Acute lobar nephronia: value of unique magnetic resonance imaging findings in diagnosis and management

Kenan Yılmaz[1], Gonca Koç[2], Sibel Yel[1], İsmail Dursun[1], Selim Doğanay[2]

[1]Division of Pediatric Nephrology, Department of Pediatrics, and [2]Department of Pediatric Radiology, Erciyes University Faculty of Medicine, Kayseri, Turkey.
E-mail: ggulkoc@gmail.com
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Acute lobar nephronia (ALN) as a focal form of acute renal bacterial infection is a fairly rare entity. Although the treatment approaches differ considerably, ALN is clinically indistinguishable from renal abscess. Therefore, urinary imaging studies play a crucial role in accurate diagnosis and follow-up. Renal ultrasonography and computed tomography imaging findings have previously been reported; herein for the first time in the English-language literature, we report a case of a 5-year-old girl with ALN whose diagnosis was based upon magnetic resonance imaging findings.

Key words: magnetic resonance imaging, ultrasound, acute lobar nephronia, pediatrics.

Acute lobar nephronia (ALN), also referred to as acute focal bacterial pyelonephritis, is a severe focal nonliquefactive infection of the kidney involving one or more renal lobules. Typical clinical characteristics include fever, flank pain, leukocytosis, pyuria and bacteriuria, which are similar to those of acute pyelonephritis or renal abscess[1]. Thus, urinary work-up is needed in order to make an accurate diagnosis of ALN and differentiate it from renal abscess, which unlike ALN often entails surgical intervention. Although computed tomography (CT) has been reported to be more sensitive than ultrasonography (US) for the detection and differentiation of ALN from renal abscess, magnetic resonance imaging (MRI) might be considered as the preferred imaging modality due to the potential radiation exposure involved in CT[2]. We present this case of ALN in order to call attention to the value of MRI findings in making the diagnosis and thus determining the proper management of such a case.

Case Report

An otherwise healthy 5-year-old girl was referred to our hospital from another center, where she had presented with fever and right flank pain, after her complaints persisted despite oral ampicillin/sulbactam use for one week. In her history, it was found that right flank pain had begun 10 days after the presentation with fever. The physical examination was unremarkable, except for a temperature of 39°C by axillary measurement, and tenderness over the right costovertebral angle. Laboratory evaluations revealed increased levels of WBC, ESR and CRP. No microorganisms were detected to have grown on urine culture.

The urinary system US performed with suspicion of acute pyelonephritis disclosed the enlargement of the right kidney, with a size of 84x42 mm, while the left kidney was normal in size (72x32 mm). Two heterogeneous hypoechoic parenchymal lesions, with poorly defined margins, of the upper and lower poles of right kidney were encountered, with sizes of 39x32 mm and 22x18 mm, respectively (Fig. 1). Neither had vascularization on color Doppler US. The patient was considered to have an acute focal renal infection, with possibilities including either lobar nephronia or abscess. On MRI images acquired for the differential diagnosis, the renal parenchymal lesions were observed to be more extensive than had been revealed by US, being located in all zones of the kidney. The larger one involved both the upper pole and the middle

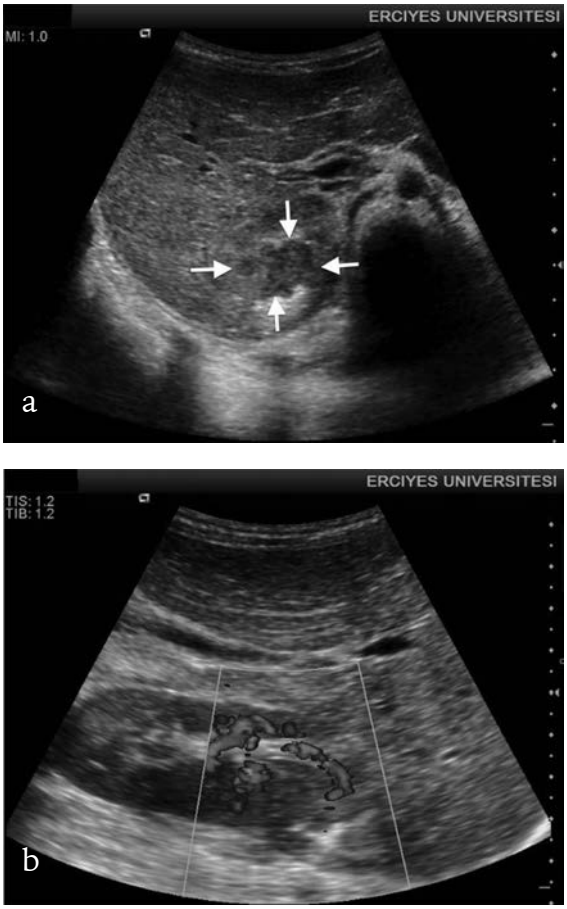
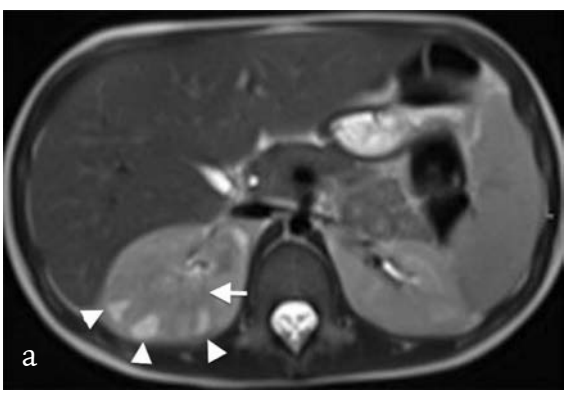


Fig. 1. Axial US and sagittal color Doppler US images of the right kidney, showing the ALN lesion located on the inferior pole. In the US image (a), the lesion is hypoechoic (arrows); lack of vascularity was detected with color Doppler US (b).



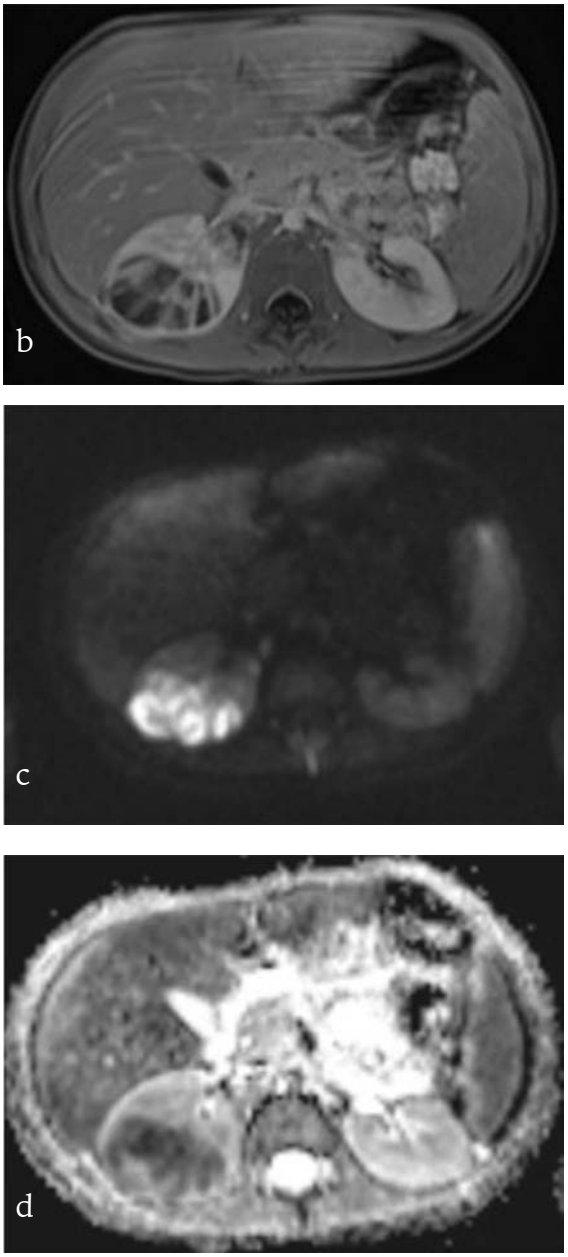


Fig. 2. Axial MR images of the right kidney, revealing the ALN lesion involving the upper pole. On the T2-w image (a), it has both hypo- (arrow) and hyperintense (arrowheads) components, but no capsule. The T1-w image (b) shows the extension of ALN into the lobules without any enhancement. Note that on the diffusion-weighted image (b=800) (c), the lesion has significant restricted diffusion, while on the ADC map (d), region of interest analysis reveals a reduced mean ADC value ($0.9x1/10^3$ s/mm^2) compared to normal renal parenchyma ($2.0x1/10^3$ s/mm^2).

zone, with a size of 29x40x52 mm, while the smaller one located on lower pole was 17x25x27 mm in size. On T2-weighted (T2-w) images the lesions had both heterogeneous hypo and hyper signal intensities compared to normal renal parenchyma. T1-w contrast-enhanced images offered a better depiction of interlobular involvement. No significant capsule was identified on either post-contrast T1-w or

T2-w images, while diffusion restriction was present (Fig. 2).

With the diagnosis of ALN, empiric treatment with intravenous meropenem was initiated, owing to persistent symptoms despite the previous administration of oral ampicillin/sulbactam. The fever was under control on the 6th day, while ESR and CRP values returned to normal on the 24th day. The patient was discharged following two weeks of hospitalization, and intravenous meropenem was replaced with oral sefixim. Antibiotic therapy was withdrawn after administration for a total of 4 weeks.

Further assessment with a voiding cystourethrogram disclosed no vesicoureteral reflux (VUR). The control MRI obtained in the 3rd month following revealed complete resolution of the lesions with scarring and parenchymal thinning of the right kidney. On DMSA renal scan obtained in the 6th month, diffuse decreased uptake with accompanying volume loss of the right kidney was detected.

Discussion

Acute lobar nephronia is defined as an intermediate form between uncomplicated acute pyelonephritis and kidney abscess. It has been reported that renal abscess develops in 25% of children with acute lobar nephronia when appropriate and adequate antibiotic therapy is not provided[3]. Diagnosis is often delayed, as symptoms are nonspecific in ALN. The most common findings include fever, flank pain, leukocytosis, pyuria and elevated CRP. There may or may not be growth in the urine culture test[4]. Our case also had similar presenting complaints, and no growth was observed in urinary cultures, which was attributed to the previously administered antibiotic therapy.

A significantly longer duration of fever before presentation (4.9 days vs. 1.4 days) and higher levels of CRP (9 mg/dl vs. 3.5 mg/dl) and WBC (18.86×10^9/L vs. 15.08×10^9/L) in children with ALN compared to those with uncomplicated pyelonephritis have been previously reported[1]. In our case, the patient had fever for 10 days before presentation and 7.5 mg/dl CRP and 18,500/mm^3 WBC levels, indicative of a complicated urinary infection. The significant increase in leukocytosis and CRP levels, as well as the clinical course, is consistent with the fact that ALN is a more severe form of renal parenchymal infection than is acute pyelonephritis. Therefore, longer hospital stays and antibiotic therapy are needed in children with ALN[1]. Although treatment with intravenous rather than oral antibiotherapy is recommended, the modality may be converted to the latter following resolution of the fever[4-6]. The overall duration of antibiotic therapy was four weeks in our case, including initial intravenous therapy followed by oral therapy.

Children diagnosed with ALN should be assessed for underlying urological abnormalities. In a study of 25 children, urinary system abnormalities were detected in 48% of the cases; 32% of cases had VUR[4]. In two other studies, VUR incidence was found to be 41.9% and 19%, respectively, of 109 and 51 cases with ALN[1,5]. No VUR was detected in our case.

Cheng et al.[5] compared patients with ALN to those with acute pyelonephritis regarding renal scar formation and found that the renal scar rate was higher in ALN (89% vs. 34.9%). In our present case, DMSA renal scan on the 6th month after treatment disclosed scarring.

Definitive diagnosis in ALN is based upon the findings of the imaging modalities. Urinary US may demonstrate enlargement of the kidney with focal, hypoperfused and hypoechogenic renal mass lesions corrupting the corticomedullary differentiation[4,7,8]. The differentiation from a renal abscess may be challenging owing to the quite similar ultrasonography findings of both entities. CT has been indicated to be the more sensitive and specific means of diagnosing and differentiating ALN as compared to US[4,7-9]. Following contrast administration, ALN appears as a wedge-shaped, non-enhancing, striated hypodense lesion[7,8]. Although to date no study has been published comparing CT and MRI in terms of their sensitivity and accuracy in detecting ALN, in our present case, the patient was scanned by MRI following urinary US due to concerns regarding the radiation exposure entailed by CT. MRI was more sensitive than US in showing the extent of ALN. T1-w images revealed non-enhancing, hypointense interlobular, multifocal involvement of ALN. On T2-w images, it had a heterogeneous signal that consisted of hypointense as well as hyperintense areas as compared to normal kidney parenchyma. Even though restricted

diffusion was encountered, resembling an abscess, the absence of a significant capsule that would be hypointense on T2-w image and enhanced on T1-w images helped differentiate ALN from a potential renal abscess.

In the clinical setting of ALN, where the typical clinical findings of infection are not present, the differential diagnosis list also includes renal neoplasms. In particular, non-enhancing, predominantly cystic-necrotic renal cell carcinoma and Wilms' tumor—the most common renal malignant neoplasms of adults and children, respectively—may be challenging to differentiate from focal renal infections by means of clinical and radiological findings. Since, in a recent study by Lassel et al.[10], a significant difference between the apparent diffusion coefficient (ADC) values of focal renal infection and those of renal cell carcinoma, caused by the more prominent diffusion restriction of focal infection, has been reported, the addition of diffusion-weighted imaging to routine MRI protocol would yield valuable information for use in discriminating between these two entities and avoiding unnecessary surgical approaches[10]. Region of interest analysis on the ADC map of our current case revealed significantly reduced ADC values in ALN, compared to normal renal parenchyma ($0.9x1/10^3$ s/mm^2 vs. $2.0x1/10^3$ s/mm^2, respectively).

In conclusion, ALN should be considered in all patients who have urinary tract infections with fever of prolonged duration and higher acute phase reactants, and who do not show clinical improvement despite receiving antibiotic therapy. Early diagnosis and differentiation of ALN from renal abscess by means of MRI would assist in making it possible to cure patients with medical treatment rather than surgical intervention, and reduce the formation of scars.

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