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Lithiasis-induced acute kidney injury: is ultrasonography enough?

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Obstructive acute kidney injury (AKI) is relatively common, reported in 8% to 17% of cases presenting with community-acquired AKI (1, 2). It is more frequent in males of advanced age, usually from bladder outlet obstruction (3). Guidelines recommend imaging, namely a renal tract ultrasound (US), within 24 hours from admission to rule-out obstruction and guarantee recovery of renal function (4, 5).

Lithiasis is not a common cause of AKI (1–2% of obstructive cases) (1, 6) and it is reported that only 0.72% of patients with urinary calculi develop AKI from stones (7). It is known that US may have difficulties in demonstrating stones-related obstruction and that unenhanced CT is most sensitive and specific for this purpose. We report therefore the imaging findings in a series of patients with lithiasis-induced AKI to understand the respective roles of these techniques.

A request for cases of AKI from urolithiasis was announced on the website of the European Society of Urogenital Radiology (ESUR). To include emergency outpatients in whom previous SC levels were unknown, AKI was defined as present in patients without history of chronic kidney disease with serum creatinine (SC) levels > 2 mg/dL; patients with SC that raised >0.3 mg/dL or >50% above baseline in 48 h; patients with history of urine output <0.5 ml/kg/h for longer than 6 h; patients in whom SC levels decreased of 0.3 mg/dL or 50% of baseline after obstruction relief (7).

We reviewed the imaging findings obtained in emergency, those on which the urologist decided his/her first therapeutic approach, in 10 patients from 2 different institutions. All were from teaching files.

The study was approved by the ethics committee and the need for informed consent was waived given its retrospective nature.

US was the first approach in all patients, followed by unenhanced CT in 5. In one case, only the CT images and the report of the US examination were found. Then, we reviewed the images of the US examinations in 9/10 patients, of both studies in 4/10 and only the CT images in 1. Patients were classified into five groups: 1) Three had bilateral, synchronous, ureteral stones. 2) Two had ureteral stones in a single kidney. 3) Two had unilateral ureteral stone in chronic renal insufficiency. 4) Two had one obstructed kidney and a contralateral small, poorly functioning one. 5) One had unilateral UPJ stone, with contralateral renal pelvis stones.

Obstruction was recognized in all patients through demonstration of hydronephrosis (9 cases) and/or identification of perirenal fluid (2 cases). US was considered sufficient to plan treatment in 5 patients. Four had stones visible at the uretero-vesical junction (UVJ): one bilateral (#3, Fig. 1) and three unilateral - 1 single kidney (#4); 1 bilateral small kidneys and history of borderline renal function (#7); 1 obstructed normal kidney and small, non-functioning contralateral one (#9). The fifth had history of stone disease, mild hydronephrosis with bilateral stones in renal pelvis and, at right, a uretero-

pelvic junction (UPJ) stone (#10).
A CT study was necessary in 5 cases. In three (#1, #2, #5; all with ureteral stones) US recognized signs of renal obstruction but not its underlying cause (Fig. 2, Fig. 3). In one (#8; stones in right renal pelvis with contralateral small kidney) CT was requested to plan nephrostomy (Fig. 4). The remaining patient (#6) had ADPKD and right ureteral obstruction from a small stone that was seen at US, but CT was requested to confirm it.
Presenting symptoms and US and CT findings in each patient are summarized in Table I.
Dilatation of the excretory system is the key finding in obstructive AKI; false-negative studies can occur in dehydrated patients, and additional evaluation following hydration is suggested when post-renal etiology of AKI is clinically suspected (5, 8). Subtler signs of obstruction, namely a thin layer of perirenal fluid, may also be present. Acute ureteral obstruction from distal stones, as seen in our patients # 3 and #5, seems the most common cause of this finding (9).
CT is regarded as the first examination technique when a renal colic is suspected, and a number of patients with lithiasis-induced AKI have been diagnosed with this technique (10 - 16). A possible post-renal, lithiasic cause of AKI has to be considered in patients with previous history of stone disease, hyperparathyroidism or metabolic diseases (16 - 18), and CT can be the best approach in them.
In our series, US was diagnostic and sufficient to plan for therapy in 5/10 cases, being able to see clearly both the obstruction and its cause. Signs of obstruction (hydronephrosis and/or perirenal fluid) were seen also in the other cases; then, post-renal AKI was correctly diagnosed in all.
We believe that the guidelines suggesting a US examination to rule-out obstruction in patients with AKI can be helpful also in cases of lithiasis-induced etiology. US is able to recognize the post-renal etiology of AKI in them and is sufficient when the stone is clearly visible, especially when located at the UVJ. CT is needed when the etiology of the obstruction is not identified or in difficult cases to plan the therapeutic approach.

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Figures

Fig. 1 A-C. Patient #3. A 16yo girl presented with bilateral lumbar pain. A) US showed mild hydronephrosis of the left kidney (open arrow) and presence of a thin layer of perinephric fluid at its lower pole (arrows in B). C) A small stone was visible at the UVJ (arrow). The same findings were present also at the right side. CT was not performed.

Fig. 2 A-C. Patient #2. A 60yo male came to emergency with bilateral lumbar pain. US showed hydronephrosis of both the right (A) and left (B) kidneys (open arrows); the ureters could not be seen, C. Coronal oblique reconstruction of the unenhanced CT study showed stones (arrows) at the middle III of both ureters.

Fig. 3 A-C. Patient #5. A 83 yo male with history of left nephrectomy for cancer came to emergency with suprapubic pain and anuria. A) The right kidney had multiple cortical and parapelvic cysts. A thin perirenal fluid collection was detected (arrows). B) The urinary bladder was empty and the distal ureter could not be evaluated; the open arrow is pointing at the balloon of the bladder catheter. C) Unenhanced CT showed a small stone at the right UVJ,

Fig. 4 A-D. A 71yo lady came with nausea and vomiting. A) The right kidney had dilatation of the upper and middle calices, a stone in the pelvis and a small stone within the lower calix. B) The left kidney was small, non dilated. C) Unenhanced CT was requested to plan for therapy. D) Nephrostomy at right was performed.

Pt #	Symptoms	US findings	CT findings
1	Right renal colic	+ Right: hydronephrosis and ureteral stone. Left: hydronephrosis only	Bilateral ureteral stones
2	Non specific lumbar pain	Bilateral hydronephrosis	Bilateral stones at middle III of ureters
3	Non specific lumbar pain	Mild bilateral hydronephrosis; thin layer of perirenal fluid; bilateral stones at UVJ	-
4	Right renal colic	Single kidney; stone at UVJ	-
5	Anuria, suprapubic pain	Single kidney: perirenal fluid; empty bladder	Single kidney, mild hydronephrosis, stone at UVJ
6	Right renal colic in ADPKD	ADPKD; mild hydronephrosis; stone at middle III of right ureter	ADPKD, mild hydronephrosis, stone middle III of right ureter
7	AKI	Bilateral small kidneys; UVJ stone at right	-
8	AKI	Stones in mildly dilated right renal pelvis; small left kidney	Stones in mildly dilated right renal pelvis; small left kidney
9	Right renal colic	Mild right hydronephrosis with stone at UVJ; small left kidney	-
10	AKI	Bilateral renal stones with mild hydronephrosis; stone at UPJ at right	-

Table I. Symptoms, US and CT findings in patients with lithiasis-induced AKI.
+ only the US report was available for review in this case

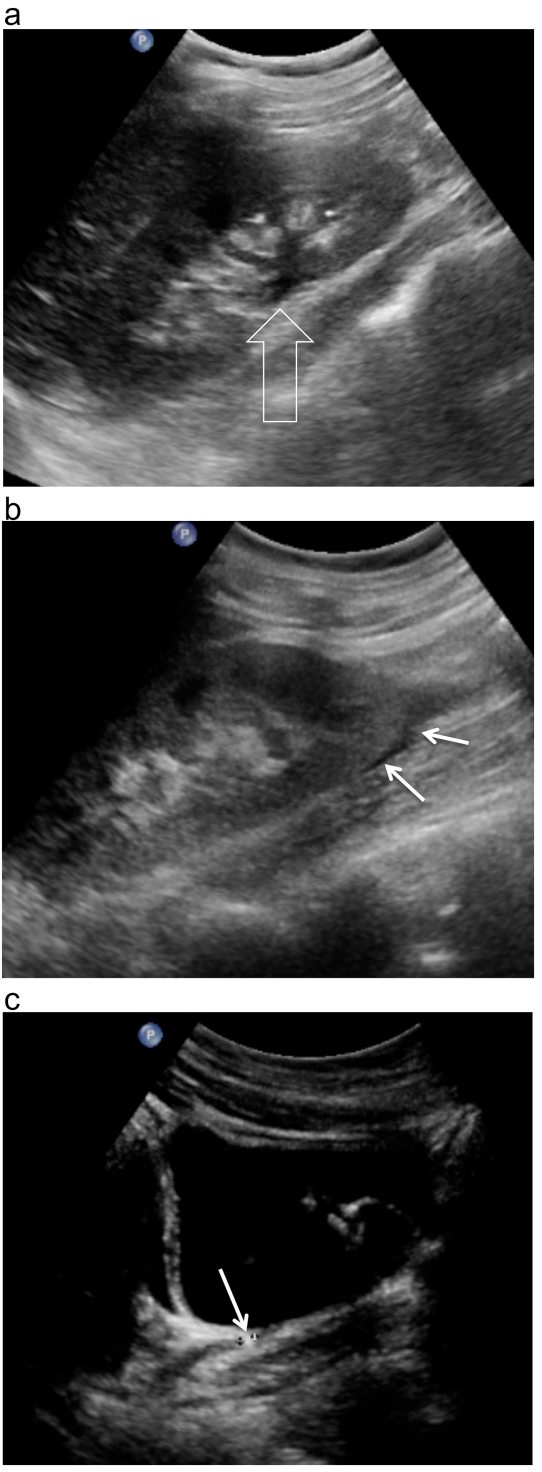

Figure 1

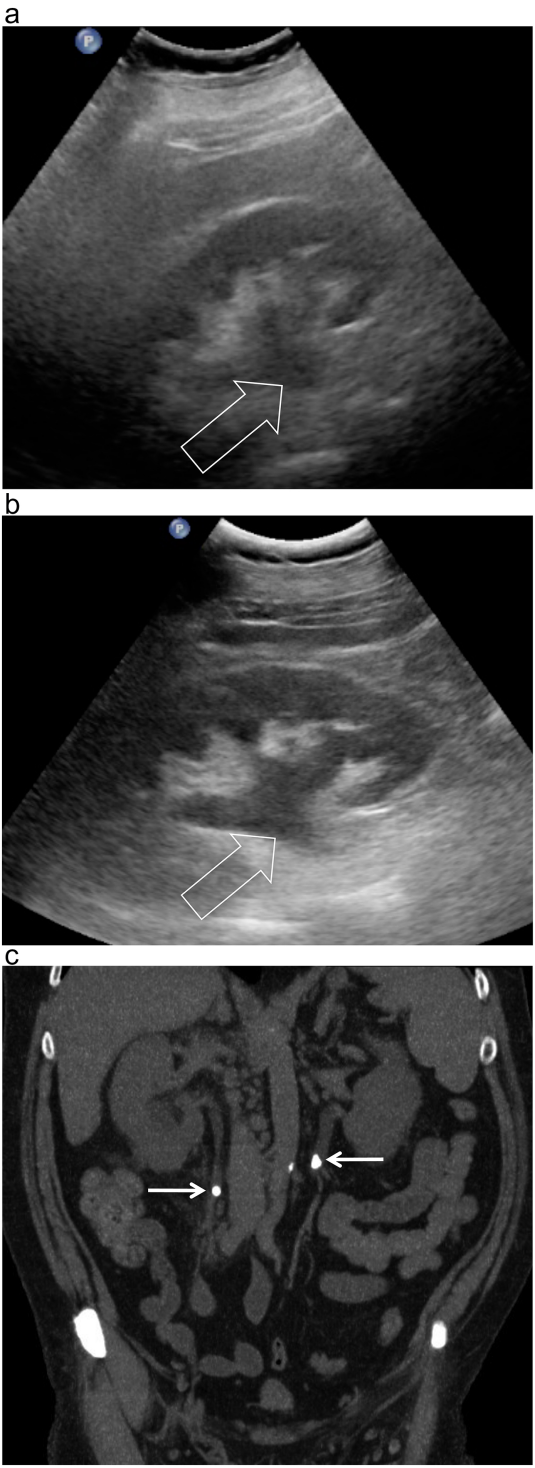

Figure 2

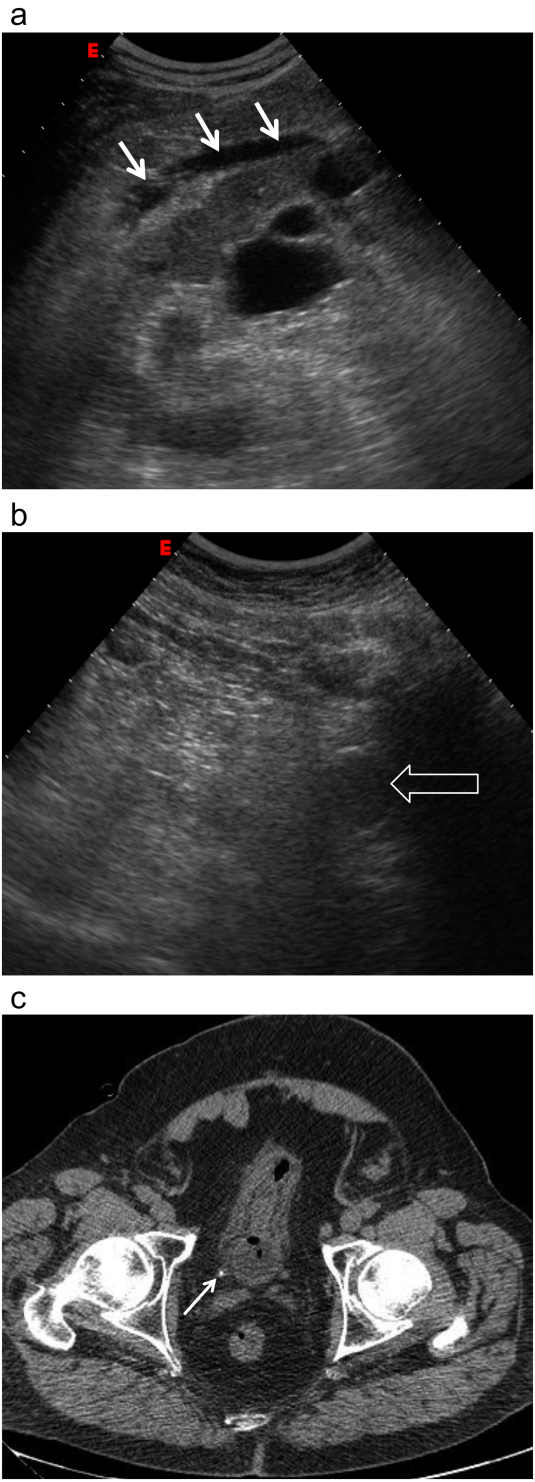

Figure 3

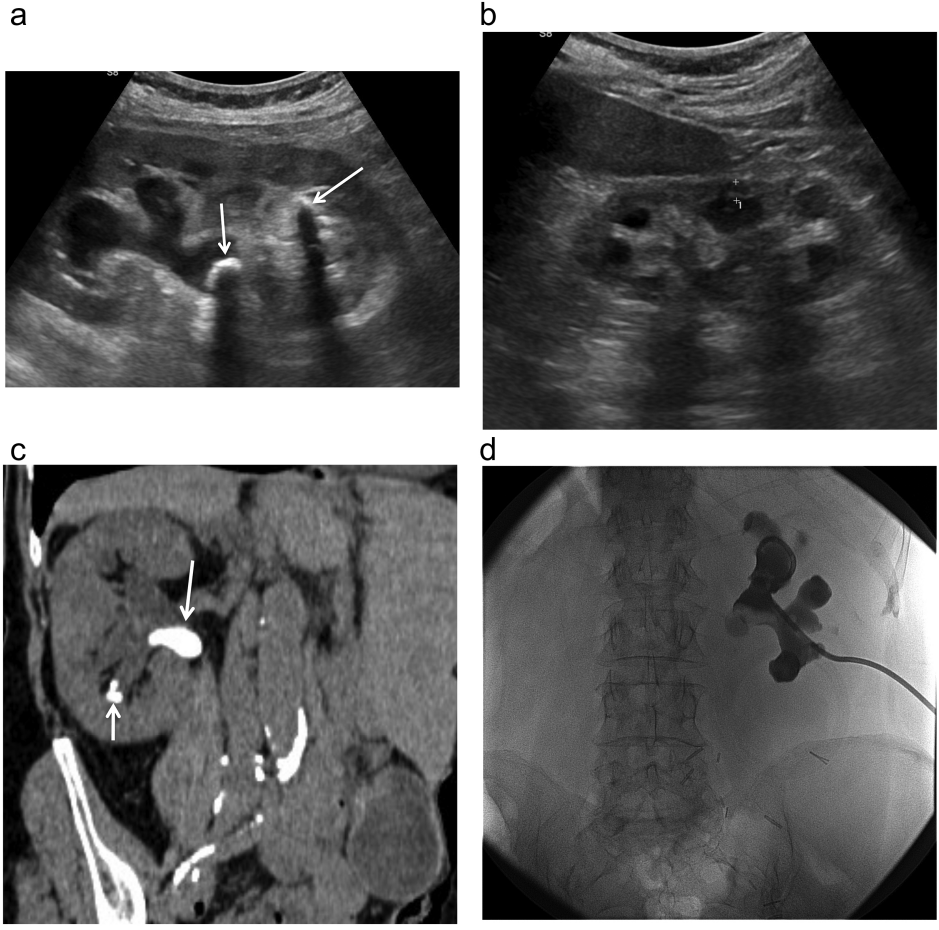

Figure 4