A Particular Form of “Urolithiasis” in a Toddler

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Milk of calcium is a viscous colloidal suspension of calcium salts that forms in dilated cysts or cavities. We present, for the first time in literature, a toddler with isolated milk of calcium and treated with a conservative approach. A boy with a history of one urinary tract infection and recurrent fever without vesicoureteral reflux showed at the age of 14 months a left obstructive staghorn stone. Because of absent function of the left kidney at mercapto acetyl tri glycine scintigraphy, a JJ stent was positioned with a leak of whitish material immediately after the stent positioning. Renal scintigraphy performed 1 month later revealed a partial resumption in renal function (18%). When he was 18 months old, the child suffered episodes of acute pain with inconsolable crying, unresponsive to paracetamol administration. Ultrasound assessment revealed left pelvic dilation (anterior-posterior diameter of 18 mm), suspended echogenic debris in the bladder, and dilated left distal ureter with particulate matter. These episodes of acute pain were followed by expulsion of numerous soft formations and emission of greenish urine. Both urine culture at the admission and culture on the greenish urines were sterile. After the expulsion of the soft formations, pain episodes stopped. The diagnosis of milk of calcium stone was made. With this case, we highlight a condition that can be easily diagnosed (if known) because the morphology of the expelled material is pathognomonic. Diagnosing it could avoid unnecessary treatments (ie, extracorporeal shockwave lithotripsy) and support a conservative approach (ie, stent positioning).

CASE PRESENTATION

A 14-month-old boy, with a history of one febrile urinary tract infection (UTI) and recurrent fever without vesicoureteral reflux, came to our attention because of one emission of milky urine. Ultrasonography revealed a left obstructive staghorn stone (Fig 1). Metabolic assessments for urolithiasis and tubulopathies on urine sample (calcium-to-creatinine, cystine-to-creatinine, oxalate-to-creatinine, and citrate-to-creatinine ratios; β2-microglobulin; fractional excretion of sodium; and tubular reabsorption of phosphate) and blood (dosages of creatinine, calcium, phosphorus, uric acid, citrate-to-creatinine ratios, sodium-to-creatinine ratios, chloride-to-creatinine ratios, bicarbonate-to-creatinine ratios, 24-hour creatinine excretion, and cystine-to-creatinine ratios) were performed 1 month later revealed a partial resumption in renal function (18%). When he was 18 months old, the child suffered episodes of acute pain with inconsolable crying, unresponsive to paracetamol administration.

CASE REPORT

abstract

Milk of calcium is a viscous colloidal suspension of calcium salts that forms in dilated cysts or cavities. Few cases are reported in literature, with a range of ages from 21 to 65 years old. Younger patients (7–19 years old) were described with milk of calcium associated with other kinds of staghorn stones (eg, cystine stones). We present, for the first time in literature, a toddler with isolated milk of calcium and treated with a conservative approach.
Acid, parathormone, bicarbonate, and pH were normal. Because of absent function of the left kidney at mercapto acetyl tri glycine scintigraphy, a JJ stent was positioned. The surgeon reported a leak of whitish material immediately after the stent positioning. Renal scintigraphy performed 1 month later revealed a partial resumption in renal function (18%). The stent was removed 2 months later.

At the age of 18 months, he presented a new episode of fever (up to 39°C) with a urine dipstick positive for leukocytes. At admission, he appeared pale and with poor appetite. Blood tests revealed C-reactive protein at 0.3 ng/mL, procalcitonin at 0.5 ng/mL, white blood cells at 13 940 per µL, and neutrophil count of 6440/µL. Intravenous ceftazidime (150 mg/kg per day) was started. By the third day, the child suffered episodes of acute pain with incoherent crying, unresponsive to paracetamol administration but well responsive to ketorolac administration. Ultrasound assessment revealed calyceal dilation of the left kidney with evidence of staghorn stone inside is shown.

**FIGURE 1** Ultrasound image. Calyceal and pelvic dilation of the left kidney with evidence of staghorn stone inside is shown.

tuberculosis complex on urine sample were negative.

After the expulsion of the soft formations, pain episodes stopped, and an ultrasound assessment performed one month later revealed medium and low calyceal dilation with hyperechoic content without posterior acoustic shadowing and a reduction in pelvic dilation (8 mm). The diagnosis of milk of calcium was made because of the peculiar consistency of the material expelled by our patient.

The radiograph diffraction spectroscopy (XRD) of the expelled material revealed the presence of hydroxylapatite, the calcium phosphate with the formula Ca₅(PO₄)₃(OH), as the main crystalline component (Fig 5A). The scanning electron microscopy (SEM) with qualitative chemical analysis by energy-dispersive spectroscopy (EDS) revealed nuclei of hydroxylapatite (Fig 5B and EDS spectrum 1) and of calcium oxalates (Fig 5C and EDS spectrum 1) enclosed in a material composed of calcium, phosphorus, sodium, chlorine, sulfur, and potassium, as well as carbon and oxygen (Fig 5B, EDS spectrum 2, and EDS spectrum 1). This material is mostly amorphous because of the absence of significant reflections in the XRD pattern other than hydroxylapatite and made of, at least in part, a mixture of small amounts of organic compounds such as calcium oxalates (ie, whewellite and/or weddelite; see the peaks of calcium, carbon, and oxygen in spectrum 2 of Fig 5B and in spectrum 1 of Fig 5C), sodium chloride, potassium chloride, and undetermined sulfur (probably enclosed in amino acids dissolved in the amorphous substance). The occurrence of some form of calcium carbonate component, although not detected by the XRD analysis or SEM observations, is also compatible with the composition of analyzed samples.

**DISCUSSION**

To our knowledge (after we conducted research on Medline, PubMed, and relevant specialty journals [all from 1980 to September 2019] and used “milk of calcium,” “soft calculi,” “children,” “urolithiasis,” and “nephrolithiasis” as key words), our patient is the first toddler with isolated milk of calcium. The milk of calcium occurrence in calyceal diverticula and renal cysts has been well described, whereas there are few reports associated with hydronephrosis. Most of the cases reported in literature are unilateral, although rare bilateral cases are described. The etiology is still unclear, but urine stagnation, obstruction, and infection could promote the formation of milk of calcium. We excluded other causes of staghorn stones because of their appearance and consistency. Struvite stones (that occur after UTIs by urease-producing organisms) and cystine stones are harder, and they infrequently shatter and are expelled spontaneously. Moreover, cystine, oxalate, and other solute excretions were normal in our patient. We had to include tuberculosis renal abscess in the differential diagnosis because it can present itself with sterile pyuria and collecting system, and the ureter can be filled with calcified caseating material. Anyway, we ruled out the hypothesis of tuberculosis infection through specific examinations. The urine culture was sterile, but we
could hypothesize that the febrile episode preceding emission of the soft formations could have been determined by a pyelonephritis confined to the upper urinary tract because of the obstruction of the left urinary tract. Moreover, the culture of the greenish urines was sterile probably because the urines were expelled by the fourth day of ceftazidime.

The analysis of the expelled material throughout combined XRD and SEM-EDS analyses revealed nuclei of hydroxylapatite and calcium oxalates enclosed in mixed material with mainly amorphous and organic composition, which reveals a qualitative chemical composition with calcium, phosphorus, sodium, chlorine, sulfur, potassium, carbon, and oxygen. At the moment, no previous reports of XRD and SEM-EDS analyses are available in cases of milk of calcium. However, in the available reports in which the expelled material was biochemically analyzed, authors described the presence of calcium carbonate in fine colloidal suspension, calcium phosphate, mixed carbonate and oxalate of calcium, carbonate and triple phosphate, calcium monohydrated with uric acid, and triple phosphate.2,3,5,6

On the basis of our findings (Fig 5), we could hypothesize that a calculogenic matrix composed of urine mucoproteins, urinary solutes, and other secretions could promote precipitation of calcium, carbonate, phosphate (hydroxylapatite), oxalate, etc, determining the formation of milk of calcium.

Examining our case a posteriori, the initial anamnestic data of milky urine and renal calculus and the emission of whitish material immediately after the stent positioning could be considered as “red flags” of milk of calcium.

The emission of soft formations or milky urine generally steers the

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**FIGURE 2**
Ultrasound images. A, Calyceal dilation of the left kidney with particulate and inhomogeneous content (asterisks). B, Left pelvic dilation with a pelvic anteroposterior diameter of 18 mm. C, Suspended echogenic debris in the bladder (arrow) and dilated left distal ureter with particulate matter (arrowhead).

**FIGURE 3**
Some of the soft formations expelled by the patient during hospitalization.

**FIGURE 4**
Sample of greenish urine.
diagnostic suspicion. However, Patriquin et al\(^1\) described the use of gravity-dependent sonography in urinary milk of calcium: it results in a highly echogenic focus with a strong acoustic shadowing that moves when a patient is scanned in various positions. Computed tomography (CT) can reveal a typical crescent-shaped dense pattern because of gravitational effect on the colloid suspension of calcium salts.\(^2\)

However, general concern over patient radiation exposure has been raised. Low-dose CT, recently introduced in clinical practice, seems to maintain high diagnostic accuracy, sensitivity, and specificity despite significant radiation dose reduction compared to standard-dose CT.\(^3\) It provides information about stone density and localization and urinary tract morphology, and it could be useful when surgical intervention is needed. Therefore, low-dose CT could become the gold standard for the diagnosis.

The main goal of treatment of milk of calcium is preservation of renal function. Nephrectomy has been considered as a treatment option,\(^3\) but it is obviously not acceptable in a kidney with residual function. Extracorporeal shockwave lithotripsy is unsuccessful in this condition.\(^10\) Percutaneous nephrostomy is considered an effective modality of treatment; when obstruction to urinary flow is present and there is poor kidney function, it could be considered to possibly improve renal function after relief of obstruction.\(^3\)

In our patient, after performing mercapto acetyl tri glycine scintigraphy, despite absent function of the left kidney being observed, a JJ stent was positioned in the left urinary tract instead of immediate left nephrectomy to evaluate a possible renal function recovery. This approach revealed a leak of whitish material after stent position and improvement in renal function (from 0% to 18%) at renal scintigraphy after 1 month. Accordingly, we can suggest considering this conservative approach for milk of calcium if the stent positioning is an achievable option.

Antibiotic prophylaxis and ketorolac\(^11\) could be considered in case of recurrent UTIs and renal colic, respectively.

**CONCLUSIONS**

Milk of calcium is a rare disease that can occur also in toddlers. The morphology of the expelled material is pathognomonic and makes milk of calcium easy to recognize (if known). In a patient that has not expelled the pathognomonic soft material yet, milky urines could help in the diagnostic suspect and ultrasound assessment (highly echogenic focus with a strong acoustic shadowing that
moves when the patient is scanned in various positions), and low-dose CT can be helpful to validate the diagnosis. It is important to recognize milk of calcium to preserve as best as possible the renal function by having a conservative approach (i.e., stent position instead of nephrectomy also in case of obstructive staghorn stone and absent renal function) and avoiding unnecessary treatments (i.e., extracorporeal shockwave lithotripsy).

**ABBREVIATIONS**

CT: computed tomography  
EDS: energy-dispersive spectroscopy  
SEM: scanning electron microscopy  
UTI: urinary tract infection  
XRD: radiograph diffraction spectroscopy

**REFERENCES**

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