CASE REPORT

Study Regarding the Importance of Water Intake in The Treatment of Bladder Lithiasis

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Abstract

Urolithiasis represents the formation of mineral, organic or inorganic deposits in the kidneys, pelvis or bladder. Lithiasis can be formed at any level of the urinary tract (upper and lower) as a result of a dysmetabolism, urinary obstruction (anatomical or pathological) or an infection (cause or effect). The study approaches in all its complexity the urinary lithiasis, in felines and humans, comparing the etiopathogenetic induced context and the consequent therapeutic approaches, in veterinary medicine, following the protocols recommended and applied in human medicine. Lithiasis elements with urinary localization due to their irritative and/or obstructive effects constitute a challenge in the non-surgical treatment of such uro-nephrological disorders, with an appreciable incidence in the pathology of the urinary tract in pets, especially in felines, dissolution and/or lithotripsy allowing the treatment of such disorders (especially involving the lower urinary tract).

Keywords: urolithiasis, feline, ammonium magnesium phosphates, water intake.

Rezumat

Urolitiaza reprezintă formarea unor concrețiuni minerale, organice sau anorganice la nivelul rinichilor, bazinetului sau vezicii urinare. Elementele litiazice se pot forma la orice nivel al tractului urinar (superior și inferior) consecutiv unor dismetabolii, obstrucții urinare (anatomice sau patologice) sau infecții (cauză sau efect al acestora). Prezentul studiu abordează în întreaga sa complexitate litiaza urinară, la feline și la oameni, comparativ în ceea ce privește contextul inductor etiopatogenetic și abordările terapeutice consecutive, în medicina veterinară având ca model protocoalele recomandate și aplicate în medicină umană. Elementele litiazice cu localizare urinară prin efectele de tip iritiativ și/sau obstructiv constituie o provocare în remedierea pe cale nechirurgicală a unor astfel de afecțiuni uro-nefrologice, cu incidență apreciabilă în patologia aparatului urinar la animalele de companie, în special la feline, disoluția și/sau litotripsia permițând remedierea unor astfel de afecțiuni (în special cu interesare a tractul urinar inferior.

Cuvinte cheie: urolitiază, feline, fosfați amoniaco-magnezieni, aport hidric .

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INTRODUCTION

The components of the urinary apparatus, such as morphology and physiology recognize similarities and overlapping mechanisms, ensuring the formation and excretion of urine (by filtration, secretion, reabsorption and concentration).

The shape of the two kidneys in felines is the classic "bean" shape, being located on the ceiling of the abdominal cavity in the sublumbar region. The right kidney is the most cranial, coming into contact with the caudal lobe of the liver. In felines, the two kidneys have a characteristic, lustrous yellow color and on both sides appear subcapsular veins that have an arborescent appearance (Vernheim's stars), originating at the lateral margin and meeting at the hilus. As a topographical feature, in felines, the left kidney is located in the space between the L1-L3 lumbar vertebrae and the right kidney is located in the space between the T12 thoracic vertebra and the L2 lumbar vertebra. Ultrasonographic examination is performed by acoustic window approach in the dorsal region of the left flank (for the left kidney) and in the dorsal region of the right flank (for the right kidney), caudal to the hypochondrium or between the last two ribs in the case of lateral approach.

The ureter crosses caudally into the retroperitoneal space along the ceiling of the abdominal cavity and is divided into an abdominal and a pelvic portion. The urinary bladder in carnivores is placed on the floor of the abdominal cavity (Figure 1). The urinary bladder as a cavity organ varies ultrasonographically according to the degree of distention by contents. Morphological and topographical peculiarities in relation to the length and caliber of the urethra predispose the male sex to the occurrence and development of lithiasis and its consequences.

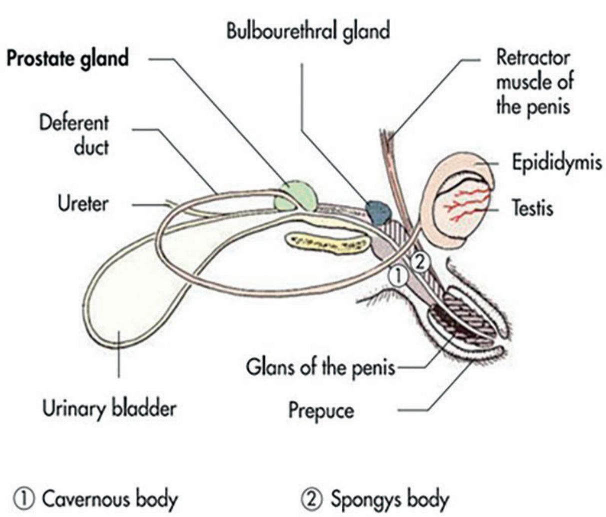


Figure 1. Uro-genital system in the cat (after: König, 2015)

In males, the urethra is a common urogenital portion, which is long and has a particular and more complex structure than the female urethra. It begins at the internal orifice of the urethra and ends at the tip of the penis through the external urethral orifice. The urethra in the male (cat) has an intrapelvic and an extrapelvic (penile) portion.

Compared with the anatomy of the urethra in humans, the urethra in cats is narrowed distally and especially in the male genitalia, so that urethral obstruction due to lithiasogenesis is a real predisposing factor. In this species and respectively in males, the urethral obstruction due to urethral irritation, urethral spasm and/or the formation of a 'urethral plug', which is most commonly made up of ammonium magnesium phosphates (struvites), is much more frequent.

Calculi located in the lower urinary tract are more frequent in felines than in humans, an additional explanation being attributed to the animal's quadrupedal position. In the same etiopathogenetic context, the bladder being located on the floor of the abdominal cavity, favors the retention of nucleate inducers, micro- and macrolytes with successive deposition of cellular aggregates, cellular detritus and mineral salts, respectively, favoring their transformation over time into obvious uroliths, responsible for the entire pathogenetic and clinical complex and intricate expression.

CASE REPORT

In supporting and carrying out this comparative study, we considered it appropriate to present a study case, considered relevant to this category of urinary pathology. The chosen case is represented by a cat (European breed), with a body weight of 7 kg, 6 years old, neutered, presented to the clinic because from the anamnestic data it appears that he expresses urinary changes, represented by disorders of urinary behavior (frequent adoption of urination position, frequent urination with reduced amounts of urine, urination in inappropriate places, vocalizations associated with the urination process, general discomfort, changes in appetite and general mood, excitability and even anxiety attacks). Feeding consists of dry and wet food and water intake offered at discretion (owner reports a relatively low water intake). Clinical examination revealed hyperthermia (39.9°C), an obvious increase in tenderness on palpation of the abdomen, polakisuria, stranguria. Clinical evaluation of explorable lymph nodes (submandibular, prepectoral, inguinal, popliteal) did not reveal any notable changes. Superficial and deep palpation of the bladder revealed a moderate degree of distention of the bladder contents, with increased sensitivity. In correlation with the clinical-anamnestic data, which indicated an infection of the lower urinary tract, we considered it appropriate to institute symptomatic medication, in addition to dietary therapy (hydric and alimentary) until a complete diagnosis was obtained, supported by further investigations. The initial drug treatment consisted in the administration of a myotropic antispasmodic - Drotaverine - 2 mg/kg (No-spa) and a betalactamin antibiotic - Amoxicillin potentiated with clavulanic acid (Synulox), in the ambulatory system continuing with the same recommendations (orally) for 10 days, to which we also added a urinary antiseptic and lithiazolitic - orally for another 30 days. Subsequent analysis revealed following urine examination (urinalysis and urine sediment) changes in urine density - hyperstenuria (specific gravity: 1.035), urinary pH: 7.1 (compared to normal 6.2-6.3) - environment favoring ammonium phosphate lithiasis, moderate hyperproteinemia (consequence of predominantly and/or exclusively protein diet), leucocyturia present and intense, with abundant sediment, predominantly represented by struvites (Figure 4).

The recommended dietary therapy consisted of a commercial diet (special diet) specific for alkaline urine and struvite-rich sediment, with controlled levels of protein, methionine (DL-methionine and calcium sulphate dihydrate) as urinary acidifiers.

Ultrasound examination (performed with a 7.5 MHz microconvex tube) revealed a bladder in a semi-full state, with relatively normal tone, overall inhomogeneous content with present and abundant cellularity, with numerous corpuscular elements in suspension and infrequent in the sediment, and a moderate reactive type of parietal involvement (with preservation of the characteristic parietal architecture) (Figure 2). Ultrasonographic examination provided relevant diagnostic elements, in relation to the type and homogeneity of bladder content, tone and degree of parietal injury.

Clinical and paraclinical re-evaluation of the patient 15 days after the institution of treatment (dietary and drug) brought visible improvements in clinical expressions (general and organ functional), urine examination showing persistence of hypersthenuria (>1,030) and leukocyturia, as well as the presence of inactive sediment.

Combating hypersthenuria and supporting the dissolution of urinary lithiasic elements (especially from the bladder) required oral fluid supplementation by administration as a brew (60-80 ml water/day).

At an interval of 30 days after the last evaluation, the clinical examination revealed an improvement of the previously recorded and described symptoms, and the results of the urine examination showed a notable recovery - within physiological limits, a decrease in urine pH (6.5) and specific gravity of 1.015. Abdominal ultrasound examination revealed a relatively homogeneous anechoic bladder (with rare suspended particles) without parietal changes (Table 1).

Three months after the start of dietary and water treatment (initial and medication-10 days), ultrasonographic evaluation revealed a normal bladder tone, transonic homogeneous content (no corpuscular elements in suspension and/or sediment), no parietal normorepresentation (1.6 mm in repletion state) (Figure 3).

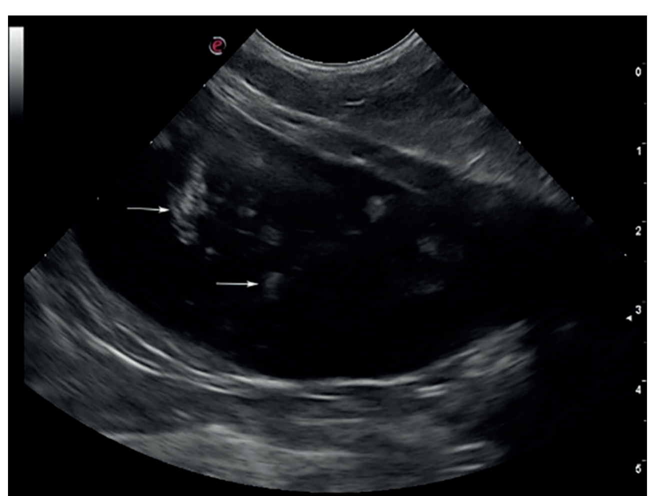


Figure 2. Ultrasonographic appearance of the bladder at the time of preliminary assessment (before initiation of the therapeutic protocol) Semi-fullness, moderate parietal reaction, suspended microlithiasic elements (arrows).

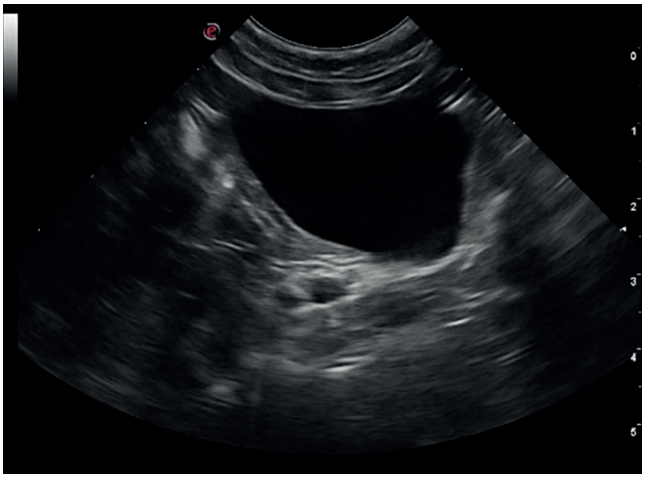


Figure 3. Ultrasonographic appearance of the bladder 3 months after initiation of the therapeutic protocol. Normotonic bladder, homogeneous anechoic content, specific parietal architecture.

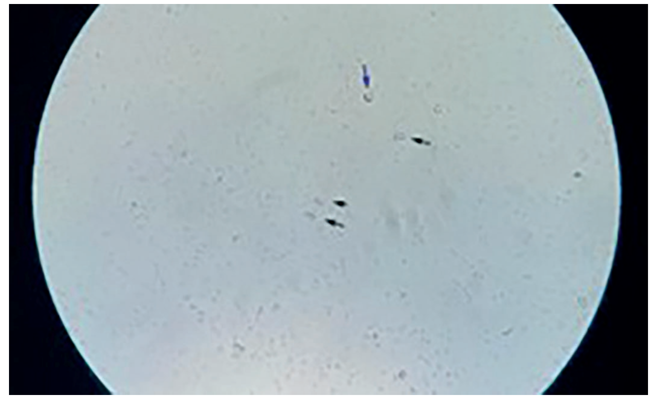
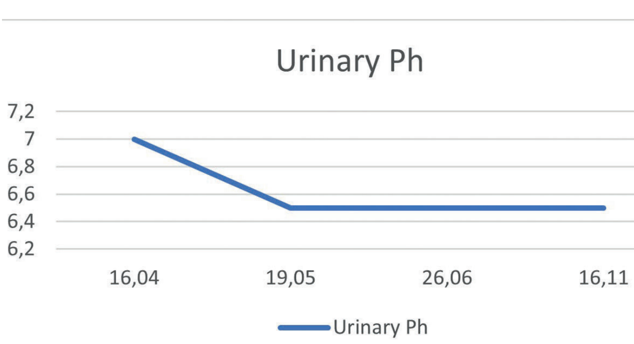


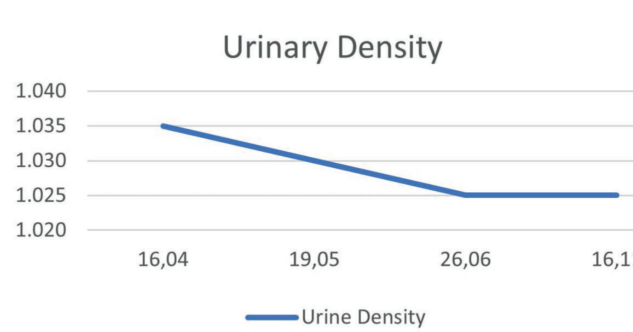
Figure 4. Stone evidence in urinary sediment. Black arrow - ammonium magnesium phosphates (struvites) and blue arrow - calcium carbonates (oxalates)

Table 1. Abdominal ultrasound examination at the end of treatment

Urinary bladder:	semi-fullness, normal tonus, homogeneous anechoic content without suspended corpuscular elements and/or sediment, no parietal reaction
Left kidney:	normal size (41.2/24.5/5.8 mm), obvious design, regular contour, normal corticomedullary ratio (in all 3 incidences), no dilatation of the pyelocaliceal system. ureteropelvic junction without changes.
Spleen:	normal size, regular outline, homogeneous echostructure, normal echogenicity, size at splenic hilum 6.8 mm
Liver:	increased in volume, generally homogeneous, normoechoic echostructure
Gallbladder:	thin wall, anechoic content, free bile duct
Right kidney:	normal size (42,3,/25,8/6,2 mm), obvious design, regular contour, normal corticomedullary ratio, no dilatation of pyelocaliceal system. ureteropelvic junction without changes.
Stomach:	moderately loose content, normal tone, normal wrinkles, thickness of the interrupting wall 2.3 mm
Intestines:	no parietal and/or lumenal changes, normal tone, no appearance of intestinal ileus
Abdominal lymphondoes:	without mesenteric, lumbo-aortic and iliac adenopathy



Graph 1. Evolution of urinary ph values over 6 months



Graph 2. Evolution of urinary density values over 6 months

DISCUSSIONS

Studies comparing the protein distribution measured by mass spectrometry in the matrix of human calcium oxalate urinary calculi with that observed in the matrix of feline urinary calculi have shown similar characteristics in lithiasogenesis in these two species. These studies indicate that cats may represent a potential animal model of human lithiasis identified on the basis of these similarities.

Calcium oxalate calculi are the second most common type of calculi in pets; in a 2007 study, they accounted for 40.8% of calculi in cats (Osbourne).

Constituents of lithiasis elements are present in normal urine, but struvite formation depends on diet, local urinary microenvironment, metabolic factors and simultaneous therapy. The precipitation theory of 'crystallization' of stone formation plays an important role in struvite urolithiasis.

Changes in urinary pH can alter the solubility of struvite crystals, with acidic pH (pH<6.3) favoring the dissolution of struvite crystals (ammonium magnesium phosphates), while neutral and alkaline urine (pH >7.0) promote struvite crystal formation. Dietary factors may alter crystal solubility and concentrations of urinary constituents. These factors may include a lower dietary anion-cation balance and/or reduced concentrations of magnesium, phosphorus or sulphur. Protein catabolism can alter urine pH and crystal solubility, increase urea production and decrease phosphorus and magnesium excretion, which can lead to stone formation.

CONCLUSIONS

1. An adequate water intake correlated with the concentration of nutrients in food is the premise to avoid the conditions of hypersthenuria and therefore of lithiasogenesis.
2. In a curative-prophylactic way, supplementing/increasing fluid intake helps to prevent stone formation by reducing hypersthenuria, reducing urine acidity and promoting the elimination of excess mineral salts.
3. Increased fluid intake is associated with a reduced risk of developing urinary lithiasis; increased consumption of fluids may reduce the risk of developing urinary lithiasis. An average daily water intake has been recommended for the prevention of urinary stones. (Xu et al., 2015)
4. The favorable and concomitant evolution of urinary pH and density parameters following fluid therapy (oral/parenteral) supports and indicates positive evolutions, i.e. a similar successful treatment in both species (feline and human) in urinary lithiasis.
5. An appropriate dietary and therapeutic management, modulated and adjusted in dynamics (according to the evolution of the investigated parameters, part of the specific protocol - in particular urinary sediment and summary as well as the elements provided by the ultrasound examination) allowed to amend the clinical signs and the return of the modified parameters in physiological limits.

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