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Case Report

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Ureterocele Complicated by Ureteral Calculi: A Case Report with Morpho-Constitutional Analysis of Calcium Oxalate Dihydrate and Carbapatite Composition Calculi

Abdelaali Belhachem,[1,2,4]* Mahammed Mehdid,[3] Naima Mankor,[2] Amina Amiar,[2] Fatma Boudia,[2,4] Houari Toumi[2,4]

[1]Pharmaceutical Inorganic Chemistry Laboratory, Faculty of Medicine, University of Oran 1, Algeria

[2]Pharmacovigilance department, University Hospital Establishment of Oran, EHU-O, Algeria

[3]Private Practice of Urology Dr MEHDID, Oran, Algeria

[4]Pharmaceutical Development Research Laboratory, University of Oran 1, LRDP-ORAN, Algeria

Abstract

Introduction: Ureterocele is a congenital abnormality characterized by cystic dilation of the ureter, which predisposes patients to urinary stasis, infections, and the formation of stones. It occurs in approximately 1 in 4,000 individuals, with a higher prevalence in women.

Case Presentation: A 41-year-old woman with hypertension presented with a ureteral stone associated with a ureterocele, which was diagnosed through imaging studies. Laboratory findings were within normal limits, revealing that the stone was composed of calcium oxalate dihydrate (Weddellite) and Carbapatite. The stone was removed via endoscopy subsequently analyzed using Fourier-transform infrared spectroscopy (FTIR) and optical microscopy.

Discussion: Ureteroceles create conditions conducive to stone formation due to urinary stasis and altered urine flow. In this case, the absence of infection suggests that stasis was the primary mechanism behind the formation of the stones.

Conclusion: Timely diagnosis and surgical intervention are essential for preventing recurrent stones and preserving renal function in patients with ureteroceles.

Keywords: Ureterocele, Calculi, FTIR, Weddellite, Carbapatite

Introduction

Ureterocele is a congenital abnormality characterized by cystic dilation of the lower ureter, often associated with other structural anomalies such as a stenotic ureteric orifice or a duplicated urinary system.[1] These abnormalities can lead to clinical complications, including obstruction, reflux, incontinence, and impaired renal function.[2] Ureteroceles are classified based on their location as either intravesical (orthotopic) or extravesical (ectopic), with extravesical ureteroceles being more common and typically associated with a duplex collecting system.[3] This condition affects approximately 1 in 4,000 individuals and is four times more prevalent in females.[4] The dilation of the distal ureter can lead to urinary stasis, predisposing patients to recurrent urinary tract infections and stone formation.[3] Although rare, intravesical ureteroceles with stones may mimic vesical calculi, complicating diagnosis and treatment. The aim of this case report is to outline the morphoconstitutional calculi caused by a ureterocele.

Case Report

A 41-year-old woman with high blood pressure accompanied by septal hypertrophy, presenting a body mass index (BMI) of 27,31 (height: 169 cm, weight: 78 kg), is classified as to be an overweight.[5] Blood samples tests revealed normal levels of calcium,

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***Corresponding author:** Abdelaali Belhachem, Pharmaceutical Inorganic Chemistry Laboratory, Faculty of Medicine, University of Oran 1, Algeria

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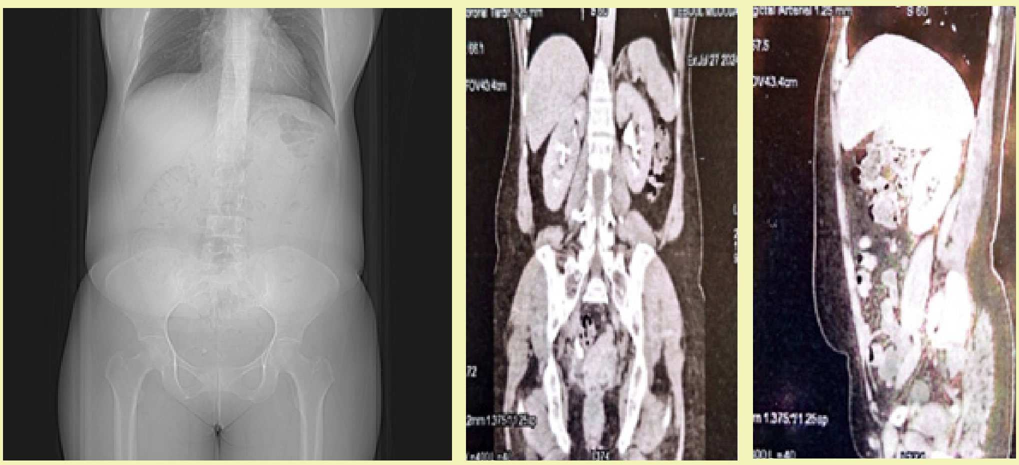
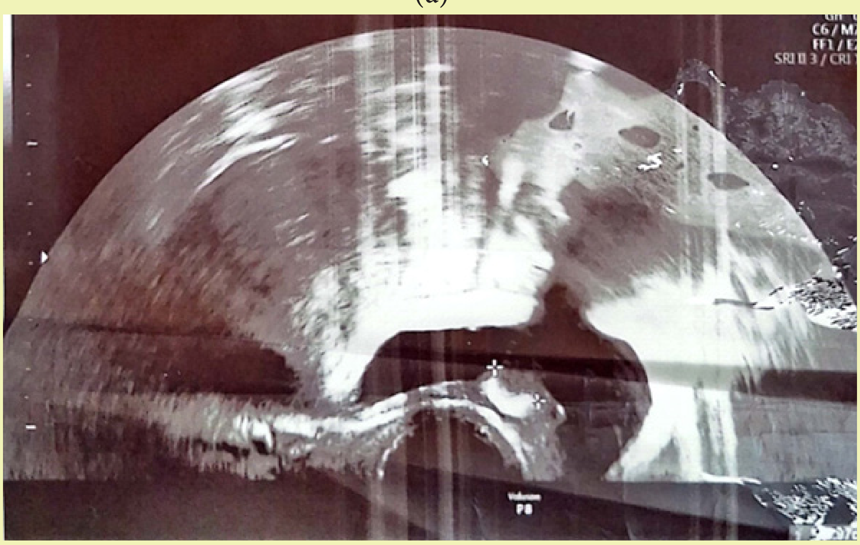
and normal potassium, sodium, magnesium, phosphate, creatinine, and urea. For the urine cytobacteriological exam (ECBU), the microscopic examination revealed a clear appearance. Cytological analysis identified the presence of calcium oxalate crystals, with no leukocytes observed. Rare epithelial cells and red blood cells were noted. The bacteriological findings indicated no evidence of a urinary tract infection. The uro-CT of the patient presents with a urinary stone at the right ureterovesical junction, measuring 7.8 x 67.1 mm, causing minimal segmental dilation of the ipsilateral pelvic ureter. Contrast passage is observed in delayed images, indicating an incomplete obstruction. There is also focal thickening and regular contrast enhancement of the distal ureteral wall, consistent with ureteritis. Additionally, there is cystic dilation of the intramural portion of the distal right ureter, protruding into the bladder lumen, measuring 9.1 mm in thickness and 13.9 mm in length, suggestive of a ureterocele. Notably, the previously described stone is located within this ureterocele Figure 1.

The stone was removed through an endoscopic procedure. It weighed of 0,25g and was examined under an optical microscope (Gx10x40) to assess the morphology of its surface and cross-section. The stone exhibited a beige spiculated surface displaying aggregated bipyramidal crystals with right angles and sharp edges. The cross-section revealed pale loose radial crystallization Figure 2.

The infrared spectra were obtained using Fourier transform infrared spectroscopy coupled with attenuated total reflection (FTIR-ATR) (Perkin Elmer, Shelton, CT, USA) within the range of 450–4000 cm^{-1}. The acquired absorption spectrum is indicative of the molecular composition and potential crystalline structure of the sample Figure 3. It reveals a mixture of calcium oxalate dihydrate (weddellite) and Carbapatite. The spectrum displays characteristic peaks of calcium oxalate dihydrate at 1614.00 cm^{-1} and 1315.96 cm^{-1}, corresponding to C=O and C-O bond vibrations, as well as a peak at 778.7 cm^{-1} for out-of-plane bending. Additionally, the broad O-H stretching band at 3330.25 cm^{-1} confirms the presence of water in the crystal structure. Peaks at 1029.00 cm^{-1}, 561.84 cm^{-1}, and 514.09 cm^{-1} correspond to vibrations of phosphate groups, indicating the presence of carbonated apatite. These findings confirm that the stone is a mixture of calcium oxalate dihydrate and carbonated apatite.



(a)



(b)

Figure 1: (a) Uro-CT with a urinary stone at the right ureterovesical junction, (b) gynecological ultrasound shows a 1 cm bladder stone

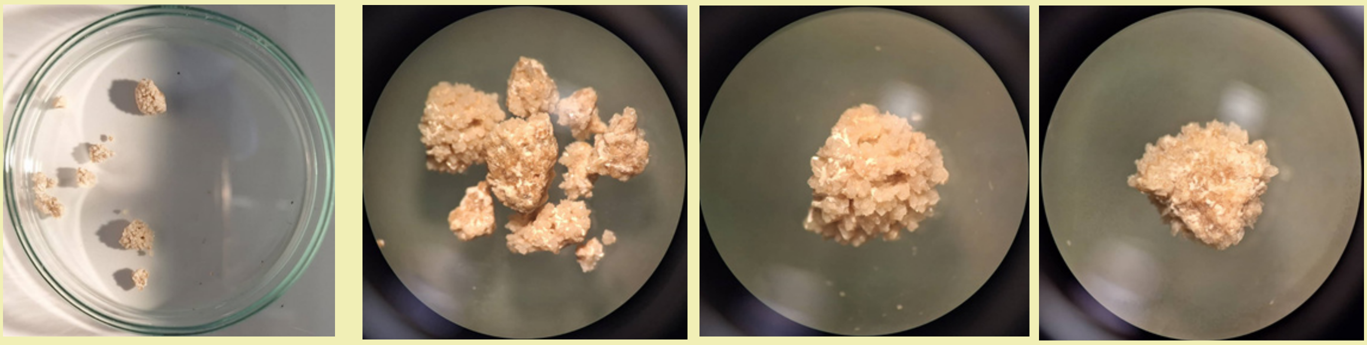


Figure 2: Surface and section of the calculi under optical microscope (10*40)

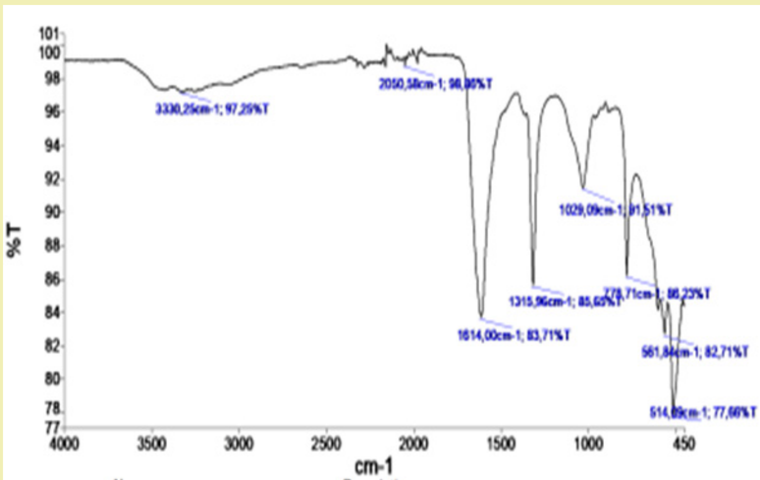


Figure 3: FTIR spectrums of the kidney stone

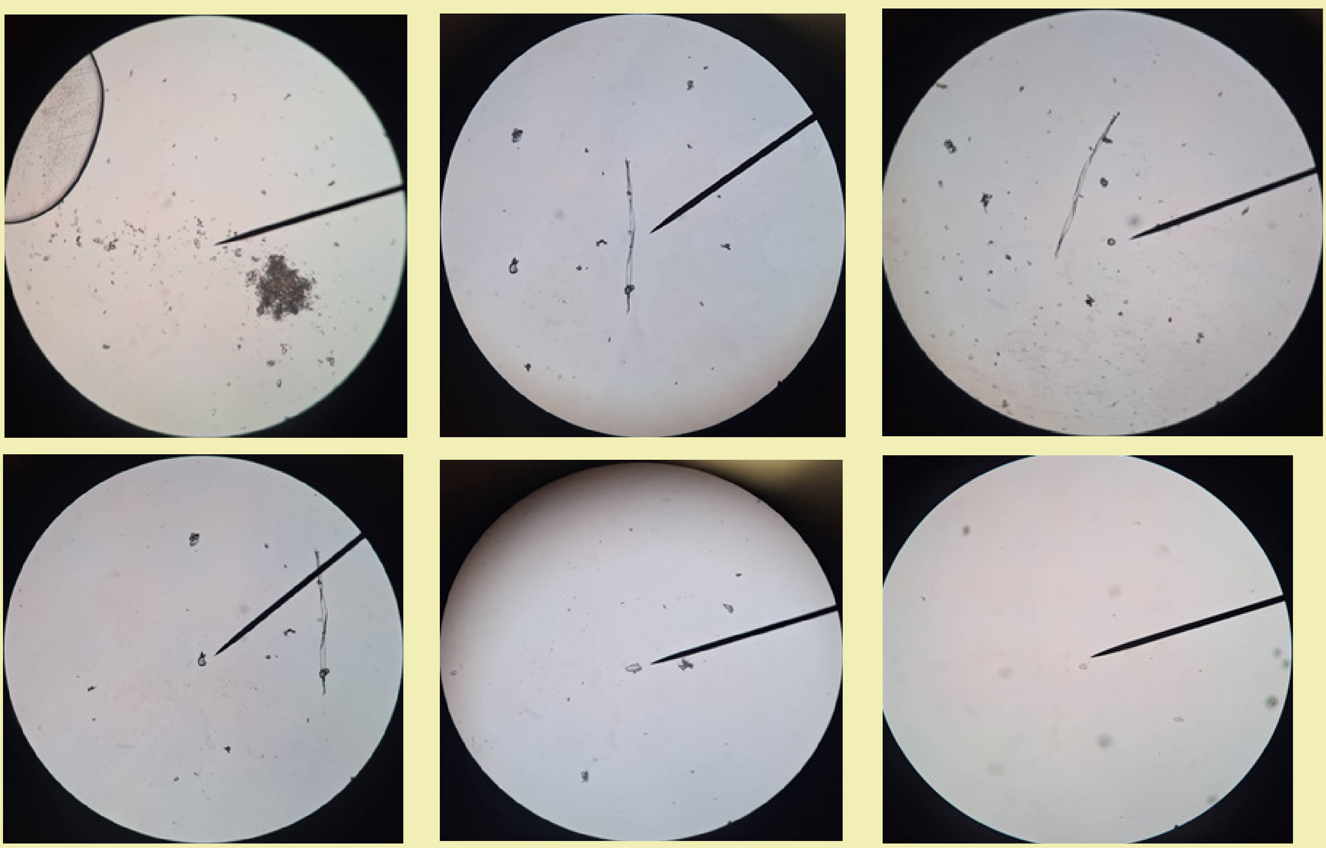


Figure 4: Crystals under optic microscope (G10*40)

Some of the calculi were dissolved in pure water and examined under a microscope to search for crystals Figure 4. The observed crystals were sharp, bipyramidal structures, suggesting the formation of calcium oxalate monohydrate, while elongated or needle-like formations indicated the presence of calcium phosphate, likely in the form of Carbapatite. These morphological observations align with the FTIR analysis of mixed calcium oxalate and calcium phosphate stones, providing valuable insight into the composition of the stones.

Discussion

In this case, the ureterocele was complicated by the formation of a ureteral calculus, a condition frequently reported in the literature, with an incidence ranging from 4% to 39%.[3,6] Ureteroceles are known to predispose patients to the development of stones due to urinary stasis and, in some instances, infection. The primary mechanism involves obstruction caused by the ureterocele, which leads to urine retention and stasis, thereby increasing the concentration of crystallizable substances such as calcium and oxalate.[7] This process promotes the formation of calcium oxalate crystals, the primary constituents of most renal calculi. Additionally, ureteroceles can disrupt the normal flow of urine, potentially causing infection and affecting the urinary pH. Calcium oxalate crystals are more likely to form in slightly acidic conditions, typically between pH 5.5 and 6.5. Although calcium salts are more soluble in acidic environments, oversaturation of calcium and oxalate ions can lead to crystal formation. Stones can also form in neutral pH, though they are less commonly found in alkaline environments.[8] Furthermore, prolonged urinary stasis and increased pressure within the ureter caused by the ureterocele may result in epithelial damage, creating nucleation sites that facilitate crystal aggregation and stone growth.[9] Metabolic factors may also contribute to this process, with some studies suggesting that patients with ureteroceles may exhibit abnormal urinary excretion of oxalate or increased intestinal absorption, further promoting stone formation. In our patient, these mechanisms likely played a central role in the development of the ureteral stone, underscoring the importance of addressing anatomical anomalies such as ureteroceles to prevent recurrent stone formation and related complications.[10]

Ureteroceles can create conditions that predispose patients to urinary tract infections, which, in turn, can lead to the formation of secondary phosphate calculi. The obstruction caused by the ureterocele results in urinary stasis, creating an environment conducive to bacterial growth and infection. Infections, particularly those caused by urease-producing bacteria such as *Proteus mirabilis*, can elevate the urinary pH, resulting in a more alkaline environment. This alkalinization promotes the precipitation of phosphate salts, including magnesium ammonium phosphate (struvite) and calcium phosphate, which contribute to the formation of phosphate calculi. These stones are often referred to as infection stones, as they commonly develop secondary to chronic or recurrent urinary infections. Therefore, patients with ureteroceles face, there is a risk of infection, which may subsequently promote the formation of phosphate stones due to altered urinary chemistry and pH.[11,12]

Conclusion

In conclusion, this case underscores the complexity of managing ureteroceles, particularly when complicated by stone formation. Ureteroceles, especially when associated with urinary stasis, create favorable conditions for the development of renal calculi due to the concentration of crystallizable substances such as calcium and oxalate. In our patient, the identified stone was composed of calcium oxalate dihydrate and carbonated apatite, both of which are common components of renal stones. The obstruction and prolonged stasis associated with the ureterocele likely contributed to the formation of this stone. Furthermore, the absence of infection, as indicated by the urine cytobacteriological findings, suggests that stasis, rather than infection, was the primary mechanism for stone formation in this case. While ureteroceles may also predispose patients to infections that could lead to secondary phosphate stone formation, this was not observed in our patient. Surgical intervention via endoscopy successfully facilitated the removal of the stone. This case highlights the importance of early diagnosis and the necessity of addressing both anatomical anomalies and potential metabolic or infectious contributors to prevent recurrent stone formation and preserve renal function.

Ethical Approval and Consent to Participate

Were not required for this kidney stone analysis as it involved the use of previously collected and anonymized clinical data. The research that involves the analysis of existing, de-identified data, without any direct patient interaction or intervention, does not necessitate ethical approval.

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Author Contributions

AAB, MM, and AA carried out the study, designed and conducted all laboratory analyses, interpreted experimental results, and prepared the manuscript. HT and FB supervised the study.

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Consent For Publication

All authors read and approved the final manuscript.

Declaration

During the preparation of this work, the authors used OpenAI's language model (Chat GPT and WordVice) in order to enhance the clarity and coherence of the manuscript. After using this tool, the authors reviewed and edited the content as needed and takes full responsibility for the content of the publication. **I**mportant to note that a close clinical and nutritional follow-up is advised for these population to prevent urolithiasis.

Competing Interests

The authors declare that they have no competing interests.

References

1. Wu K, Jing J. Recurrent adult urinary tract infection secondary to unrecognized ureterocele urolithiasis. *Uro Precision.* 2024;2(4):180-183.
2. Ghanem K, Leslie SW, Badreldin AM. Ureterocele. 2023.
3. Insuan P, Insuan W. An intravesical ureterocele with a large impact stone: a case report. *Insight Urology.* 2024;45(1):58-61.
4. Subihardi LME, Rahman IA, Yogiswara N, Rizaldi F. Prolapsed ureterocele mimicking a vulval mass in young female with complete duplex system and ureteral stone: A case report. *International Journal of Surgery Case Reports.* 2023;106:108087.
5. WHO. Classification for BMI. WHO. 2024.
6. Ezaki T, Hongo H. Spontaneous ureterocele wall rupture by a ureteral stone: A case report. *Urology Case Reports.* 2023;47:102330.
7. Khan SR. Reactive oxygen species, inflammation and calcium oxalate nephrolithiasis. *Translational andrology and urology*. 2014;3(3):256.
8. Evan AP. Physiopathology and etiology of stone formation in the kidney and the urinary tract. *Pediatric nephrology.* 2010;25:831-841.
9. De Coninck V, Keller EX, Rodríguez Monsalve M, et al. Evaluation of a portable urinary pH meter and reagent strips. *Journal of Endourology.* 2018;32(7):647-652.
10. Abdelaali belhachem MM, Amina Amiar, Houari Toumi. Gestion Des Calculs Urinaires Associes A L'ureterocele : Mecanismes, Traitements Et Prevention. EHU - Oran Algerie. 2024.
11. Schwaderer AL, Wolfe AJ. The association between bacteria and urinary stones. *Annals of translational medicine*. 2017;5(2):32.
12. Skolarikos A, Neisius A, Petřík A, et al. editors. Urolithiasis. EAU Guidelines Edn presented at the EAU Annual Congress Amsterdam. 2022.