Case Report

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Urethral obstruction and urolithiasis associated with patent urachus in a 12-week-old kitten

Lindsey E Lavin, Amanda R Amore and Stephanie L Shaver

Abstract

Case summary A 12-week-old intact male domestic shorthair kitten presented for dysuria. The patient had a urethral obstruction that was relieved with urinary catheter placement. A cutaneous opening at the umbilicus was identified. Three-view abdominal radiographs and a contrast study revealed a patent urachus with no evidence of urine leakage into the abdomen. An exploratory laparotomy was performed that confirmed a patent urachus, which was excised, and cystic and urethral calculi, which were removed via cystotomy. The patient recovered well from surgery, with a 12 h period of stranguria occurring 2 days postoperatively, attributed to residual inflammation. Calculi analysis revealed struvite stones, likely secondary to infection and inflammation. At the time of writing, 3 months postoperatively, the kitten had one episode of hematuria and inappropriate urination, which resolved with a short course of non-steroidal anti-inflammatory drugs, but had been otherwise been asymptomatic and healthy.

Relevance and novel information To our knowledge, this is the first report of urolithiasis and patent urachus in a pediatric feline patient. Based on the occurrence of struvite stones in the presence of a patent urachus in an animal of this age, we suspect that chronic infection and inflammation led to the development of urolithiasis. Correction of the patent urachus resulted in almost complete resolution of clinical signs and no crystal formation was appreciated on recheck urinalysis.

Keywords: Feline congenital abnormality; patent urachus; pediatric urolithiasis; urethral obstruction

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Introduction

The urachus, a tube-like structure, lies within the umbilical cord and is closely associated with the umbilical arteries and veins.[1] It acts as a passageway from the fetal urinary bladder to the allantoic cavity.[1] When the umbilical cord is transected at birth, closure of the urachus occurs. If the urachus does not close after birth, then an animal has a patent or persistent urachus.[2]

Patent urachus is a congenital anomaly reported in many mammalian species, including cats.[3–5] Patent urachus in cats is a communication between the umbilicus and the urinary bladder,[2–7] which may also include a communication between the urinary bladder and peritoneal cavity.[5] Additionally, urachal diverticulum, in which a macroscopic or microscopic defect of the bladder apex forms as a result of a portion of the urachus failing to close, has been described in cats.[6] Both of these anomalies have been associated with recurrent urinary tract infections (UTIs) and urolithiasis.[3,4,6] Patent urachi, in particular, have been associated with omphalitis,[4,6] ventral abdominal dermatitis[7] and peritonitis.[5] Urolithiasis has been reported concurrently with patent urachus in one adult cat; however, in that case, it was hypothesized that

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chronic stranguria led to patency of a previously quiescent urachal anomaly.[3] To our knowledge, this is the first report of urolithiasis and a patent urachus in a pediatric feline patient.

Case description

A 12-week-old intact male domestic shorthair kitten presented for vocalization and lack of urination. The stray kitten was found 4 days prior to presentation and had been urinating and defecating without issue for 2 days. On the third day, vocalizing in the litterbox, stranguria and decreased urine production were noted, without hematuria.

At the referring veterinary clinic, an enlarged, firm bladder and 'blister' over the umbilicus were diagnosed. The red, raised, 'blistered' area expressed clear fluid when pressure was applied to the abdomen. On abdominal palpation, a structure was noted, extending from the umbilicus to caudal abdomen. Manual bladder expression was performed under sedation and a urethral plug was released. During expression, fluid continued to flow from the 'blister'. A 3.5 F indwelling rigid polyurethane urinary catheter (TomCat catheter; MILA) was placed to prevent further obstruction. Urinalysis and chemistry panel revealed proteinuria (500 mg/dl; reference interval [RI] negative), pyuria (>50/high-powered field [hpf]; RI 0–3/hpf), hematuria (>50/hpf; RI 0–3/hpf), marked rods on urine cytology, a mildly increased blood urea nitrogen (35 mg/dl; RI 16–33 mg/dl) and hyperkalemia (7.1 mmol/l; RI 3.7–5.9 mmol/l). Complete blood count (CBC) was unremarkable. Cefovecin (Convenia; Zoetis) subcutaneously (SC) at 10 mg/kg and dexamethasone (Azium; Schering-Plough) SC at 0.5 mg/kg were administered. The patient was hospitalized overnight and discharged the following morning for evaluation at a referral center.

On presentation to the referral center, the kitten was bright, alert and responsive, painful on abdominal palpation and had a 1 × 1 mm inflamed, moist area around the umbilicus (Figure 1). A rigid urinary catheter without collection system was in place; the patient was producing red-tinged urine. The perineum, ventral abdomen and tail were wet with urine. Bilateral medial strabismus and bilateral forelimb polydactyly were also noted. The kitten postured to urinate multiple times with increasing vocalization each time. The urinary catheter was replaced under sedation with a polytetrafluoroethylene flexible urinary catheter (Slippery Sam Tomcat urinary catheter; Patterson Veterinary) and a sterile closed collection system. A coccygeal epidural was attempted but was unsuccessful. Repeat CBC was unremarkable and chemistry panel revealed hyperglycemia (175 mg/dl; RI 70–150 mg/dl). Hyperkalemia and azotemia had resolved.

Three-view abdominal radiographs were obtained, which revealed the urinary catheter extending beyond the margins of the bladder and terminating at the umbilicus (Figure 2). Subsequently, a contrast study was performed, which identified contrast within the urinary bladder and external to the body wall with no evidence of contrast leaking into the abdomen (Figure 3). Though the diagnosis of patent urachus was inferred from these radiographs, the contrast study was unsuccessful at highlighting the structure of the urachus. Several radiolucent filling defects were also noted within the bladder. Differential diagnoses included air bubbles from the introduction of contrast vs calculi. The radiologist suspected that the large filling defects were air bubbles, but smaller defects near the urinary catheter may have been calculi.

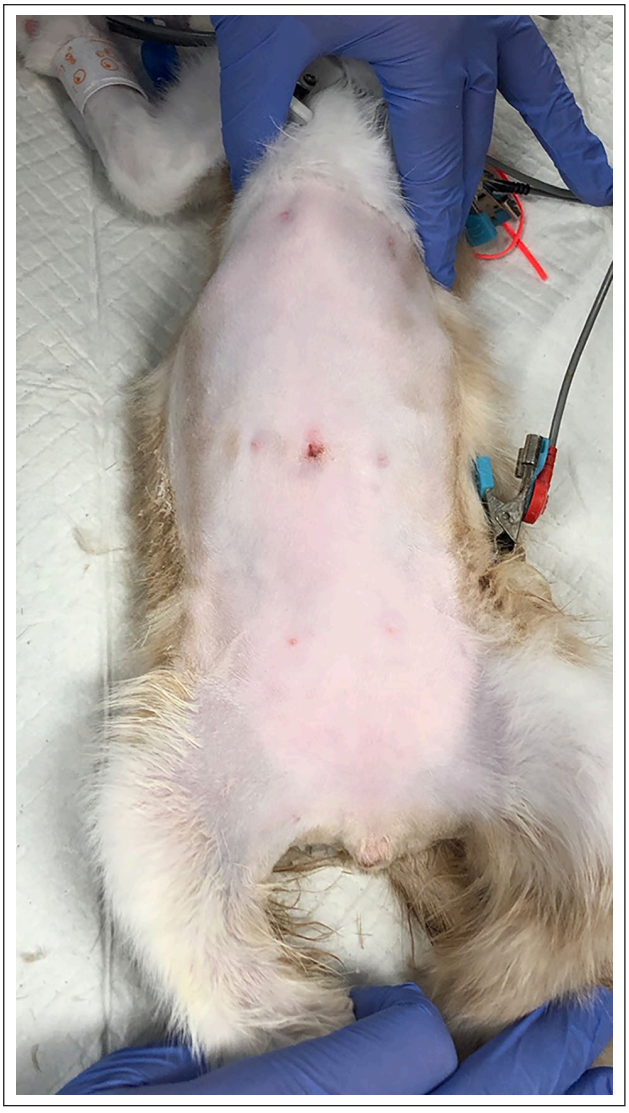

Figure 1 Patient after preoperative clipping and aseptic preparation of the ventral abdomen. A 1 × 1 mm area of erythematous, inflamed tissue is observed, associated with the umbilicus

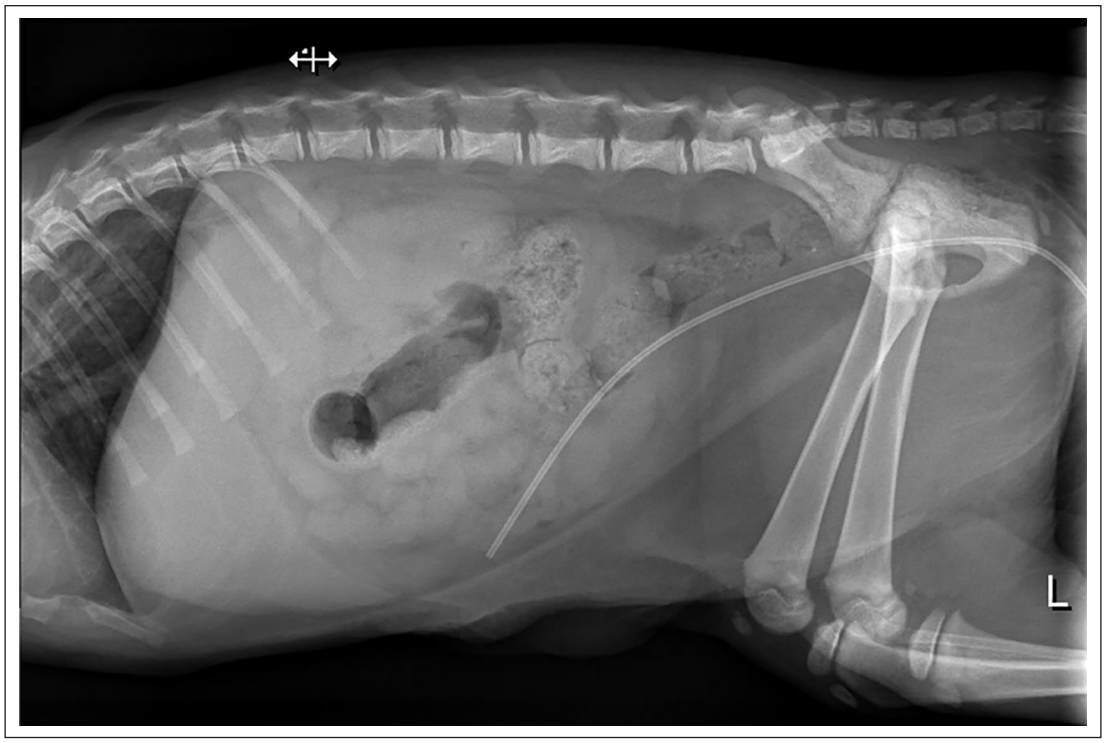

Figure 2 Left lateral abdominal radiograph revealing extension of the urinary catheter beyond the apex of the bladder and extending towards the umbilicus

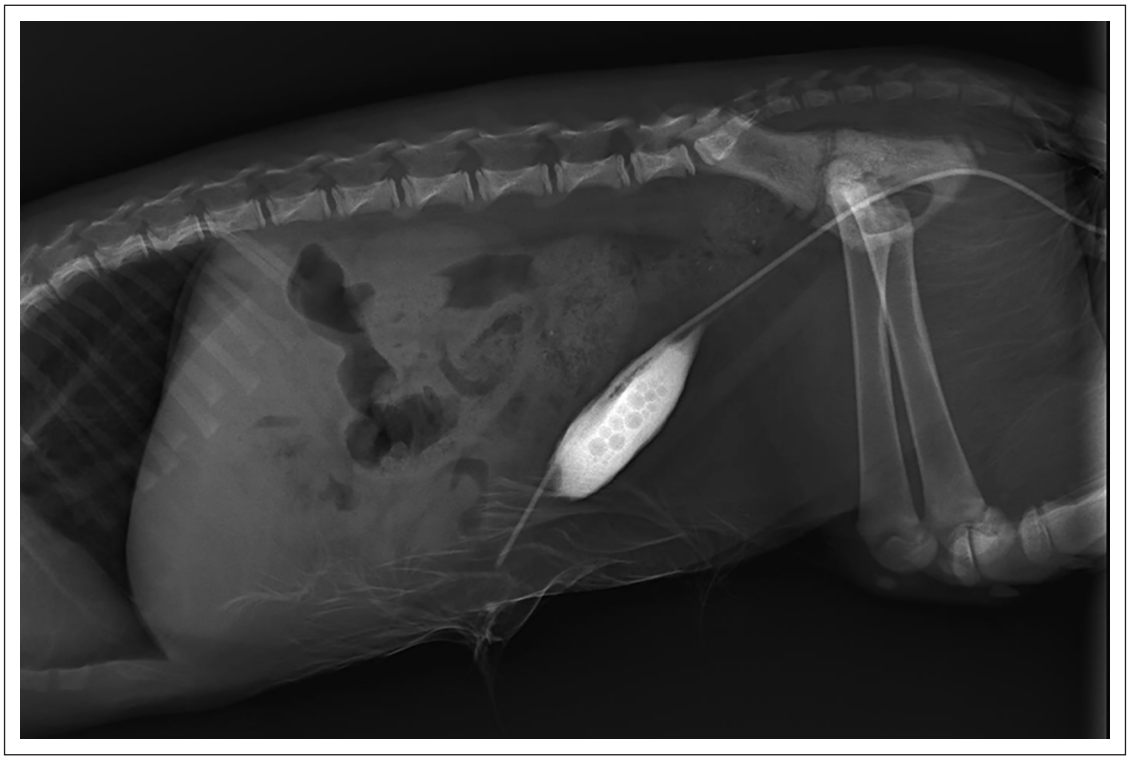

Figure 3 Left lateral abdominal radiograph revealing contrast leaking out of the umbilicus onto the ventral abdominal fur, with no evidence of contrast leaking into the peritoneal cavity. Radiolucent filling defects are observed throughout the bladder. The patent urachus is not specifically identified in this radiograph but is inferred based on extension of the urinary catheter beyond the bladder and presence of contrast on the surrounding fur

The following day, an exploratory laparotomy was performed. During the procedure, a patent urachus was confirmed and excised. Intraoperatively, a urethral obstruction and both cystic and urethral calculi were identified. The calculi were removed via cystotomy and the urethral obstruction was relieved. The patient was also neutered uneventfully. Postoperative recovery was routine. Treatment was started with maintenance crystalloid fluids (lactated Ringer's solution at 50 ml/kg/day) and methadone (Methadone hydrochloride; Mylan Institutional) at 0.1 mg/kg intravenously (IV) q4–6h for pain management. That evening, the pain management regimen was transitioned to buprenorphine (Buprenex; Reckitt Benckiser) at 0.02 mg/kg IV q6–8h and gabapentin (Neurontin; Pfizer) at 6.6 mg/kg PO q8–12h. The patient was discharged the following day with buprenorphine at 0.01 mg/kg PO q8–12h, gabapentin at 6.6 mg/kg PO q8–12h and amoxicillin/clavulanate potassium (Clavamox; Zoetis) at 13.75 mg/kg PO q12h.

The kitten re-presented to the referral hospital 2 days postoperatively for inconsistent stranguria, which resolved at home with oral gabapentin administration. In the hospital, moderate discomfort, pain on abdominal palpation and stranguria with urine production were noted. Stranguria was attributed to residual postoperative inflammation. No postoperative imaging was performed; therefore, persistent calculi were a possible contributing factor. Subcutaneous crystalloid fluids and dexamethasone sodium phosphate at 0.1 mg/kg SC were administered. No further complications or concerns were reported at surgical recheck and suture removal. The calculi analysis was consistent with 100% struvite composition. Urine culture and urinalysis 2 weeks postoperatively revealed no organism growth, specific gravity of 1.060 (RI 1.015–1.060), pH of 6.5 (RI 5.5–7.0) and no evidence of crystalluria. Recommendations were made to the owner to increase the kitten's water intake. A diet change was discussed; however, the owner did not pursue a prescription diet change at this time. Approximately 9 weeks postoperatively, one episode of hematuria and inappropriate urination was reported, which quickly resolved after treatment with a non-steroidal anti-inflammatory drug (NSAID), prescribed by the primary care veterinarian. The kitten was otherwise asymptomatic 3 months postoperatively.

Discussion

The urachus is an important fetal structure that should close after birth. Patent urachus in cats is infrequently reported. The small number of case studies that exist for feline patent urachus and urachal diverticulum have associated this condition with recurrent UTIs[3,4,6] and omphalitis,[4,6] both of which were appreciated in the patient in this report. Anecdotally, ventral abdominal dermatitis has been reported in cats[7] and was also present in this kitten. UTIs may occur in conjunction with patent urachus owing to the abnormal connection between the environment and urinary bladder. Patent urachus was previously documented with urolithiasis in a single case study from 1971.[3] In this report, an adult cat appeared to have urachal reopening rather than failure to close directly after birth.[3] The authors hypothesized that the urachus had opened as a result of increased intra-abdominal pressure from stranguria and urolithiasis. In the current case, it is most likely that the urachus failed to close after birth, although reopening secondary to stranguria and urolithiasis cannot be excluded.

Urolithiasis is rarely reported in pediatric veterinary patients.[8–12] The kitten in the current case is one of the youngest cats in the literature with documented urolithiasis. A previous case in 1981 reported urolithiasis in an 11-week-old kitten.[8] That kitten had a single large struvite calculus and no urachal anomalies. After cystotomy was performed to remove the calculus, as well as a diet change implemented, the kitten had no recurrence of clinical signs.[8] Canine pediatric urolithiasis has been reported in a few more case studies, but none in recent years.[9–12] All reported cases of canine pediatric urolithiasis with chemical calculi analysis available, report calculi of phosphate origin with magnesium ammonium phosphate (struvite) as the most common. However, in previous reports of canine pediatric urolithiasis, no associations have been identified with congenital urinary tract abnormalities.[9–12]

In children, urolithiasis with calculi of phosphate composition have previously been reported. However, calculi of mixed composition (phosphate with uric acid, oxalates, or urates), as well as pure cystine calculi, are also common.[13] Human pediatric urolithiasis within the first year of life is a rare condition; urolith formation in infants appears to be associated with urinary metabolic abnormalities, systemic illness and UTIs.[13] A review of 93 medical records of children under the age of 1 year with urolithiasis reported that 79.5% were affected by at least one urinary metabolic abnormality, 26.9% had UTIs at the time of diagnosis of urolithiasis and 16% had another systemic illness.[13] Similar correlations have not yet been definitively identified in pediatric feline or canine patients.

Struvite uroliths are one of the most common uroliths in cats.[14,15] In contrast to dogs, cats generally form struvite uroliths in sterile urine, with only about 5% of struvite urolithiasis cases occurring secondary to UTIs.[16] Cats <1 year of age or >10 years of age make up the majority of cases of struvite urolithiasis secondary to infection.[17] Cats >10 years of age tend to more commonly have metabolic diseases (diabetes mellitus, chronic kidney disease and hyperthyroidism), which have been associated as predisposing factors to UTI and calculi formation.[18] The etiology of infection in cats <1 year of age is unknown, though congenital anomalies may play a role.

Appropriate treatment of UTIs is essential. In the current case, cefovecin, a third-generation cephalosporin, was the initial antibiotic treatment. Cefovecin is passed in urine for up to 14 days after a single subcutaneous injection[19] and effectively clears UTIs in cats.[20] However, the American College of Veterinary Internal Medicine antibiotic use consensus states that medications important to human health (such as third-generation cephalosporins and fluoroquinolones) should be used sparingly, to decrease the risk of developing antimicrobial resistance.[21] This suggests that cefovecin was not the best empiric antibiotic choice. No statistically significant difference in the efficacy of UTI treatment has been identified between treatment with cefovecin vs cephalexin.[20] Therefore, a more appropriate first-line treatment would have been amoxicillin or a first-generation cephalosporin. Additionally, previous studies suggest that short courses of antibiotics are sufficient for the treatment of UTIs in dogs.[22,23] Though similar research is lacking in cats, cefovecin, which lasts 14 days, is likely an unnecessarily long treatment.

Inflammation also played an important role in this case. In women, NSAIDs, rather than steroids, are recommended for treatment of UTIs, based on their ability to inhibit prostaglandins.[24] Prostaglandins are major contributors to urinary tract inflammation.[25] Reasoning for the use of dexamethasone over an NSAID by the primary veterinarian is unknown. Regardless of reasoning, the dose of dexamethasone used was very high. The maximum recommended dose of dexamethasone for a cat is 0.5 mg per cat or approximately 0.1 mg/kg, not 0.5 mg/kg as used in this case.[26] No adverse effects due to dexamethasone overdose were observed.

Long-term management for this case was based on avoiding common risk factors for development of struvite uroliths and crystals. Risk factors include alkaline urine, consuming a diet high in phosphorus and magnesium, and eating large, infrequent meals.[13] Thus, preventative strategies include increasing water intake, decreasing urine pH and feeding a prescription diet.[13] Additionally, prescription diets can be utilized to dissolve existing stones.[27] Though clinical signs had resolved 3 months postoperatively, radiographs were not repeated to confirm the resolution of urolithiasis. However, based on the eventual resolution of clinical signs, successful removal of stones or subsequent dissolution was suspected.

In this case, based on the presence of a known UTI that was likely chronic owing to patent urachus, we suspect that infection and concurrent inflammation contributed to development of struvite urolithiasis.

Conclusions

Descriptions of pediatric urolithiasis and urachal anomalies are lacking in veterinary patients. It is an important consideration that pathogenesis of urolithiasis in young animals may differ from that of adult animals and may have a stronger relationship with congenital anomalies. Urolithiasis should be considered when evaluating cats of any age with patent urachus.

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Ethical approval This work involved the use of non-experimental animals only (owned or unowned) and followed internationally recognized high standards ('best practice') of individual veterinary clinical patient care. Ethical approval from a committee was not therefore needed.

Informed consent Informed consent (either verbal or written) was obtained from the owner or legal custodian of all animal(s) described in this work for the procedure(s) undertaken. For any animals or humans individually identifiable within this publication, informed consent for their use in the publication (verbal or written) was obtained from the people involved.

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