CASE REPORT

Cortical nephrocalcinosis asymmetrically involving the kidneys: a case report documenting the development via imaging

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ABSTRACT

We report the case of a 38-year-old man with known human immunodeficiency virus infection who presented with severe *Bordetella Bronchiseptica* pneumoniae that led to septic shock and acute renal insufficiency, after which he developed bilateral cortical nephrocalcinosis, affecting most severely the right kidney with associated atrophy. The onset and progressive development of the findings were documented via both ultrasound and computed tomography. As far as we know, this is the first time that the development of cortical nephrocalcinosis has been documented via imaging, interestingly revealing a gradual decrease of the right kidney size, together with a change from a punctate pattern of cortical calcifications to a rim of calcifications.

Key-words: Acute cortical necrosis; acute renal insufficiency; *Bordetella Bronchiseptica*; cortical nephrocalcinosis; septic shock.

INTRODUCTION

Nephrocalcinosis consists of the generalized deposition of calcium (calcium oxalate or calcium phosphate) in the renal parenchyma, which can be either cortical or medullary in location. It is most commonly seen as an incidental finding, but it may be severe enough to cause renal failure[1,2].

Cortical nephrocalcinosis is characterized by a peripheral location of the calcifications and is relatively uncommon; about 20 times less common than medullary nephrocalcinosis[1,3]. Interestingly, some clinical conditions may demonstrate combined cortical and medullary nephrocalcinosis (e.g. primary or secondary oxalosis, chronic pyelonephritis, intrarenal infection in HIV-seropositive patients)[1].

CLINICAL CASE

We report the case of a 38-years-old man with previous history of human immunodeficiency virus (HIV) infection, routinely followed up by an infectious diseases physician at our hospital since 1997, with CD4+ count of 814.9 cells/uL and CD8+ of 1030 cells/uL, regularly medicated with Lopinavir, Ritonavir, Atazanavir and Raltegavir. Basal creatinine level was 0.63 mg/dL (0.7-1.3), glomerular filtration rate (GFR) 126 ml/min/1.73 (>90 ml/min/1.73) and the patient was not under vasopressor drugs. Between February and March 2016, he was admitted at the hospital with the diagnosis of a severe community-acquired pneumonia and *Bordetella Bronchiseptica* was isolated in sputum culture. At the time of admission, the patient had a CD4+ count of 218 cells/μL and was initially medicated with

Gentamicin, Ciprofloxacin, Piperacillin and Tazobactam. Within one day after admission, the patient developed septic shock. In this setting, an acute renal insufficiency was installed two days after; creatinine level was 5.4 mg/dL, with an estimated glomerular filtration rate (GFR) of 12.4 ml/min/1.73 and urea 272 mg/dL (15-45 mg/dL). Urine cultures were negative; urine tests showed pH of 6; increased erythrocytes 200 cel/uL;

Figure 1

Ultrasound (US) of the upper abdomen with a convex probe; longitudinal views **(A, B, C, E)** and axial views **(D, F)**. Examination performed during admission in February 2016 **(A-D)**, showing the different echostructures between the normal left kidney **(B)** and the altered right kidney **(A, C, D)**. US performed after the patient was discharged in May 2016 **(E, F)**, allowing a comparison of the differences in the right kidney at three months' interval. In February, there was a diffuse increase of the echogenicity of the parenchyma, with loss of normal corticomedular differentiation. In May, there was a shrinkage of the kidney size, and a shadowing because of the cortical calcifications.
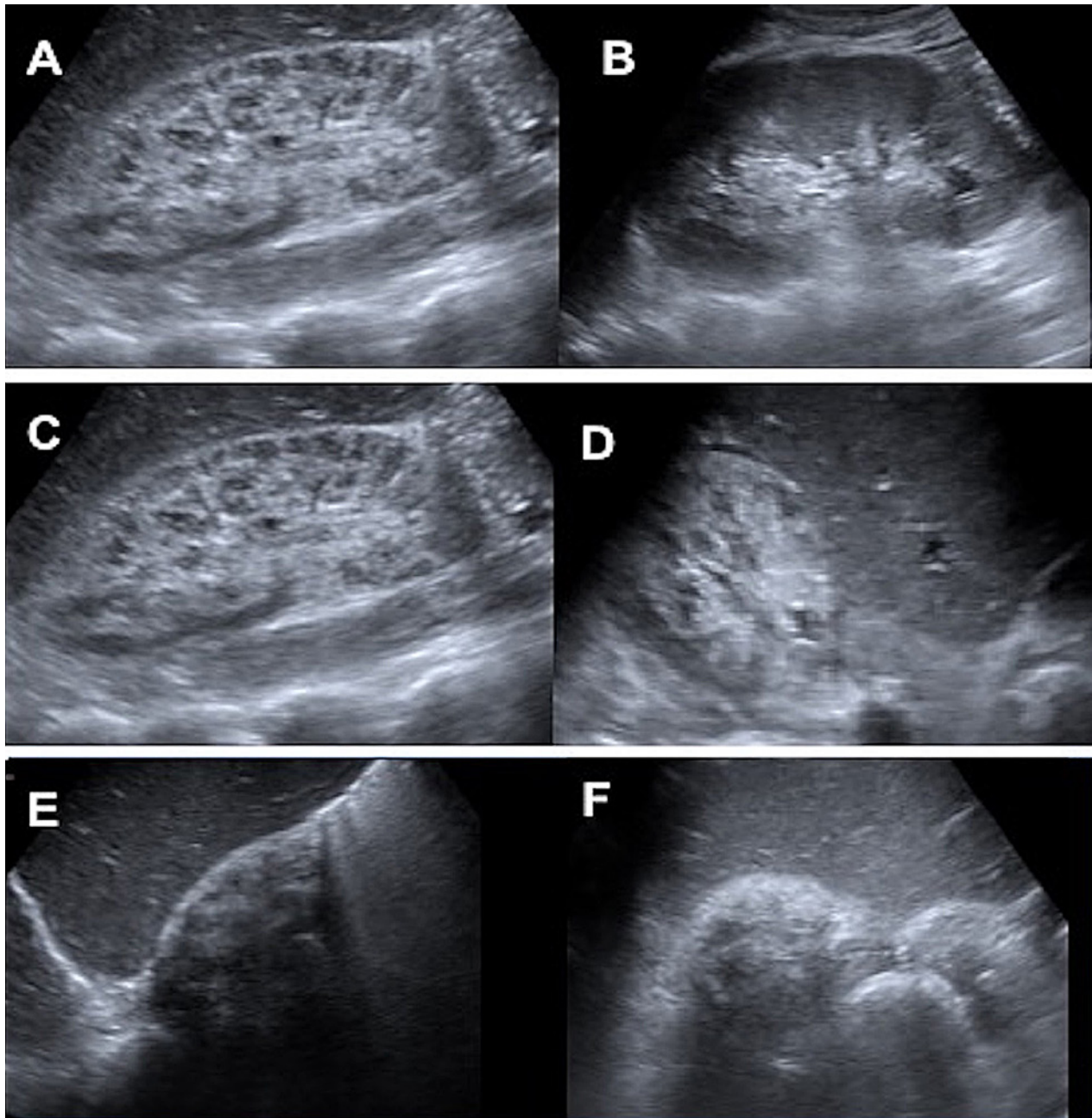
Figure 2

Computed tomography (CT) performed in July 2016. Images at the level of the upper third of the kidney **(A-C)** and at middle third of the kidney **(D-H)**. Unenhanced CT **(A, D)**, revealing thin peripheral band of cortical calcifications extending into the septal cortex on the right kidney and scattered punctuated calcification in the left kidney. In the corticomedular **(B, E)** and nephrographic **(C, F)** phases, the spared medullary pyramids retain normal attenuation. Images **(G)** and **(H)** are reconstructions to show the renal arteries and veins, respectively.
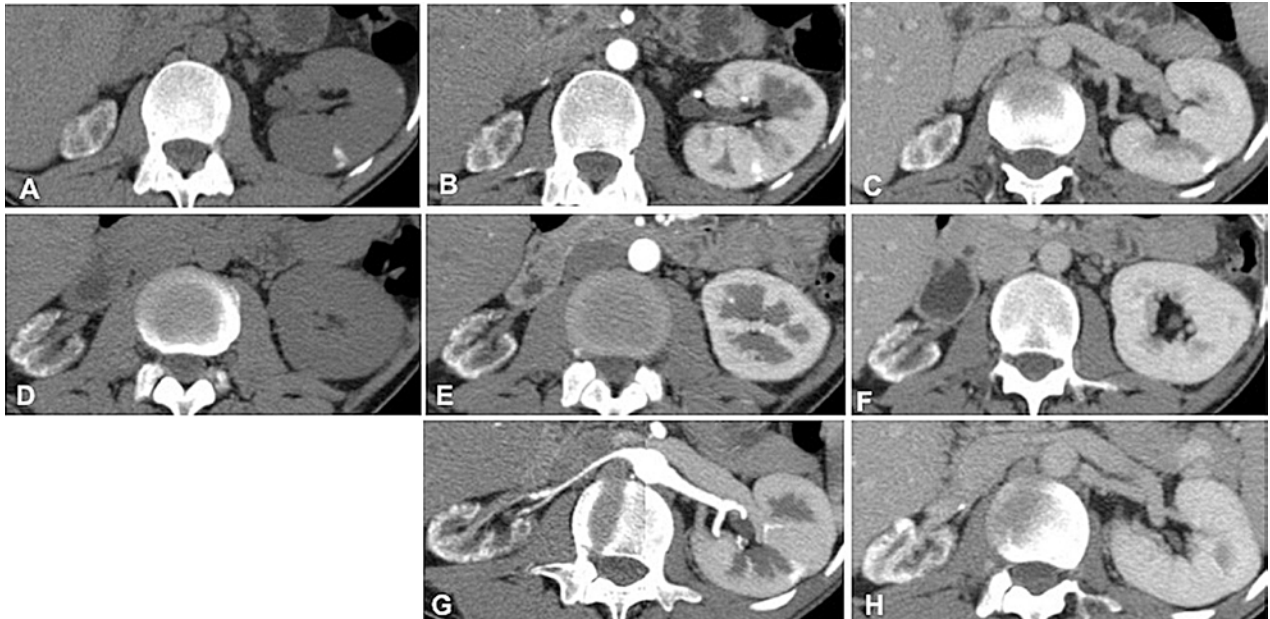
proteins 30 mg/dL and creatinine 100 mg/dL, as well as increased ratio protein/creatinine of 300 mg/g (<150 mg/g); calcium levels were normal; values of oxalate and pyridoxine were not evaluated. Gentamicin was interrupted. At that time, an ultrasound (US) demonstrated normal-size kidneys without hydronephrosis, but increased hyperechogenicity of most of the right renal parenchyma with loss of normal corticomedular differentiation (Fig. 1).

By May 2016, the renal function had returned to normal levels and the patient performed an US that showed a marked decrease in size of the right kidney, diffuse hyperechogenicity of the parenchyma with posterior acoustic shadowing suggesting the presence of parenchyma calcifications (Fig. 1). A CT was subsequently performed in July 2016 (Fig. 2 and Fig. 3) and confirmed an atrophy of the right kidney (6.5 cm of length) with a thin peripheral band or rim of cortical calcifications extending into the septal cortex, with sparing of the medullary pyramids, which retained the attenuation of the soft tissue. The left kidney was slightly enlarged (12.5 cm in length), but occasional punctate calcification randomly distributed in the cortex was also found. These findings were attributed to cortical nephrocalcinosis. CT angiography showed permeable kidney vessels, with a gradual and regular

Figure 3

Computed tomography (CT), coronal reconstruction, showing both kidneys before **(A)** and after contrast enhancement in corticomedular phase **(B)**.
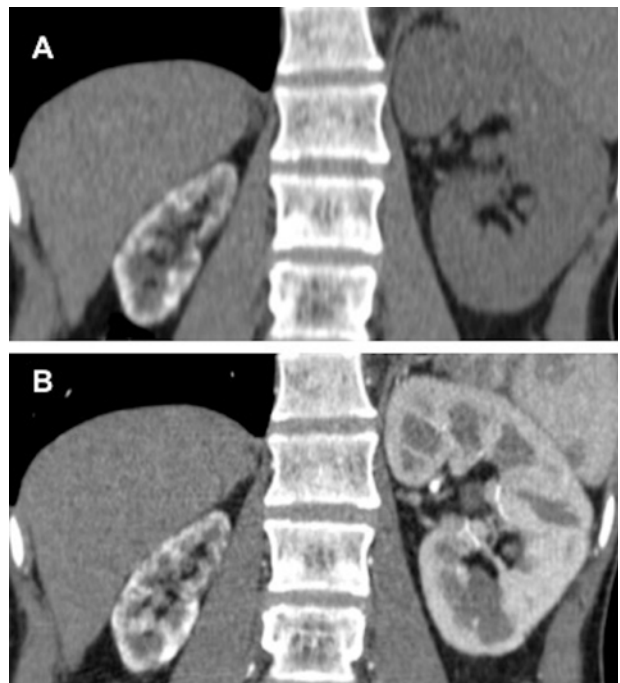
Figure 4

Unenhanced computed tomography (CT), performed during admission in February **(A)** and March **(B)**, and after discharge home in July **(C)**, documenting the onset and progressive development of cortical neph-rocalcinosis. The images reveal a gradual decrease of the right kidney size, together with a change from a punctate pattern of cortical calcifications to a rim of peripheral calcifications.
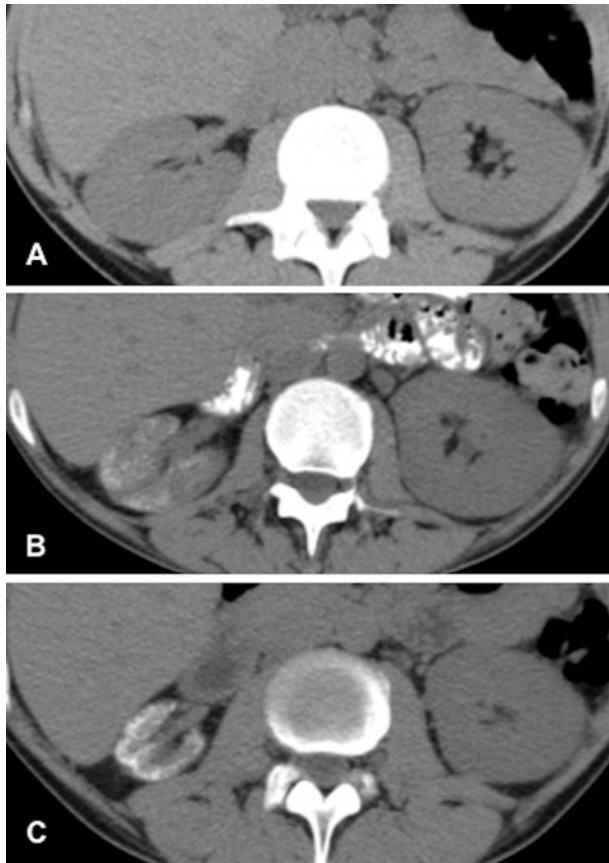
luminal decrease of the right renal artery, thought to be due to a decrease of the atrophic kidney needs. A retro-spective analysis of previous examination found a thoracic CT performed during the course of the pulmonary infec-tion, that allowed a partial view of the kidneys interested in the upper abdomen and documented a progressive increase in cortical nephrocalcinosis and a simultaneous progressive decreased in the right kidney size, from nor-mal size to an atrophic kidney (Fig. 4).

■ DISCUSSION

Cortical nephrocalcinosis is an extremely rare finding. The most frequent causes are acute cortical necrosis and chronic glomerulonephritis[4-8]. But there are several other causes, such as intrarenal infection in HIV-seropositive patients by atypical mycobacterium or other organisms (e.g. Mycobacterium avium intracellular; Pneumocystis carinii; Hystoplasma; Cytomegalovirus), chronic pyelone-phritis, Alport syndrome, vesicoureteral reflux, autosomal recessive polycystic kidney disease, acute or chronic trans-plant rejection, chronic hypercalcemia, hyperoxaluria, primary or secondary oxalosis, sickle cell disease, vitamine B6 (piridoxine) deficiency, nephrotoxic drugs (e.g. Ampho-tericin B, ethylene glycol, methoxyflurane)[3,4,9].

In our case, the most likely predisposing factor for the development of cortical nephrocalcinosis was the acute cortical necrosis in the setting of septic shock after severe *Bordetella Bronchiseptica* pneumoniae. This is a common respiratory commensal of wild and domestic animals, rarely infecting humans. However, in immunosuppressed patients, especially in those with HIV infection, *Bordetella Bronchiseptica* can cause severe pulmonary infections[10]. Although we cannot explain how a systemic cause could have affected both kidneys so differently, we did find a similar case in the literature, in which a cortical nephro-calcinosis of the right kidney was found after preeclampsia during pregnancy[11]. Another cause that was investigated was an intrarenal infection by atypical mycobacterium or other organisms in a HIV-seropositive patient. This seems less likely as no agent was identified in tests performed; furthermore, this infection tends to cause dystrophic calcification that asymmetrically involve the renal cortex and medulla, leading to combined cortical and medullary nephrocalcinosis[12,13].

Renal cortical necrosis represents death of the renal cortex with sparing of the medulla, and is one of the most common causes of cortical nephrocalcinosis. It can result from any condition that causes an acute and prolonged shock[14]. Acute cortical necrosis may be seen in cases of sepsis, severe dehydration or bleeding, renal infarction or ischemia, haemolytic uremic syndrome; rejected renal transplant, extracorporeal shock wave lithotripsy, toxaemia of pregnancy, drugs, snake bite, arsenic poisoning[3,4,11,15]. The characteristic cortical calcification occurs within a few weeks after the onset of acute cortical necrosis. The medullary pyramids are usually spared, retaining the attenuation of the soft tissue. When cortical nephrocalcinosis first appears, the kidneys are still enlarged because of inflammatory oedema. With time, the kidneys become atrophic, as documented in the case we present.

Nephrocalcinosis found incidentally may be the pre-senting feature and the radiologist may be the first to suggest a diagnosis based on the pattern and

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distribution of renal parenchymal disease[1]. Radiographs may detect kidney calcifications depending on the size (if >2 mm), degree of increased attenuation (if on CT >100 HU), contrast factors and the spatial resolution of the film. Ultrasound (US) and computed tomography (CT) can detect nephrocalcinosis earlier than abdominal radiographs. US shows increased echogenicity of the renal cortex, which may simulate other medical conditions if acoustic shadowing is not present (acoustic shadowing depends on the degree of calcification). MR is not a good imaging modality for calcifications detection, which appear as a signal void in both T1 and T2 weighted images[4,16].

CT is considered the most sensitive and accurate imaging modality in depicting increased attenuation values in the basal and septal cortex with sparing of the medulla. It depicts nephrocalcinosis at an early stage and provides better imaging of the density and extent of the calcifications. Three patterns may be seen, although none is specific to any etiology: i) the most common pattern is a thin peripheral band or rim of calcification, often extending into the septal cortex; ii) a second pattern is two parallel lines of calcification, known as tram track appearance; these lines may be continuous, but more often they are interrupted, reflecting the more patchy distribution of cortical necrosis; iii) the least common pattern is punctate calcification distributed randomly in the cortex, representing necrotic calcified cortical glomeruli and tubules[17].

The imaging signs of installation and development of cortical nephrocalcinosis, in US and CT, are interestingly depicted in the case we present. US was able to very soon (depict seven days after acute renal insufficiency was installed) a marked increase in parenchymal echogenicity of a normal-size kidney. On follow-up (three months later), the main features were an atrophic kidney with marked hyperechogenicity of the cortex and posterior acoustic shadowing (Fig. 1). CT performed at admission, one month and five months later, revealed a gradual decrease in right kidney size, together with a change from a punctate pattern of cortical calcifications to a rim of calcifications. On the other hand, on the upper pole of the left kidney which was affected to a much lesser degree and did not decrease in size, we found only scattered calcifications (Fig. 4). As far as we know, this is the first time that the development of cortical nephrocalcinosis has been documented via imaging and, maybe for that reason, we could not find literature describing a change in the cortical calcifications pattern. Looking at our images, it seems that the peripheral band of calcifications might have resulted from the convergence of the punctate calcification as a consequent of parenchyma atrophy. So, we can only speculate that in severe cases of diffuse nephrocalcinosis, the punctate pattern can evolve to a rim pattern of calcifications after kidney atrophy.

Nephrocalcinosis is caused by multiple different conditions and the renal prognosis is determined by the underlying cause. Whereas most patients with nephrocalcinosis do not progress to end-stage renal disease, certain underlying conditions, if not effectively treated, may be associated with progressive kidney dysfunction [2]. Although it is an irreversible condition when found, the importance of early detection relates with the ability of the clinician to closely follow-up renal function, undertake protective kidney measures and start a timely program for patients with end-stage renal disease.

Disclosure of potential conflicts of interest: none declared.

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