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NOTE

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Urolithiasis in a captive Siberian chipmunk (*Eutamias sibiricus*)

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ABSTRACT. This clinical case describes struvite urolithiasis in a pet chipmunk. Physical examination revealed the presence of two ovoid palpable masses in the caudal part of the abdomen, which were later confirmed by radiography as urinary bladder stone. The animal underwent ventral midline laparotomy and uroliths were successfully removed. Uroliths analysis revealed the presence of struvite and bacteriology showed the presence of *Proteus mirabilis*. Little is known about aetiology and incidence of urolithiasis in chipmunks. Client education about husbandry, dietary needs, and animal behaviour is necessary, especially when dealing with less commonly kept exotic companion mammals. This is the first report of struvite urolithiasis in a pet chipmunk.

KEY WORDS: chipmunk, haematuria, struvite, urolith, rodent

A 7-year-old, intact female pet chipmunk (*Tamias sibiricus*), weighing 120 g, was presented for a 14-day history of haematuria. The animal has been kept legally as a single pet animal and was nulliparous. Housing was provided in a wire cage, with wood shavings as a substrate. A commercial grain pelleted diet for rats, with dry fruits and vegetables were offered, as well as water in a drinking bottle, *ad libitum*.

On physical examination, the animal was alert with a normal posture and was in good body condition (BCS 3/5). Clinical abnormalities were limited to the presence of blood-stained hairs in the perineal area and rounded mass palpated in the caudal abdomen, with a diameter of 10 mm.

The animal was anesthetized with 2% isoflurane (Attane; Piramal Enterprises Limited, Telangan, India) in oxygen (1.5 l/min) via facemask and placed on heating pad (Fig. 1). Abdominal radiography revealed bilateral oval radiopaque structures within the caudal abdomen compatible with urocystoliths and also vertebral spondylosis lesions (L1–L2; L2–L3 and L7–S1) (Fig. 2). Blood was collected from the cranial vena cava and did not show any abnormalities [1]. Urinalysis demonstrated an alkaline pH of 8.0 and presence of erythrocytes [8]. No urine crystals were detected.

The chipmunk was premedicated with subcutaneous injection of butorphanol (0.1 mg/kg, Morphasol 4 ; Swissmedic, Bern, Switzerland) and midazolam (0.1 mg/kg, Midazolam Sintetica; Sintetica SA, Mendrisio, Switzerland). The anesthesia was induced and then maintained with 1.5% isoflurane in oxygen (1.5 l/min) via facemask. The animal was placed in dorsal recumbency on a heating pad kept on 39 degrees. A ventral midline laparotomy was performed. The urinary bladder was located and two stay suture fixations were placed on the bladder wall (Fig. 3). Standard cystotomy using dorsal approach was performed and both uroliths were removed (Fig. 4). The urinary bladder wall was slightly thickened, but no adhesions with uroliths were identified. The urinary bladder was flushed using normograde and retrograde hydro-propulsion. The urinary bladder wall was sutured in two layers using inverting continuous suture pattern and 5–0 polyglactin (Vicryl Plus, Ethicon, Diegem, Belgium). After abdominal lavage with tempered saline, the abdomen was routinely closed with 4–0 polyglactin 910.

Sample of urine was submitted for bacteriology showed the presence of low amount of *Proteus mirabilis* with sensitivity to enrofloxacin, marbofloxacin, ciprofloxacin, ceftazidime and cefotaxime. Both uroliths were submitted for mineral analysis (optical crystallography and infrared spectroscopy) (Minnesota Urolith Center, University of Minnesota, College of Veterinary Medicine, St Paul, MN, USA). Both uroliths were composed of magnesium ammonium phosphate (struvite).

Postoperative treatment consisted of subcutaneous administration of meloxicam (0.2 mg/kg q12 hr, Metacam; Boehringer Ingelheim Vetmedica GmbH, Ingelheim am Rhein, Germany); metoclopramide (0.5 mg/kg q12 hr, Paspertin; Mylan Pharma GmbH, Steinhausen, Switzerland); and enrofloxacin (15 mg/kg q12 hr, Baytril 2.5%; Provet SA, Lyssach, Switzerland). A crystalloid fluid solution was administered at 20 ml/kg subcutaneously (Duphalyte; Pfizer Olot, SLU, Girona, Spain). Recovery

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Fig. 1. Placing a chipmunk on heating pad and inhalation anaesthesia during abdominal radiography.

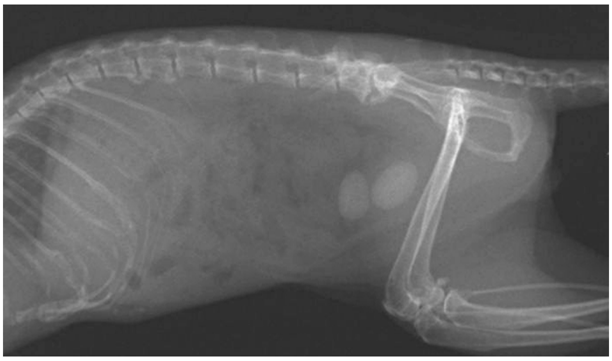

Fig. 2. Left lateral body radiograph of a pet chipmunk confirming a presence of two large radiopaque calculi.

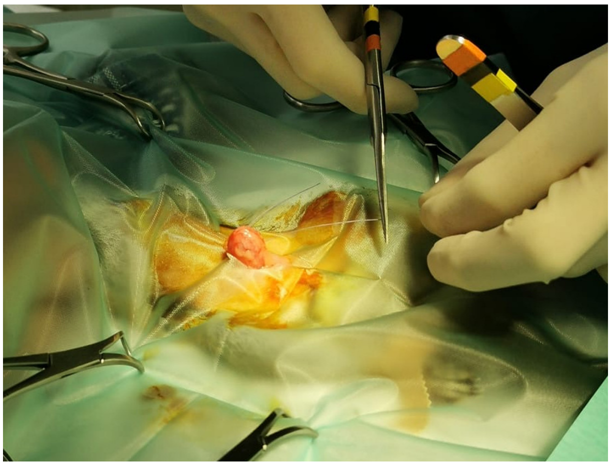

Fig. 3. Cystotomy, perioperative view. Placing two stays suture fixations on bladder wall.

Fig. 4. Detailed view of two cystolithes, which were confirmed, using mineralogic analyses, to be struvites.

was uneventful. Faecal output and spontaneous intake of food was observed 4 hr following recovery from anaesthesia. Administration of antimicrobials (enrofloxacin) and analgesics (meloxicam) was continued for 10 days after the surgery. Ten months after the surgery the patient was alert and did not show any recurrence of the disease.

Diseases of the urinary tract, such a urolithiasis are quite common health disorders in exotic companion mammals. The presence of uroliths can be either subclinical, associated with haematuria and urinary tract infection and in severe cases can lead to obstruction of the urine outflow with subsequent life-threatening health impairment [6, 13, 19, 21, 23].

Calculi can occur at any site in the urinary tract and the prevalence of type of uroliths varies among exotic companion mammals. In ferrets, cystine and struvite urolithiasis are currently believed to be the most common urolith`s type recognized in North American ferrets [14]. Uroliths in rabbits are usually composed of various calcium salts, predominately calcium carbonate in 69.4%, then compound (23%), mixed (3.3%) and a very rare calcium sulphate dihydrate [11, 17, 23]. Uroliths reported in rats are predominately of struvite (80.4%) origin with fever calcium phosphate (5.9%) [17]. Information from the literature regarding urolithiasis in chipmunk are scarce, only purine and compound urolithiasis were described in a squirrel related species [17]. Literature mention struvite urolithiasis in chipmunks, without more information [25].

Metabolic factors, urine concentration (dehydration, urine retention), urine pH and excess consumption or excretion of calculogenic minerals can all have an impact on calculi/struvite formation [9, 23]. Struvite uroliths are comprised of magnesium, ammonium and phosphate and especially forming in alkaline urine, and as a consequence of persistent urease-producing bacterial infections [21]. Under physiologic conditions, urinary ammonia increases in response to induce acidity [22]. Combination of alkaline conditions and an increasing in ammonia, allows formation of struvite crystals (since struvite tends to precipitate in alkaline urine, and its solubility increases greatly when urine pH is 6.6 or less) [3]. This occurs when urea-splitting bacteria degrade the excess of urine protein during urinary tract infection [2, 5]. *Escherichia coli, Klebsiella* spp., *Pseudomonas* spp., *Ureaplasma* spp., *Staphylococcus* spp., and *Proteus* spp. have been implicated in struvite urolith formation [4, 7, 16]. In a pathogenesis of struvite urolithiasis in rats it has been supposed urinary tract infection with urease-producing bacteria, as well as contribution of diet [16, 21, 24, 26]. In one study, multiple rats from the same vendor's facility were diagnosed with bacterial urinary tract infection (predominantly *Proteus mirabilis*) and urolithiasis [21]. These rats, housed at the vendor's facility, were fed with the same commercial diet, had an alkaline urine and all the uroliths were defined as struvite. Urine culture, in the present case, revealed the presence of *Proteus mirabilis*, which similarly to rats, might predispose our patient to struvite urolithiasis and thus should be considered in the etiopathogenesis.

In ferrets, the metabolism of organic acids in plant protein promotes struvite crystallization producing alkaline urine [15, 20]. Since chipmunks and rats are both omnivores, similar metabolic and nutritional pathways can be implicated in the etiology of struvite urolithiasis [10]. However, if the chipmunk is fed a herbivorous diet, the urine becomes alkaline, affecting the formation of struvite uroliths, as previously described in rats [25].

Although there are available commercial diets for squirrels, quality of these diets may be poor and insufficient on levels of protein and protein source (plant, insect or animal origin). The chipmunk was fed a diet for rats, which may not be satisfactory regarding chipmunk nutrition.

Regarding the size of uroliths, the treatment of choice was surgical removal, followed by antibiotics, analgetics and supportive care. The proper choice of the antibiotic was confirmed with urine culture and antibiogram. Medical management of struvite uroliths include in general diet modification, eradication or control of urinary tract infections, and the administration of urease inhibitors [4, 18]. For companion animals commercially available litholytic and urine-acidifying diets are highly effective [12, 18]. Unfortunately, no such a product exists for small exotic mammals. It has been recommended to the client to avoid treats, to encourage water consumption (to increase urine output) and to feed species specific diet [18, 21].

The cause of struvite calculi formation in the present case could be either ascending urinary tract infection with urease-producing bacteria (*Proteus mirabilis*), or spontaneous calculi formation based on dietary, metabolic, and urine pH changes.

In conclusion, based on our observations, exotic companion patients are mostly presented with already developed urolithiasis. In case of large uroliths, medical therapy is limited, and surgical therapy needs to be advocated followed by urine culture and appropriate antibiotic therapy. Veterinary surgeons and pet owners should pay attention to the urinary tract disease prevention, such as proper diet and control of water consumption, especially in less commonly kept exotic companion mammals. Authors also recommend measuring pH of the urine, especially in chipmunks, as alkaline pH can be one of the predisposing factors to the urolith formation.

CONFLICT OF INTEREST. None of the authors of this article has a financial or personal relationship with other people or organizations that could inappropriately influence or bias the content of this paper.

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