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CASE REPORT

A Case of Multiple Struvite Formation in the Urinary Bladder of a Geriatric Dog

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ABSTRACT

This report describes the clinical, laboratory, radiographic and ultrasonographic findings for diagnosing urolithiasis in a dog. A 12-year-old Golden Retriever was brought to the Aydin Adnan Menderes University, Faculty of Veterinary Medicine Research and Practice Animal Hospital, Aydin, Türkiye, due to haematuria and polyuria which has been present for two years. Physical examination revealed a hard mass in the caudal abdomen. Radiographs confirmed the presence of uroliths in the urinary bladder, and ultrasonography showed acoustic shadowing, giving a hyperechoic appearance, leading to a diagnosis of urolithiasis. Uroliths were surgically removed by cystotomy and were found to be yellow, four- to six-sided, and in various size and shape, weighing 158 grams in total. Biochemical analysis identified them as struvite. Although various medical and surgical treatment options exist for urolithiasis, traditional cystotomy remains the most commonly used and effective method, especially for multiple, large stones, as demonstrated in this case report.
Key Words: Cystotomy, Diagnostic imaging, Geriatrics, Urinary calculi, Urolithiasis

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Geriatrik Bir Köpekte İdrar Kesesinde Çoklu Strüvit Taşı Oluşumu

ÖZ

Bu raporda, bir köpekte ürolitiazis tanısı için klinik, laboratuvar, radyografik ve ultrasonografik bulguların araştırılması amaçlandı. On iki yaşında Golden Retriever cinsi bir köpek iki yıldır devam eden hematüri ve poliüri nedeniyle Aydın Adnan Menderes Üniversitesi Veteriner Fakültesi Araştırma ve Uygulama Hastanesi'ne getirildi. Fiziksel muayenesinde kaudal abdomende sert bir kitle tespit edildi. Radyografi, idrar kesesindeki ürolit varlığını doğruladı ve ultrasonografide hiperekoik bir görünüm veren akustik gölgelenme görülerek ürolitiyazis tanısı konuldu. Ürolitler cerrahi olarak sistotomi ile çıkarıldı ve sarı renkli, dört ile altı kenarlı, boyut ve şekil bakımından değişken, toplam 158 gram ağırlığında olduğu görüldü. Biyokimyasal analiz sonucunda struvit oldukları belirlendi. Ürolitiyazis için çeşitli medikal ve cerrahi tedavi seçenekleri mevcut olsa da, geleneksel sistotomi, bu vaka raporunda gösterildiği gibi, özellikle büyük, çoklu taşlarda kullanımı en yaygın olan etkili bir yöntem olmaya devam etmektedir.
Anahtar Kelimeler: Sistotomi, Tanısal görüntüleme, Geriatri, Üriner taşlar, Ürolitiyaz

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INTRODUCTION

Urolithiasis is a common and frequently recurring urogenital problem in dogs, which refers to the urolith formation in any part of the urinary system (Hoxha and Rapti 2018). It is most commonly seen in dogs aged between 2-10 years. Clinical signs, including haematuria, dysuria, pollakiuria, and stranguria, can vary depending on the location, size and the number of uroliths (Nelson and Couto 2014). Diagnosis of urolithiasis primarily involves taking a thorough medical history, carrying out a clinical examination including urinalysis, complete blood count, serum biochemical analysis, radiographic and ultrasonographic (USG) examinations (Tuna et al. 2018; Polat and Sagliyan 2022). In uroliths, medical or surgical treatment is applied depending on the type, size and number of uroliths, the general health status of the patient and the severity of the symptoms. If left untreated, urolithiasis can result in partial or complete obstruction of the urinary tract, leading to severe complications including rupture of the urogenital tract, metabolic acidosis, hydronephrosis, hyperkalaemia, peritonitis, cardiac arrhythmias and death in cases of severe obstruction (Birla Singh and Sailo 2013; Okpara et al. 2021).

This case report documents the clinical, laboratory, radiographic and USG examination findings and describes the treatment results of multiple uroliths weighing 158 grams in the urinary bladder of a 12-year-old female Golden Retriever.

CASE PRESENTATION

A 12-year-old, 32 kg, spayed female Golden Retriever was brought to Aydin Adnan Menderes University, Faculty of Veterinary Medicine Research and Practice Animal Hospital, Aydin, Türkiye with complaints of haematuria, oliguria, polyuria and dysuria that started 2 years ago. The anamnesis revealed that the patient had experienced intermittent haematuria and frequent urination while walking, with low and occasionally absent urine output, over the past two years. Furthermore, these symptoms had progressively worsened over the last two weeks.

Clinical, haematological, biochemical, urinalysis, radiographic and USG examinations were performed. Body temperature (38.6°C), respiratory rate (24 min^{-1}), heart rate (90 min^{-1}), mucous membranes (anemic), dehydration level (2-4 %), capillary refill time (3-4 secs) and submandibular lymp nodes (normal) were evaluated during the physical examination. Abdominal palpation revealed rigidity and a firm mass in the abdomen which was not attached to the abdominal wall. Haematological analysis revealed mild azotaemia (BUN: 32 mg dL^{-1}; RI: 6-27 mg dL^{-1}, BUN/CRE 45.7; RI: 7-37) and hyperkalaemia (K: 7.4 mmol L^{-1}, RI: 3.5-5.8 mmol L^{-1}), while other findings were within reference ranges (Table 1).

Table 1: Results of biochemical analysis of the blood.

Blood biochemistry

Parameter	Result	Min.	Max.
GLU (mg/dL)	105	70	140
TP (g/dL)	6.8	5.1	8.0
ALB (g/dL)	3.2	2.4	3.9
BUN (mg/dL)	32	6	27
CRE (mg/dL)	0.7	0.3	1.5
Ca (mg/dL)	11.7	7.9	12.0
PHOS (mg/dL)	4.4	2.1	6.5
Na (mmol/L)	151	138	160
K (mmol/L)	7.4	3.5	5.8
ALT (U/L)	55	5	125
AST (U/L)	46	5	60
ALP (U/L)	65	20	121
TBIL (mg/dL)	0.54	0.10	0.90
AMY (U/dL)	891	500	1500
GLOB (g/dL)	3.6	2.3	5.2

A 5 mL urine sample was centrifuged at 1500 rpm for 5 minutes and microscopic examinations were performed on the remaining sediment. The colour and specific gravity (1.005) were evaluated on the chemical analysis. Blood was detected at an intensity of 3+, with a urinary pH of 8; and no protein or glucose was present. Microscopic examination revealed the presence of erythrocytes, epithelial debris and crystals.

Laterolateral radiographic examination (Bucky table 150 kV, 500 mAs; Comed Medical Systems Co, Seongnam, Gyeonggi-do, South Korea and CR system ImagePilot Sigma, Konica Minolta Healthcare

Americas, Inc., Wayne, NJ, USA) showed numerous uroliths in the bladder (Figure 1).

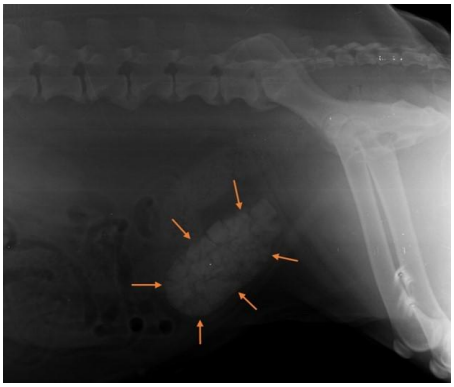

Figure 1: Laterolateral X-ray image of the patient showing a urinary bladder filled with uroliths (arrows).

USG examination (8.0 MHz microconvex probe, Mylab 30-Esaote®, Genova, Italy) revealed normal kidneys, thickening of the bladder wall as well as multiple uroliths giving a hyperechoic acoustic shadow in the urinary bladder (Figure 2).

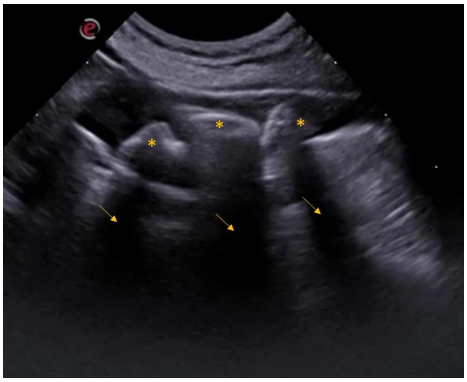

Figure 2: Ultrasonographic image of the urinary bladder demonstrating multiple hyperechoic uroliths (asteriks), with distal acoustic shadowing (arrows).

Based on clinical, radiographic and ultrasonographic evaluation, urolithiasis was diagnosed and surgical removal via cystotomy was indicated. Medetomidine HCl (40 µgkg^{-1}, IM, Tomidin®, Provet, Istanbul, Türkiye) was used for sedation and Ketamine HCl (5 mg/kg^{-1}, IM, Ketasol®, Interhas, Ankara, Türkiye) was administered intramusculary for the induction of anaesthesia. Pre-oxygenation with a face mask was performed for five minutes prior to induction and heat support was provided intra-operatively to minimise hypothermia and reduce the risk of delayed recovery. Following intubation, anaesthesia was maintained using isoflurane (3% inhalant, Isoflurane® USP, USA) and closely monitored during the anesthesia. The patient was positioned in dorsal recumbency and prepared for a caudal midline laparotomy, following standard aseptic and antiseptic protocols. A cystotomy was performed on the dorsal aspect of the markedly enlarged urinary bladder, which exhibited discoloration and had a thickened wall (Figure 3 A-B). The uroliths were removed and the bladder was lavaged with saline to eliminate any remaining small calculi. The urinary bladder was closed using a 3-0 polydioxanone (PDS) suture (Polidioxanone, Boz Tıbbi Malzemeler, Ankara, Türkiye) using Schmieden and Cushing technique, and the abdomen was closed using routine procedures. Lactated Ringer's solution (10 mL kg^{-1} h^{-1}, IV, Polifleks, Polifarma, Türkiye) was administered during the surgery. Cefazolin sodium (20 mg kg^{-1} day^{-1}, 7 days, IM, Iespor®, Istanbul, Türkiye), meloxicam (0.2 mg kg^{-1} day^{-1}, 3 days, SC, Bavet Meloxicam®, 5 mg mL^{-1}, Bavet, Istanbul, Türkiye) and nitrofurantoin (5 mg kg^{-1} day^{-1}, 7 days, PO, Piyeloseptyl®, Biofarma, Istanbul, Türkiye) were administered post-operatively. The uroliths were angular and yellow in color. They varied in size and shape, and had a total weight of 158 grams (Figure 4). Analysis identified the uroliths as struvite, and a c/d diet alongside vegetables low in magnesium, such as cabbage, was recommended for the patient.

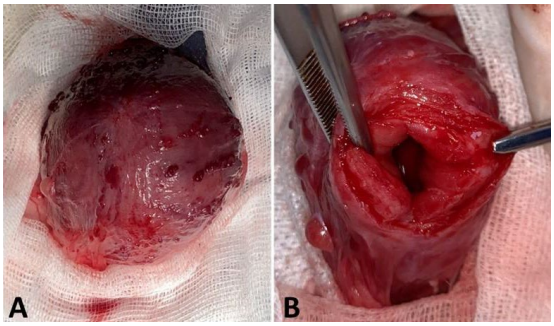

Figure 3: Discoloration (A) and the thickened wall (B) of the urinary bladder.

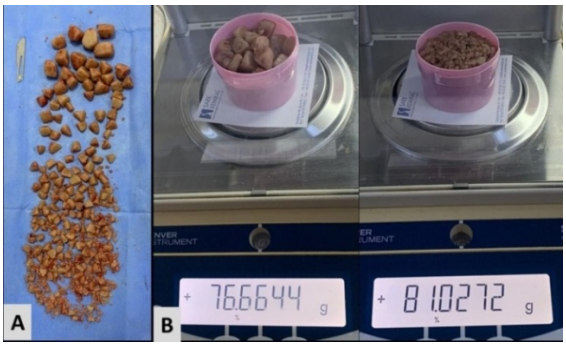

Figure 4: Removed uroliths (A) and their recorded weight on a scale (B).

DISCUSSION

Urolithiasis is the general term describing the presence of uroliths in the urinary tract. It occurs anywhere in the urinary system, but are most common in the urinary bladder. The exact cause of urolith formation has not yet been fully determined. However, there exist many factors affecting urolith formation such as breed, gender, age, anatomical and functional abnormalities of the urinary tract, metabolic disorders, urinary tract infections, diet,

urine pH and body water homeostasis (Osborne et al. 2009).

Urolithiasis has been reported to occur more frequently in some dog breeds including Dachshund, Pekingese, Dalmatian, Miniature Schnauzer, Poodle, Pug, Cocker Spaniel, Terrier, Bulldog, Beagle and Basset Hound. Although the average age of affected dogs is reported to be between 5 and 8 years, it has been stated that struvite uroliths can occur in dogs of all ages (Picavet et al. 2007; Low et al. 2010; Okafor et al. 2014; Mendoza-López et al. 2019). Some studies have reported a higher incidence of urinary calculi in male dogs (Mendoza-López et al. 2019), while other studies have indicated a higher probability in female dogs (Ling et al. 2003; Picavet et al. 2007; Burggraaf et al. 2021). In the presented case, multiple uroliths were found in the urinary bladder of a 12-year-old female Golden Retriever dog.

Radiographic and USG examinations are the most important imaging methods in the diagnosis of uroliths. These examination methods provide information about the presence, localisation, size, density and shape of uroliths. Direct radiography is the first step in the evaluation of the urinary system. It is useful in the diagnosis of radiopaque uroliths over 1 mm in the urinary bladder and urethra. In this case, multiple radiopaque uroliths were detected in the urinary bladder using direct radiographic imaging. USG examination is widely used for evaluating urinary system diseases due to its ease of use, low cost, non-invasive nature and short examination time, as well as lack of necessity for a contrast agent (Sancak et al. 2009; Tion et al. 2015). Uroliths in the urinary bladder have been reported to appear as hyperechoic lesions on USG examination and to create a strong acoustic shadow in the distal regions (Yaygıngül 2024). Similarly, the USG examination in our case revealed multiple hyperechoic uroliths in the urinary bladder, which created an acoustic shadow distally. In the treatment of uroliths, medical or surgical interventions are chosen based on the type, size and number of uroliths, the patient's general health status and the severity of their symptoms. Medical treatment includes dietary modifications, antibiotic therapy and urine acidifiers. The main part of treatment for dogs is controlling urinary tract infections using appropriate antimicrobial agents based on culture and antibiogram results. This process should be supported by specialised dietary therapy designed for dissolution. Struvite uroliths can be dissolved medically, and specific diets are formulated to acidify the urine, increase urine volume and dilution, and reduce the concentrations of crystalloids (e.g., magnesium and phosphate) as well as crystalloid precursors (e.g. urea). The average time required for the dissolution of struvite uroliths in dogs, using antimicrobial agents combined with a specific diet, is approximately 3 months; despite the treatment is not always successful (Osborne et al. 1999a; Syme 2012).

Surgical intervention is performed when medical treatment is ineffective, the urolith is large or causing urethral obstruction, or when rapid symptoms relief is required. Surgical techniques include open cystotomy, laparoscopic cystotomy, laser lithotripsy, percutaneous cystolithotomy (PCCL), cystoscopic urolith removal and urohydropropulsion (O'Kell et al. 2017). In this case, urinary bladder uroliths were removed via cystotomy because the entire urinary bladder was filled with uroliths.

It has been reported that the most common uroliths found in dogs are magnesium ammonium phosphate (struvite), calcium oxalate, urate and cystine. Struvite uroliths in dogs usually develop due to urinary tract infections involving urease-producing bacteria, with *Staphylococcus* spp. being the most commonly implicated pathogen (Syme 2012). It has also been documented that struvite uroliths are more prevalent in females. This is attributed to the female urethra being shorter and wider than the male urethra, making females more susceptible to urinary tract infections (Osborne et al.1999b; Burggraaf et al. 2021). A study by Houston et al. (2004) reported that female dogs were more prone to struvite uroliths, with a significant difference ratio of 12:1 compared to males, as detected through urine analysis. However, calcium oxalate uroliths were more common in male dogs, at a ratio of approximately 3:1 compared to females. In the present study, struvite uroliths were found in a female dog, which is consistent with existing literature on the subject. Although struvite urolithiasis is relatively common in dogs, the exceptionally substantial stone burden, the patient's advanced geriatric status and the unusually prolonged period of mild clinical signs collectively render this case both clinically noteworthy and worthy of detailed reporting.

Three months after the surgery, the owner reported that the dog was in good health.

CONCLUSION

In conclusion, uroliths can be treated medically or surgically, and it can be successfully managed in dogs with early diagnosis and appropriate treatment. However, open cystotomy still remains the most common treatment method with a very high success rate for patients with multiple and large sized uroliths covering the urinary bladder, as in the case reported here.

Conflict of interest: The authors have no conflicts of interest to report.

Authors' Contributions: RY contributed to the clinical case management, data collection, literature review, writing of the original draft, reviewing and editing of the manuscript. AG and BB contributed to the clinical case management and writing, review and

editing of the manuscript. All authors have read and approved the finalized manuscript.

Ethical approval: This study is not subject to the permission of HADYEK in accordance with the "Regulation on Working Procedures and Principles of Animal Experiments Ethics Committees" 8 (k). The data, information and documents presented in this article were obtained within the framework of academic and ethical rules.

Explanation: This study has not been presented elsewhere before.

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