Scientific Works. Series C. Veterinary Medicine. Vol. LXXII (1), 2026
ISSN 2065-1295; ISSN 2343-9394 (CD-ROM); ISSN 2067-3663 (Online); ISSN-L 2065-1295

UROLITHIASIS IN WILD FELIDS

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Abstract

Urolithiasis in wild felids is uncommon under natural conditions but becomes clinically relevant in captivity due to dietary, environmental, and behavioral changes. Th This study describes a case series conducted between 2020 and 2025 on nine captive large felids (Panthera leo and Panthera tigris altaica). Clinical evaluation revealed signs of urinary tract involvement, including dysuria, hematuria, pollakiuria, and lethargy. Urinalysis identified crystalluria in 4/9 animals, with calcium oxalate, struvite, bilirubin, and cystine crystals, along with hyaline and non-hyaline casts. Biochemical analysis showed severe azotemia (mean BUN 162 mg/dL; creatinine 17.1 mg/dL), indicating advanced renal dysfunction. Urinary findings, including high specific gravity (>1.030), alkaline pH, proteinuria, and leukocyturia, suggest altered urinary homeostasis. Although urolith formation appeared infrequent, the presence of renal impairment highlights the clinical significance of urinary disorders in captive wild felids and supports the need for regular monitoring and preventive management strategies.

Key words: *urolithiasis, wild felids, crystalluria.*

INTRODUCTION

Urolithiasis in wild felids is relatively uncommon under natural conditions, but it acquires significant clinical importance in captivity, where environmental, dietary, and behavioral changes favor the development of urinary disorders. This condition is characterized by the formation of uroliths within the urinary tract and has a multifactorial etiopathogenesis comparable to that described in domestic cats, but influenced by the biological and ecological particularities of wild species (Miller & Fowler, 2015).

Wild felids, such as *Panthera leo*, *Panthera tigris*, *Panthera pardus*, and *Lynx lynx*, are strict carnivores adapted to a high-protein diet and an indirect water intake derived mainly from prey consumption. Physiologically, these species exhibit an increased capacity for urine concentration, a typically acidic urinary pH, and a reduced frequency of urination, all of which represent efficient evolutionary adaptations for water conservation. In natural environments, these characteristics do not usually favor urolith formation, as the diet is naturally balanced and physical activity levels are high (Vihol et al., 2017).

However, in captivity, these parameters may be significantly altered. Diets may contain inappropriate mineral levels or differ substantially from natural prey composition, water intake may be insufficient, and reduced physical activity along with chronic stress may influence metabolism and urinary function. These changes lead to increased urinary supersaturation with lithogenic substances, thereby promoting crystallization and urolith formation (Corpa et al., 2003).

The etiology of urolithiasis in wild felids is complex and involves the interaction of dietary, metabolic, and environmental factors. Nutritional imbalances, particularly excess minerals such as calcium, phosphorus, and magnesium, as well as insufficient water intake, contribute to alterations in urine composition. From a metabolic perspective, increased urine concentration capacity, possible disturbances in calcium or purine metabolism, and, in some cases, hepatic disorders may play an important role. Environmental factors, such as chronic stress and restriction of natural behaviors, have also been implicated in the pathogenesis of this condition (Vihol et al., 2017).

The types of uroliths identified in wild felids are similar to those described in domestic cats. Struvite uroliths occur more frequently in captivity and are associated with changes in urinary pH and dietary composition. Calcium oxalate uroliths are commonly reported in large felids, especially in captivity, being correlated with concentrated urine and hypercalciuria, and they cannot be dissolved through medical therapy. Urate uroliths are less common and are mainly associated with hepatic or metabolic dysfunctions. Cystine and silicate uroliths are considered rare and are linked to genetic factors or specific dietary characteristics (Vihol et al., 2017).

Clinical manifestations of urolithiasis in wild felids are difficult to detect, especially in natural environments where direct observation is limited. In captivity, signs such as dysuria, pollakiuria, hematuria, behavioral changes, lethargy, or anorexia may be observed. In severe cases, urinary tract obstruction may occur, representing a medical emergency. In the wild, the condition may remain clinically silent, and diagnosis is often established post mortem (Vihol et al., 2017).

Diagnosis of urolithiasis in these species is challenging and often requires chemical immobilization. Imaging investigations, particularly ultrasonography, represent the methods of choice, complemented by radiography and urinalysis. Biochemical evaluation may provide additional information regarding metabolic status and renal function (Vihol et al., 2017).

Treatment depends on the type of urolith and the severity of the case. Surgical interventions are frequently required, especially in cases involving non-dissolvable uroliths such as calcium oxalate. Dietary management and correction of metabolic imbalances are difficult to implement in captivity but remain essential for preventing recurrence. Fluid therapy and general supportive care are used to stabilize patients (Vihol et al., 2017).

Prevention represents the most effective strategy and involves adapting the diet as closely as possible to natural feeding patterns, ensuring adequate water intake, reducing stress, and periodically monitoring animals in captivity. In this context, proper environmental and nutritional management plays a central role in reducing the incidence of urolithiasis (Tordiffe et al., 2012).

MATERIALS AND METHODS

This descriptive case series was conducted at Târgoviște Zoo and in local households in Dâmbovița County between 2020 and 2025 and included captive wild felids, , with an emphasis on large felines: 5 lions (*Panthera leo*) and 4 Siberian tigers (*Panthera tigris altaica*), aged between 15 and 25 years.

Clinical examination was performed under sedation when the animals were alive and could be handled safely, or during postmortem evaluation after death. Sedation was performed using a combination of medetomidine (10-20 µg/kg, intramuscularly) and ketamine (2-5 mg/kg, intramuscularly), ensuring adequate immobilization and analgesia. In selected cases, butorphanol (0.2-0.4 mg/kg, IM) was added to enhance sedation and provide additional analgesic effects.

Physiological parameters, including heart rate, respiratory rate, mucous membrane color, and oxygen saturation, were continuously monitored throughout the procedure. Reversal of sedation was achieved using atipamezole (50-100 µg/kg, IM) when necessary.

The protocol was selected based on its reliability, safety profile, and suitability for minimizing stress and handling-related risks. in wild or non-cooperative animals, in accordance with current veterinary anesthesia guidelines and animal welfare standards.

Urine samples were analyzed by dipstick and sediment examination with Potchem UA 4210 to detect crystalluria, casts, bacteria, and lipid droplets (Figure 10).

The VetScanner IA system was used to support data analysis and interpretation (Figure 1).



Figure 1. Vet Scanner IA



Figure 2. Biochemical examinations with Arkay Spotchem

RESULTS AND DISCUSSIONS

The clinical examination of the wild felines revealed a cachectic condition, anorexia, marked lethargy, dehydration, and weakness, with reduced responsiveness and poor body condition in all patients (n = 9) (Figures 2-5). The evaluation of the urinary apparatus showed dysuria (n = 5), hematuria (n = 2), pollakiuria (n = 2), and stranguria (n = 1), suggestive of lower urinary tract involvement.



Figure 3. Lion with weight loss and dysuria



Figure 4. Tiger with weight loss and stranguria

Palpation elicited discomfort in the caudal abdomen, and the findings were consistent with a urinary tract disorder requiring further investigation (urinalysis, imaging, and culture where feasible).



Figure 5. Lion with weight loss and chronic kidney disease

Macroscopic examination of the urine samples revealed in a yellow color, no turbidity, and a normal characteristic odor in 7 wild felines and gross hematuria in 2 large cats.

Microscopic examination of urine by VetScanner IA identified the following elements (Figures 6-10):

Crystals: calcium oxalate monohydrate and dihydrate, struvite, bilirubin, cystine;

Cylinders: hyaline and non-hyaline;

Bacteriuria: bacteria-like structures were observed microscopically;

Lipuria: considered compatible with the elimination of marking pheromones;

or more cautiously.

Crystalluria was detected in 4 of the 9 examined animals, whereas overt urolith formation appeared to be infrequent in the studied wild felids.

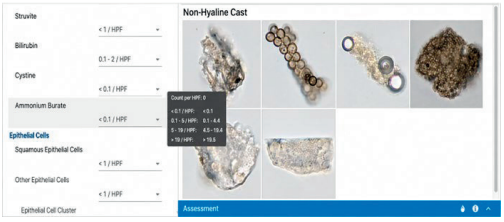


Figure 6. Urine sample with non-hyaline cast (original)

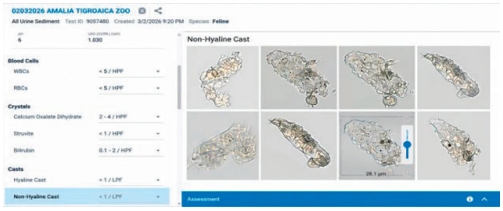


Figure 7. Urine sample with non-hyline cast (original)

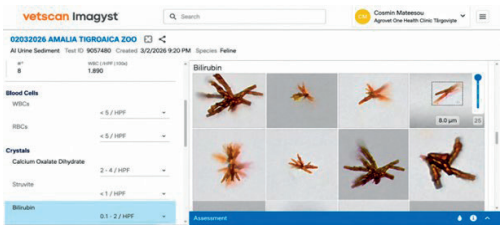


Figure 8. Urine sample with bilirubin cast (original)

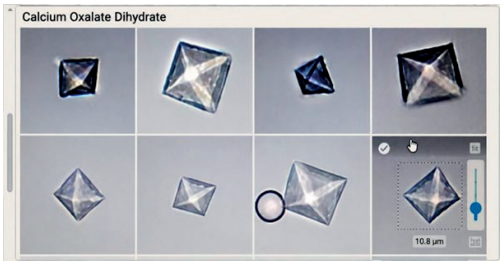


Figure 9. Urine sample with calcium oxalate dihydrate (original)

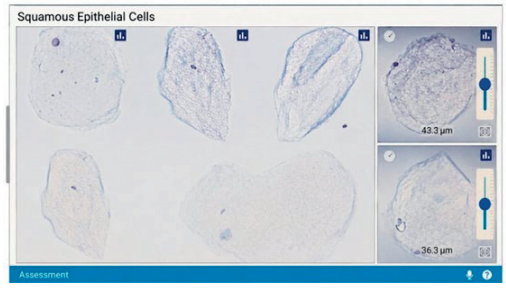


Figure 10. Urine sample with squamous epithelial cells (original)

Severe azotemia was observed across the evaluated animals, with mean BUN of 162 mg/dL and mean creatinine of 17.1 mg/dL, consistent with severe renal dysfunction/uremia. Hematological analysis revealed that total WBC counts were within reference limits, with a normal differential leukocyte count (neutrophils, lymphocytes, monocytes, eosinophils all in range). RBC count was decreased (RBC 5.5 $\times 10^6/\mu L$) with macrocytosis (MCV 64.9 fL, MCH 25.6 pg, MCHC 39.5 g/dL – increased), while HGB (11.6 g/dL) and HCT (26.9%) are at the low end of normal. Marked thrombocytopenia is present (PLT 18 $\times 10^3/\mu L$; PCT 0.016% – low). The analyzer flagged macrocytosis and thrombocytopenia.

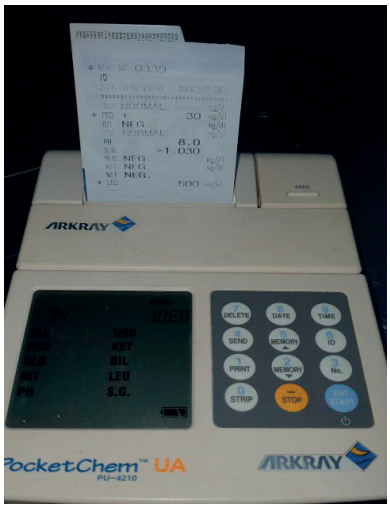


Figure 11. Urine strip examination with PocketChem UA (original)

Table 1. Median urinary dipstick results in the wild felids studied

Parameter	Tiger	Lion
Temperature	18°C	20°C
Glucose (GLU)	Normal	Normal
Protein (PRO)	+ (30 mg/dL)	+++ (300 mg/dL)
Bilirubin (BIL)	Negative	Negative
Urobilinogen (URO)	Normal	Normal
pH	8.0	7.5
Specific gravity (S.G.)	> 1.030	> 1.030
Blood (BLD)	Negative	++ (0.2 mg/dL)
Ketones (KET)	Negative	Negative
Nitrite (NIT)	Negative	Negative
Leukocytes (LEU)	500 Leu/µL	500 Leu/µL

Urolithiasis is well recognized as a major urinary disorder in domestic cats, but it has been reported far less frequently in nondomestic felids and large feline species. Nevertheless, the available literature indicates that this condition

does occur in wild felids, although most reports are limited to isolated case descriptions. Early reports documented struvite urolithiasis in a cheetah (Weber, Raphael, & Boothe, 1984), while later studies described cystine urolithiasis in a caracal (Tordiffe, van der Watt, & Reyers, 2012) and urolithiasis in an Asiatic lion (*Panthera leo persica*) (Vihol et al., 2017). Additional reports include urolithiosis in two lions (Corpa et al., 2003) and hydronephrosis associated with urinary tract pathology in a tiger (Gajendragad et al., 2004). These observations suggest that, although uncommon, urolithiasis should be considered an important differential diagnosis in captive wild felids, particularly in animals showing urinary signs, renal dysfunction, or obstructive complications.

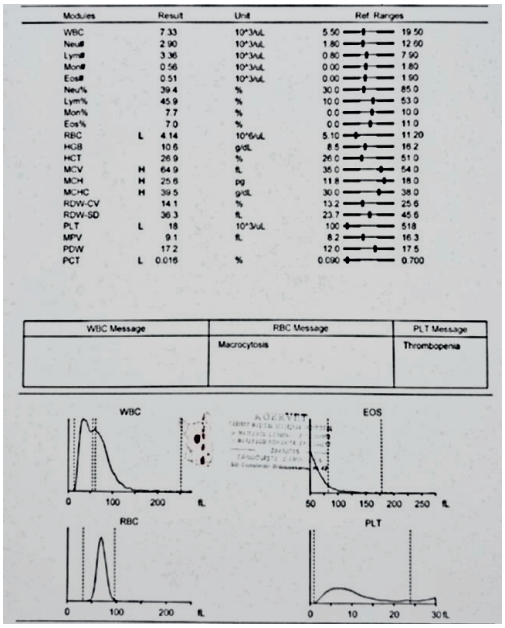


Figure 12. Hematological results of one of the wild felines

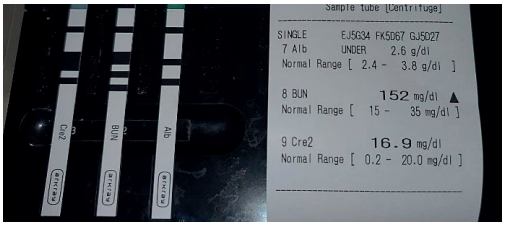


Figure 13. Biochemical results of one of the wild felines

CONCLUSIONS

The present study, conducted at the Târgoviște Zoo between 2020 and 2025, documents clinically relevant urinary findings in captive large felines (*Panthera leo* and *Panthera tigris altaica*) and supports the implementation of a structured surveillance protocol.

Urinalysis performed on free-catch samples, assisted by the VetScanner IA system, demonstrated a heterogeneous crystalluria profile, including calcium oxalate (mono- and dihydrate), struvite, bilirubin and cystine crystals, together with hyaline and non-hyaline casts. The concomitant presence of casts suggests renal tubular involvement in at least part of the evaluated cases and highlights the need to interpret crystalluria not only as a lower urinary tract issue but also in relation to potential renal pathology.

Clinical signs (dysuria, hematuria, pollakiuria, stranguria and caudal abdominal discomfort) were consistent with lower urinary tract disease; however, the marked azotemia (BUN 162 mg/dL; creatinine 17.1 mg/dL) indicates severe renal dysfunction/uremia, highlighting the likelihood of advanced renal impairment and the necessity of integrated assessment (urinalysis, hematology, biochemistry and imaging).

Despite an exclusively carnivorous diet, overt urinary stone formation appeared to be infrequent (4/9).

Hematological findings (macrocytosis with decreased RBC count and marked thrombocytepenia) in the context of severe azotemia emphasize the systemic impact of advanced disease and support the need for comprehensive clinical monitoring, particularly in geriatric zoo felids.

Overall, the results support the implementation of a structured surveillance protocol in captive wild felids, , incorporating periodic urinalysis (with sediment evaluation), biochemical renal profiling and, when feasible, imaging and microbiological culture, in order to facilitate earlier detection of urinary tract disorders and renal disease and to improve clinical outcomes in long-lived, geriatric individuals.

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