Case Report

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# Struvite ureterolithiasis associated with ureolytic bacterial pyelonephritis in a cat

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## Abstract

*Case summary* A 2-year-old female spayed domestic shorthair cat with a 1-week history of lethargy and dysorexia was presented to a veterinary teaching hospital. Physical examination identified severe left nephromegaly, hyperthermia and abdominal pain. Abdominal ultrasound revealed a left ureteral dilation due to obstruction by a ureterolith, associated with marked subcapsular effusion. Urinalysis showed alkaline urine with crystals of struvite. Culture of urine from the renal pelvis and the urinary bladder was positive for *Staphylococcus pseudintermedius*. An infected struvite ureterolith due to the presence of urease-producing bacteria was suspected. The ureterolith was removed via ureterotomy and a temporary ureteral stent was positioned in an antegrade fashion. Results of infrared spectroscopy showed pure struvite urolithiasis. The stent was removed via cystoscopy 35 days after surgery. The cat was still doing well at the 6-month follow-up.

*Relevance and novel information* To the best of the authors' knowledge, this is the first case of a struvite ureterolith due to ureolytic pyelonephritis in a cat.

**Keywords:** Ureterolith; ureteral stent; infected struvite; urease-producing bacteria

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## Introduction

In cats, ureterolithiasis is a common disease.[1] Calcium oxalate ureteroliths account for nearly 98% of all cases.[2] However, other types of ureteral calculi have also been described in cats, such as dried solidified blood, urate or apatite.[3,4] Struvite ureteroliths are believed to be a rare condition in cats, without any clinical description in case reports or studies in the veterinary literature. Struvite ureterolithiasis was however, mentioned in two series on feline uroliths submitted to urolith centres.[3,4] Moreover, feline struvite calculi are typically sterile, unlike canine struvite calculi, and rarely associated with urease-producing bacteria.[4] This case report describes the diagnosis, treatment and outcome in a cat with a struvite ureteral calculus associated with a ureolytic bacterial pyelonephritis and cystitis (*Staphylococcus pseudintermedius*).

## Case description

A 2-year-old female spayed domestic shorthair cat was presented to the emergency service with a 1-week history of lethargy and dysorexia. The cat was originally from Guadeloupe and had no relevant history. A rectal temperature of 40°C was recorded to first presentation at the referring veterinarian, who had administered an anti-inflammatory drug (meloxicam 0.2 mg/kg SC) and

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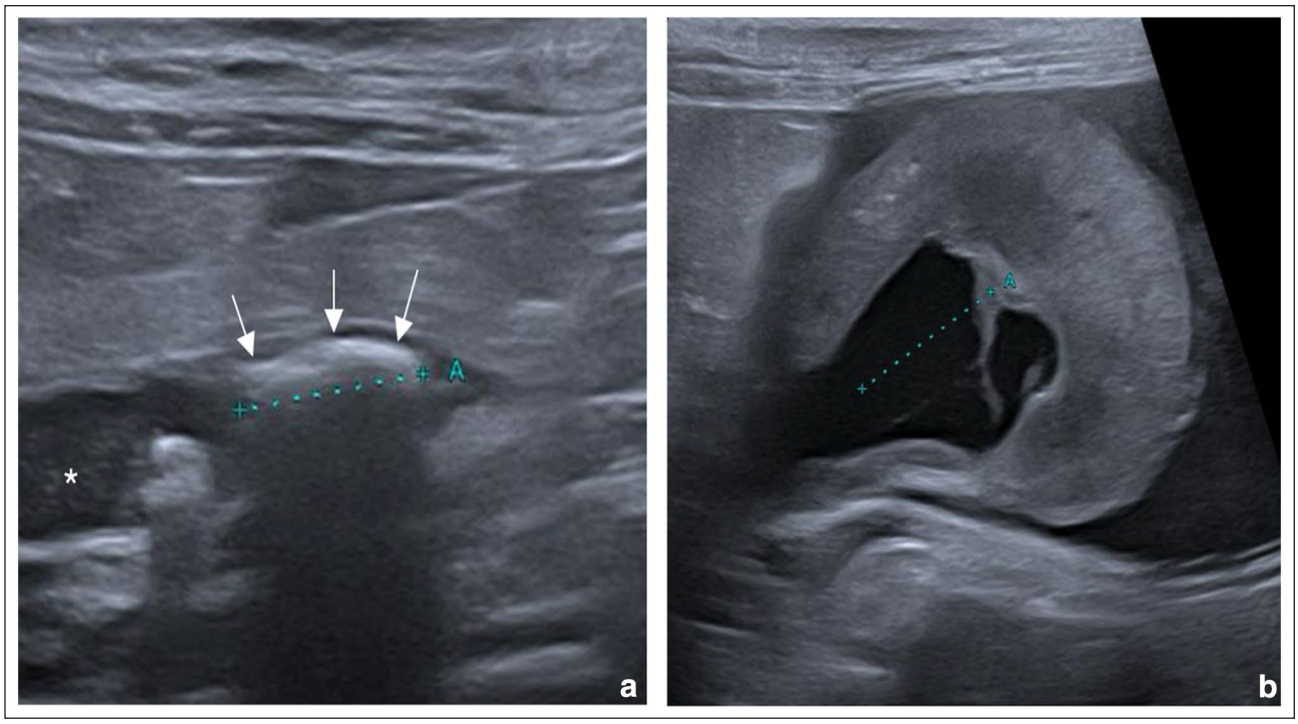


**Figure 1** B-mode ultrasound images of (a) the left ureter in the longitudinal plane and (b) the left kidney in the transverse plane, acquired using a linear array transducer (Canon Aplio A450). (a) A well-defined hyperechoic element 1 cm wide is causing strong acoustic shadowing within the ureteral lumen (ureteral calculus, arrows), associated with an upstream dilation by a heterogeneous particulate fluid (*). Peripheral steatitis is also noted. (b) A severe pelvic dilation (up to 1.2 cm) containing a heterogeneous echogenic fluid is associated with a severe heterogeneous subcapsular effusion, with multiple amorphous echogenic septa attached to the kidney. The renal capsule is markedly thickened with peripheral steatitis

initiated antibiotic therapy (amoxicillin and clavulanic acid 15 mg/kg SC) before referral.

The cat was presented 12 h later to the veterinary teaching hospital. Physical examination revealed severe abdominal pain, left nephromegaly, tachycardia (250 beats/min) and a normal rectal temperature (38.7°C), possibly after the treatments already initiated by the referring veterinarian.

A complete blood count (CBC) and serum biochemistry were performed at the veterinary school laboratory. Biochemical abnormalities included a mild hypercreatinaemia (143.44 µmol/dl, reference interval [RI] 45.76–156.64), increased serum amyloid A (SAA) (105.6 µmol/l, RI 0–10) and mild hyperglobulinemia (59 g/l, RI 26–51). The CBC showed a mild neutrophilic leukocytosis (33,190/mm$^3$, RI 2870–17,020). Cytological evaluation of a blood smear revealed mild toxic changes in the neutrophils.

An abdominal ultrasonographic examination (Aplio A450; Canon Medical System) was performed by a European College of Veterinary Diagnostic Imaging resident (VM). It revealed left ureteral dilation and an intraluminal hyperechoic structure associated with strong acoustic shadowing located in the cranial third of the left ureter, consistent with ureteral obstruction by a ureterolith. There was diffuse ureteral wall thickening, demonstrating ureteritis. Marked ipsilateral pelvic dilation (up to 1.2 cm) with heterogeneous echogenic material was also present. In addition, marked subcapsular effusion and mild perirenal effusion were observed. The wall of the urinary bladder was diffusely thickened and the content was echogenic, suggesting bacterial cystitis (Figure 1). Urine was collected via cystocentesis for analysis and culture.

Abdominal radiographs revealed a single, large (8 mm), smoothly marginated structure of mineral opacity in the area of the left ureter, associated with marked left nephromegaly (5 cm) (Figure 2). Based on the radiopacity, a struvite or urate ureterolith was suspected.[5]

Urinalysis revealed alkaline pH, a mildly low urine specific gravity (1.028, lower RI >1.035) and struvite crystals. Phagocytosis of cocci bacteria by neutrophils was detected in the urine sediment on cytological analysis. Quantitative urine culture was positive for *S pseudintermedius*, sensitive to amoxicillin and clavulanic acid. At this stage, infection-induced struvite due to urease-producing staphylococcal pyelonephritis was strongly suspected.

Medical management consisted of intravenous (IV) fluid therapy and analgesia (methadone, 0.2 mg/kg IV

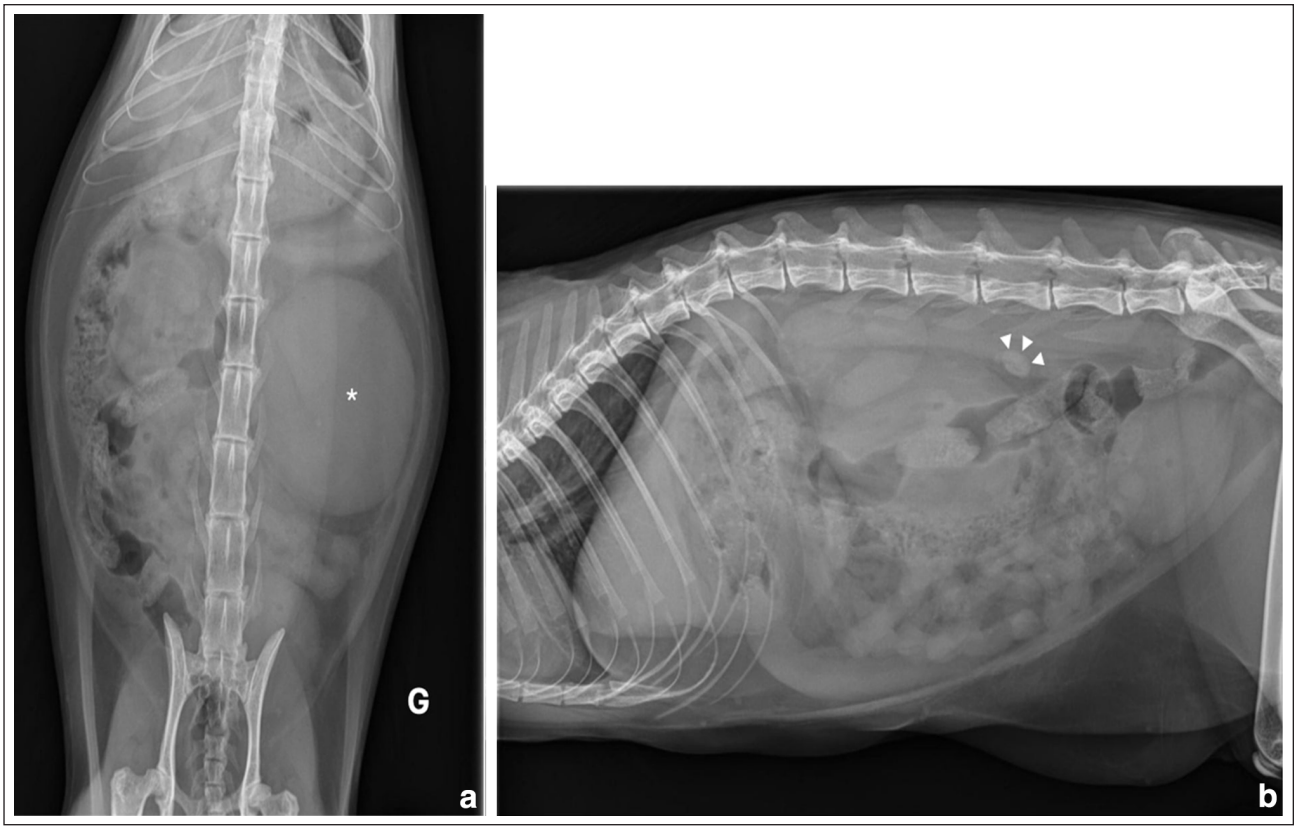


**Figure 2** (a) Ventrodorsal abdominal radiograph showing a marked left nephromegaly (up to 5 cm) (*) with renal asymmetry. (b) Left lateral radiograph showing a large (8 mm), smoothly marginated structure of mineral opacity located caudally to the kidneys in the area of the left ureter (arrowheads)

q4h), which normalised the heart rate within 12 h. Additional medical management included antiemetic therapy (maropitant, 1 mg/kg IV q24h), antibiotics (amoxicillin and clavulanic acid, 20 mg/kg IV q8h) and an appetite stimulant (transdermal mirtazapine q24h).

A left ureterotomy via a ventral midline coeliotomy was performed 2 days after presentation. One large, smooth, grey urolith was removed from the left ureter and the ureterotomy was subsequently closed in a transverse fashion using an 8-0 polyglycolic suture. A 2.5 Fr soft double pigtail multifenestrated ureteral stent was then positioned in an antegrade fashion from the renal pelvis to the urinary bladder.

Urine from the renal pelvis was collected during surgery and culture was positive for *S pseudintermedius*, sensitive to amoxicillin and clavulanic acid. Results of infrared spectroscopy (Vet'Analysis) showed that the urolith was composed solely of struvite.

Based on these findings, a diagnosis of ureteral obstruction by a struvite ureterolith was made. The presence of concomitant pyelonephritis and cystitis due to *S pseudintermedius*, a urease-producing bacterium, was highly suggestive of an infection-induced ureterolith.

The cat was kept on IV fluids, antibiotics and analgesia. Renal blood parameters were repeated 2 days postoperatively and showed no abnormalities (creatinine 105.6 µmol/l, SAA 31 µg/l). Ultrasonography revealed a reduction in the size of the left renal pelvic dilation (up to 7 mm), resolution of the subcapsular effusion and reduced signs of inflammation of the urinary tract. The cat was therefore discharged 3 days postoperatively with non-steroidal anti-inflammatory drugs for 3 days (meloxicam, 0.1 mg/kg PO q24h) and antibiotics for 2 weeks (amoxicillin and clavulanic acid, 15 mg/kg PO q12h).

At the 2-week follow-up, the owner reported haematuria and pollakiuria. Bacterial urine culture was negative. An ultrasonographic examination revealed severe left-sided ureteritis, cystitis and mild renal pelvic dilation (2.5 mm vs 1.2 cm initially), possibly due to the presence of the ureteral stent (Figure 3).

The ureteral stent was removed under cystoscopic examination 35 days after surgery.

No recurrence of the lower urinary tract signs was reported by the owner 7 days after the removal of the ureteral stent. An email follow-up 6 months after discharge revealed no recurrence of clinical signs.

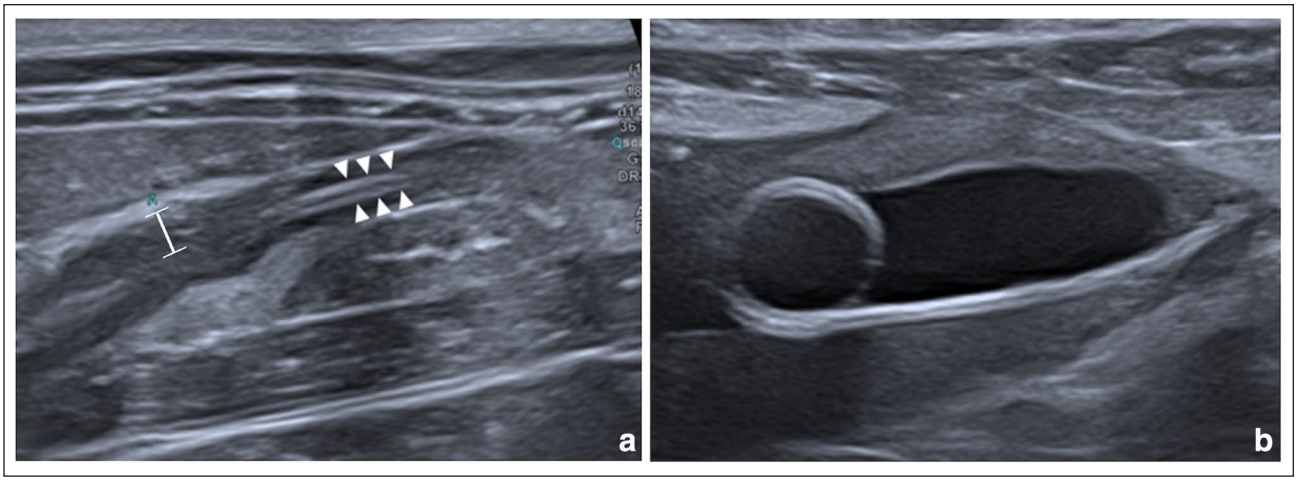


**Figure 3** B-mode ultrasound images of (a) the left ureter in the longitudinal plane and (b) the bladder, acquired using a linear array transducer (Canon Aplio A450). (a) The ureteral wall appears markedly thickened (up to 1.5 mm, calipers), heterogeneous and irregular, with a peripheral steatitis. The ureteral stent is also visualised (arrowheads). (b) The ureteral stent is visible protruding into the bladder lumen, forming a loop; this is associated with marked bladder wall thickening (up to 7.6 mm) and a peripheral steatitis. Hyperechoic foci are observed within the cranioventral pole of the bladder wall (sutures)

## Discussion

Urolithiasis is the most common cause of ureteral obstruction in cats, with calcium oxalate calculi accounting for over 98% of cases.[1,2] Struvite uroliths have previously been reported in the upper urinary tract of cats. Nevertheless, according to two studies on large populations of cats, their proportion is low, in the range of 1–8%.[3,4] Moreover, clinical reports of ureteral struvite calculi in cats have not been published in the veterinary literature; these data are exclusively extracted from series of analyses conducted by diagnostic laboratories.

Urease-producing bacterial infection inducing the formation of a struvite urinary calculus is a rare phenomenon in cats compared with dogs, accounting for only 7% of cases.[4] To the best of the authors' knowledge, no data regarding the presence of a potential ureterolith associated with ureolytic bacterial pyelonephritis exist.

In this cat, urine cultures obtained from the urinary bladder and the renal pelvis were positive for the same *S pseudintermedius* strain, suggesting a link between these two infections. While, in cases of primary bladder infection, a struvite urolith within the urinary bladder might have been expected before the formation of a renal pelvic or ureteral urolith, ultrasonography and cystotomy did not reveal a urinary bladder urolith in this cat, suggesting that the pyelonephritis might have been primary. However, in this case, there was no anamnestic or clinical evidence of pre-existing conditions that would have predisposed the cat to develop urinary tract infections.

Subcutaneous ureteral bypass (SUB) is the standard surgical procedure in cases of ureteral obstructions in cats.[6–8] However, in this report, ureterotomy was performed together with the placement of a ureteral stent.

This choice was prompted by several factors. One of them was the identified pyelonephritis. Although it does not seem to be an absolute contraindication according to the veterinary literature, the insertion of foreign material into a septic environment is generally discouraged owing to potential complications.[9] Furthermore, the placement of a SUB device in cats with pyelonephritis diagnosed before surgery is associated with an increased risk of subsequent urinary tract infections.[7] Another factor, and the most important one, was the strong suspicion of a struvite ureterolith secondary to pyelonephritis caused by urease-producing bacteria. This obstructive episode was, therefore, unlikely to be associated with a chronic underlying lithiasis that would have warranted the placement of a SUB device because of the high risk of recurrence.[10] In addition, it was considered unlikely that a new episode of ureolytic bacterial pyelonephritis would develop in the future and lead to a new ureterolith of the same type. Finally, the suspicion of an infected urolith that could have contributed to recurrent urinary tract infection led to the decision to perform surgical removal.

The placement of the ureteral stent was performed to reduce the risk of urinary leakage and stenosis at the surgical site, which is a common complication of ureterotomy.[11] While long-term or definitive ureteral stenting is commonly described in feline medicine, the stent was removed because of the low expected risk of recurrence

of ureteral obstruction in this case and because of the high risk of encrustation of the stent.[11,12] Indeed, in human medicine, more than 75% of ureteral stents become encrusted within 2 weeks of placement and may contribute to the inflammatory response induced by the presence of the foreign material.[13] The same process is suspected in feline medicine, though is significantly less documented. In this report, the cat had a negative urinary culture at follow-up but showed marked pollakiuria and severe signs of ureteritis and cystitis on ultrasound examination. These findings prompted the removal of the stent via cystoscopy 35 days after surgery.

## Conclusions

To the best of the authors' knowledge, this case report is the first description of a struvite ureterolith caused by the presence of ureolytic bacterial pyelonephritis in a cat. This is a rare condition that was suspected on the basis of urinalysis results and the radiopacity of the ureterolith. The low risk of recurrence prompted the removal of the ureterolith via ureterotomy. A ureteral stent was placed to reduce the risk of postoperative complications and the decision to remove it was influenced by the high risk of encrustation. Follow-up indicated that the cat was still doing well 6 months later.

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**Ethical approval** The work described in this manuscript involved the use of non-experimental (owned or unowned) animals. Established internationally recognised high standards ('best practice') of veterinary clinical care for the individual patient were always followed and/or this work involved the use of cadavers. Ethical approval from a committee was therefore not specifically required for publication in *JFMS Open Reports*. Although not required, where ethical approval was still obtained, it is stated in the manuscript.

**Informed consent** Informed consent (verbal or written) was obtained from the owner or legal custodian of all animal(s) described in this work (experimental or non-experimental animals, including cadavers, tissues and samples) for all procedure(s) undertaken (prospective or retrospective studies). For any animals or people individually identifiable within this publication, informed consent (verbal or written) for their use in the publication was obtained from the people involved.

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