CASE REPORT

MR Imaging of Focal Medullary Sponge Kidney: Case Report

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We present a case of focal medullary sponge kidney (MSK) that mimicked a renal tumor. Evaluation of a patient with history of macrohematuria revealed a left renal mass of 3-cm diameter. T1-weighted magnetic resonance (MR) images revealed a mass of mixed intensity protruding toward the renal sinus. On fat-saturated T2-weighted MR images, the lesion’s remarkable hyperintensity suggested the presence of an aggregation of tiny cysts. On diffusion-weighted MR images, the mass also demonstrated high intensity, and its apparent diffusion coefficient was partly decreased \(1.12 \times 10^{-3} \text{ mm}^2/\text{s}\). On computed tomography, precontrast images revealed no calcification in the mass. Although slight enhancement was seen in the corticomedullary phase, thick and dense streaks of contrast radiating peripherally were identified in the mass in the excretory phase. Focal MSK was diagnosed. We discuss the potential of MR imaging for diagnosing focal MSK.

Keywords: CT, diffusion-weighted imaging, medullary sponge kidney, MRI, MR urography

Introduction

Medullary sponge kidney (MSK) is a developmental abnormality characterized by cystic dilatation of the collecting ducts in the pyramids¹,² and is usually diagnosed by plain X-ray of the abdomen or intravenous urography (IVU) based on imaging characteristics, such as calcification of the renal medulla and dilatation of the collecting ducts. Although computed tomography (CT) has been used to recognize these findings,³-⁵ we believe magnetic resonance (MR) findings related to MSK are not reported.

MSK often occurs in both kidneys and multiple renal pyramids; its rare occurrence in only one kidney or pyramid¹ is termed “focal” or “segmental.”⁶,⁷

We report a case of focal MSK that mimics a renal tumor and describe its appearance on MR.

Case Report

A 31-year-old man with a several-year history of asymptomatic macrohematuria visited a nearby clinic, where he underwent IVU that showed possible compression of the infundibulum in the upper pole of the left kidney (Fig. 1). He was referred to our hospital for further examination because he was found to have a mass of 3-cm diameter in the left kidney. The patient had no appreciable past history or familial history. Laboratory data were within normal ranges, and urinary cytology was negative. On MR imaging, fat-saturated T1-weighted images revealed a mass of mixed intensity protruding toward the renal sinus in the left kidney (Fig. 2). On fat-saturated T2-weighted images, the mass was described as remarkably hyperintense. MR urography showed the mass to be an aggregation of tiny cysts (Fig. 3). On diffusion-weighted images, the entire mass showed high intensity (Fig. 4A). However, the apparent diffusion coefficient (ADC) was relatively low on the side of the papilla \(1.12 \times 10^{-3} \text{ mm}^2/\text{s}\) and high on the side of the cortex \(1.97 \times 10^{-3} \text{ mm}^2/\text{s}\) (Fig. 4B). On CT, precontrast images revealed no calcification. Although the
Fig. 1. Intravenous urography scanned 5 min after injection of iodine contrast showed possible compression of the infundibulum in the upper pole of the left kidney.

Fig. 2. Axial fat-saturated T1-weighted imaging (water selective excitation, repetition time [TR]/echo time [TE] = 200 ms/3.9 ms) showed a mass of mixed intensity protruding toward the renal sinus in the left kidney (arrow).

mass showed slight enhancement in the cortico-medullary phase (Fig. 5A), thick and dense streaks of contrast radiating peripherally were identified in the mass in the excretory phase (Fig. 5B). We also created an oblique sagittal maximum intensity projection image (CT urography) (Fig. 5C). Focal MSK was diagnosed based on CT findings. One year later, the mass was stable in size and appearance on CT.

Discussion

MSK is a developmental abnormality involving the medullary pyramids and characterized by cystic dilatation of the collecting ducts.1,2 Morbidity is estimated at one in 5,000 to 20,000 people.8 Although most patients with MSK remain asymptomatic, 2.6 to 20% demonstrate clinical symptoms, such as renal colic, urinary tract infection, and macro-hematuria due to urinary stones.2,9 Therefore, MSK is mainly diagnosed by kidney-ureter-bladder radiography (KUB) and IVU. KUB may demonstrate calcification that corresponds to the renal pyramids, and IVU shows characteristic findings of so-called “bunches of grapes,” “pyramidal blush,” or “bouquets of flowers.”10 We believe that in our case, stools in the colon overlying the left kidney may have disturbed the clear depiction of characteristic IVU findings.

Recent improvements in imaging devices and techniques have resulted in the frequent use of CT or MR imaging for evaluating renal masses before IVU. Thus, familiarity with the characteristic CT and MR findings of MSK is important. Ginalski and associates3 reported that hyperdense papillae of 55 to 70 Hounsfield units on precontrast CT may suggest the presence of MSK, even if macroscopic calcification is not detected. However, a similar finding can also be observed that results from high medullary concentration of sodium chloride.11 It may be difficult to diagnose MSK using only precontrast CT. The appearance of an MSK lesion in the excretory phase of contrast-enhanced CT and CT urography corresponds to that seen on IVU and should aid differentiation of MSK from other renal tumors.3–5 In fact, our case was diagnosed using the excretory phase and CT urography. However, in cases with only single phase scanning after contrast administration, focal MSK tends to be misdiagnosed as a hypovascular renal tumor, especially when it involves only one medulla and demon-
Fig. 3. Coronal magnetic resonance (MR) urography (single shot fast spin echo, repetition time [TR]/echo time [TE] = 10,000 ms/800 ms, 5-cm slice thickness) showed the mass as an aggregation of tiny cysts (arrow).

Fig. 4. The axial diffusion-weighted echo-planar imaging (respiratory trigger, single shot, b factor = 1,000 s/mm², repetition time [TR]/echo time [TE] = 1197 ms/71 ms, 0.7 half scan factor, one signal average, spectral presaturation inversion recovery, 2 sensitivity encoding [SENSE] factor, diffusion gradients applied in 3 axes) showed a hyperintense mass at the corresponding site (arrow) (A). The axial apparent diffusion coefficient (ADC) map calculated with 3 different b factors (0, 500, and 1,000 s/mm²) showed a relatively hypointense region with a value of $1.12 \times 10^{-3}$ mm²/s on the side of the papilla (arrow) and a hyperintense region with a value of $1.97 \times 10^{-3}$ mm²/s on the side of the cortex (arrowheads) (B).

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strates no calcification. It is desirable to perform an additional scan of the excretory phase in patients with renal medullary mass.

To our knowledge, MR findings of MSK are not reported. In our case, the lesion showed mixed intensity on T1-weighted imaging, and its obvious high intensity on T2-weighted imaging was thought especially to reflect the pathological characteristics of this disease, such as the dilation of collecting ducts and aggregation of cystic structures. MR urography directly showed such pathological changes and should be very useful for diagnosing MSK. One interesting finding was that the ADC of the lesion was heterogeneous, though the mass was entirely hyperintense on diffusion-weighted imaging (b = 1,000). High ADC on the side of the cortex can be explained pathologically by dilation of the collecting ducts and aggregation of cystic structures. On the other hand, the ADC on the side of the papilla was relatively low and rather similar to those of solid masses like renal cell carcinoma or angiomyolipoma, though the imaging parameters and methods used to calculate ADC differed somewhat. This finding may reflect clotted blood in cystic structures, or increased cellularity of the interstitium around the cysts. Given the history of macrohematuria, mixed intensity on T1-weighted imaging, and remarkable hyperintensity on T2-
Fig. 5. The renal mass showed slight enhancement (arrow) in the cortico-medullary phase of dynamic computed tomography (CT) (A). Thick and dense streaks of contrast radiating peripherally (arrow) were identified in the mass in the excretory phase (B) and on CT urography (C).

In conclusion, we presented MR findings of focal MSK that mimicked a renal tumor. Remarkable hyperintensity on T2-weighted imaging and aggregation of cystic structures on MR urography are key findings in establishing a diagnosis of focal MSK.

References
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