral reimplantation. Her blood pressure normalized but her renal failure persisted. She subsequently underwent successful living-related renal transplant.

Discussion

The kidneys and adrenal glands are common sites of pediatric neoplasms. US is typically the initial imaging modality of choice given its availability and safety. Though specific sonographic features of such lesions as Wilms tumor, lymphoma, and multilocular cystic nephroma have been described [1–3], in practice there is significant overlap in imaging features among these entities. Doppler blood

Fig. 2 Non-contrast coronal CT image shows bilateral hypodense renal masses

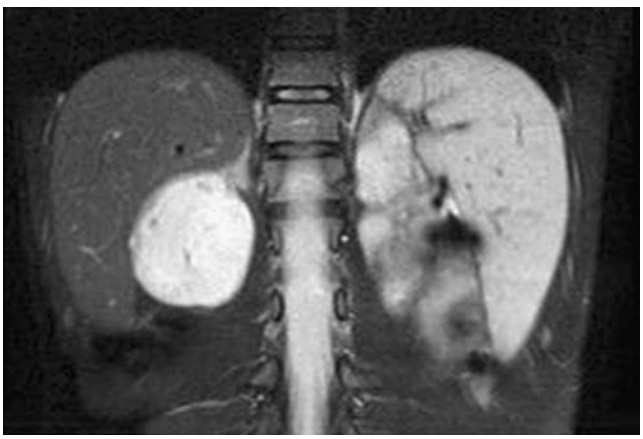

Fig. 3 T2-W coronal MR image demonstrates a large right renal mass and numerous left renal masses, some of which were not evident on the US or CT scans. All were hyperintense to adjacent renal cortex on T1- and T2-W sequences

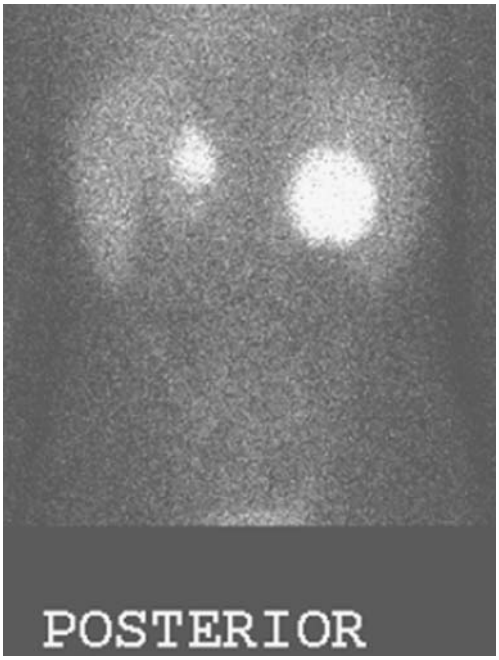

Fig. 4 Functional imaging. Tc-99m-DMSA renal scintigraphy (posterior projection) demonstrates marked uptake of the radiotracer in a distribution corresponding to the masses depicted on CT, MR, and US scans. Here, functional imaging reveals the "masses" depicted by the other modalities to be functional renal tissue

flow analysis can be helpful in distinguishing avascular from vascular masses but rarely renders the specific identity of a mass.

Contrast-enhanced CT is another mainstay of renal mass imaging with well-reported CT characteristics of benign and malignant lesions [2, 3]. Though recent studies support a wider role for preoperative percutaneous biopsy [4], in the US and Canada it remains common for patients with malignant-appearing lesions on CT to be referred for definitive surgical therapy based on imaging findings alone.

CT and MR imaging are complicated by limitations on the use of iodinated and gadolinium contrast agents in patients with renal impairment. Moreover, gadolinium has been associated with nephrogenic systemic fibrosis [5].

Renal scintigraphy is most commonly used to assess relative renal function, perfusion, excretion and scarring. In patients with a history of vesicoureteral reflux or recurrent pyelonephritis, Tc-99m-DMSA scintigraphy may demonstrate cortical defects attributable to pyelonephritis or scarring and can be used to follow patients longitudinally to assess progressive cortical damage [6]. Cortical scintigraphy may also be helpful in the diagnosis of acute complicated urinary tract infection in the setting of equivocal clinical data such as a negative urine culture. Tc99m-DMSA scintigraphy can demonstrate cortical defects in culture-negative suspected acute pyelonephritis that resolve after treatment [7].

Our patient presented due to her significant renal insufficiency and symptoms related to hypertension. Additionally, she was found to have a urinary tract infection. The renal US scan obtained to exclude an obstructive cause of renal failure revealed unexpected bilateral masses. CT and MR examinations, obtained without contrast due to her renal insufficiency, provided greater definition of the bilateral masses, but no further clarity regarding their specific nature.

Functional imaging in the form of Tc-99m-DMSA renal scintigraphy was the critical step in advancing the diagnostic evaluation and avoiding unnecessary and potentially harmful surgery. By revealing the renal "masses" as the child's only functional renal tissue, scintigraphy was able to guide biopsy, which prompted further investigation into the cause of the chronic pyelonephritis. Vesicoureteral reflux was identified as the etiology of the chronic pyelonephritis that had scarred the normal renal parenchyma beyond recognition by CT, MR, and US.

Unifocal mass-like renal hypertrophy in response to vesicoureteral reflux has been reported previously [8]. To our knowledge, however, *multiple*, *bilateral* renal masses that represent tubulointerstitial nephritis as the only functioning renal parenchyma in a patient with chronic renal failure is very rare. This is a very atypical appearance

Fig. 5 Vesicoureteral reflux. Spot radiograph from a voiding cystourethrogram demonstrates massive reflux of urine into the ureter and intrarenal collecting system with marked tortuosity and dilatation of the ureter and calyces, consistent with grade 5 vesicoureteral reflux

of reflux nephropathy, and it is unclear which factors produced this unusual response to a common condition. Awareness of this appearance may justify functional imaging as a complement to anatomic imaging in the diagnostic evaluation of pediatric renal masses in the setting of renal failure.

References

1. Davidson AJ, Hartman DS, Choyke PL et al (1997) Radiologic assessment of renal masses: implications for patient care. Radiology 202:297–305
2. Chepuri NB, Strouse PJ, Yanik GA (2003) CT of renal lymphoma in children. AJR 180:429–431
3. Israel GM, Bosniak MA (2005) How I do it: evaluating renal masses. Radiology 236:441–450
4. Silverman SG, Gan YU, Mortele KJ et al (2006) Renal masses in the adult patient: the role of percutaneous biopsy. Radiology 240:6–22
5. Martin DR (2008) Nephrogenic systemic fibrosis. Pediatr Radiol 38 [Suppl 1]:S125–S129
6. Piepsz A, Ham HR (2006) Pediatric applications of renal nuclear medicine. Semin Nucl Med 36:16–35
7. Levtchenko EN, Lahy C, Lévy J et al (2001) Role of Tc-99m DMSA scintigraphy in the diagnosis of culture negative pyelonephritis. Pediatr Nephrol 16:503–506
8. Damry N, Avni F, Guissard G et al (2005) Compensatory hypertrophy of renal parenchyma presenting as a mass lesion. Pediatr Radiol 35:832–833