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BLADDER STONES IN A NINE YEARS OLD FEMALE DOG – CASE REPORT

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Abstract. A nine years old female dog, crossbreed, spayed admitted to a veterinary clinic with a urinary tract problem. Symptoms have been grown slowly over six months. The dog was behaved normally at home, showing no pain. In the clinic the dog had ultrasonography of the abdominal cavity, the bladder wall was thickened, no other shading structures were found. It was deciding to do a diagnostic laparotomy. As a result of surgery, 4 stones were removed from the bladder. Oval stones with blunt edges, reached about 2 cm in diameter. Often non-specific symptoms may go unnoticed for a long time by the owner, and when the dog get to the veterinary clinic we can only chirurgic remove the stones. Especially, if urolithiasis is sterile urolithiasis and fills the entire bladder.

Key words: urolithiasis, struvites, dog.

INTRODUCTION

Urolithiasis is quite common in dogs. It can affect both the lower and upper urinary track. Studies (Osborne et al. 2009) indicate that up to 97% of stones delivered to the lab for its composition examination were removed from the lower urinary tract (i.e. from the bladder, urethra). This is probably due to the easier operation in these places than, for example, in the kidneys. Surgical removal of urinary stones located in the upper urinary tract is usually recommended only when they cause obstruction or contribute to recurrent infections.

Analysis of the mineral composition of the stones is important to determine their type, which will facilitate taking measures to prevent the recurrence of stones, e.g. by changing the diet. Two types of stones are most common in dogs: magnesium ammonium phosphates (struvites) and calcium oxalates (CaOx). This is confirmed by the research under the guidance of Houston and team in 2004, where among over 16,000 examined stones, 43.8% were struvites and 41.5% oxalates. Similar results were obtained by the Low's team in 2010. Analysis of approx. 25.5 thousand of the stones showed that 53.4% of stones were struvites and 42% were CaOx. Single studies indicate that the frequency of some stones may have been changing in recent years, e.g. the number of diagnosed CaOx stones decreased from 49.5% in 2006 to 41.8% in 2018 (Kopecny et al. 2021). Other types of stones are much less common. Depend-

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ing on the studies, the frequency of their occurrence is as follows: urate stones 3–5%, silicate stones 1–6.7%, cystine stones 0.4–1.3% (Houston et al. 2004; Low et al. 2010). Stones of mixed composition, i.e. those for which the content of one of the minerals are not dominant (>70%), are formed in approx. 7% of individuals with urolithiasis (Nelson and Counto 2010).

In dogs, a strong association has been shown between female sex and an increased risk of urolithiasis with struvites (Ling et al. 1988; Osborne et al. 1999a; Low et al. 2010). It should be added that magnesium-ammonium phosphate stones in dogs are most often caused by urease-positive bacteria, f.e. *Staphylococcus* spp. It is not without significance that the female urethra is shorter and wider than the male one, so females are more vulnerable for urinary tract infection (Osborne et al. 1999a; Seaman and Bartges 2001). It was reported by Low et al. (2010) that 76.6% of the struvite stones analyzed came from females. According to the above studies the most common location of struvites is the urinary bladder. Anatomical reasons should be study here. The dog assumes a horizontal posture, so this is also the position of the bladder, which may favor the retention of crystals or small stones inside the organ, instead of excreting them together with the urine. Those stones can lead to blockage of the external opening of the urethra and the inability to empty the bladder.

There are breed predispositions to an increased risk of urinary stones, e.g. in Miniature Schnauzer, Shih-tsu or Pekingese dogs (Low et al. 2010). In the case of non-pedigree dogs, it is difficult to determine the degree of risk. For the purposes of this article, the genetic basis of the development of urolithiasis was omitted.

The formation of urate stones is a complex process. One cause cannot be singled out and some are related to each other. We can distinguish improper diet (rich in mineral salts and protein promotes crystallization), too low urine pH (which may be affected by the diet or medication), urinary retention (and its too high density), damage to the kidney tubules, bacterial infection, metabolic disorders, the use of certain drugs (e.g. furosemide, glucocorticosteroids, vitamin and mineral preparations) (Hufnagle et al. 1982; Okafor et al. 2013; Jackowska-Pejko 2019). In general, either the composition of the urine is disturbed, or primary foci of crystallization appears.

Clinical signs urolithiasis are related to the number, type, and location of the stones. Assuming that most of them are located in the bladder, we most often deal with hematuria, unproductive urge to urinate, painful and difficult urination, and even vomiting (Nelson and Counto 2010).

The aim of the study was to discover the causes of ailments occurring in a nine years old bitch and related to bladder stones.

MATERIAL AND METHODS

Subject of research

A nine years old mixed-breed female dog, spayed, was admitted to the veterinary clinic with an urination problem.

According to the clinical interview, these difficulties were manifested when patient first urinates normally during on a walk, and then squats down every few meters and urinates a few drops of urine or unproductive urge to urinate is observed. These symptoms now occur every time on a walk but have been slowly building up for about 6 months. The dog at home behaves normally, happy to play, eats and drinks the same amount. According to the owners, he shows no signs of pain.

Course of the study

At the clinic, the female dog had an ultrasound of the abdominal cavity, but due to the small amount of urine in the bladder, the examination did not show much. Only the wall of the urinary

bladder in the ultrasound image seemed to be thickened, no echogenic structures were found. Urine was collected by the owner. At the clinic, the female dog received an antibiotic – enrofloxacin to be continued at home (a total of 10 days of treatment) and meloxicam with anti-inflammatory and analgesic properties.

The patient returned to the clinic after 14 days because the symptoms have not subsided. The owners brought urine in a sterile disposable container for examination. General examination of urine and its sediment as well as biochemical examination and complete blood count were ordered.

Based on the results (Tables 1 and 2) it was decided to perform a diagnostic laparotomy with a focus on bladder examination. The procedure was performed under general anesthesia with the use of butorfonal, medetomidine and ketamine. As a result of the procedure, 4 stones were removed from the bladder (Fig. 1). Those stones had rounded edges and a diameter of about 2 cm (Fig. 2) and were sent to an external laboratory for their mineral composition evaluation. Intraoperatively, a massive inflammation of the bladder wall was found. Postoperatively, the patient received an again antibiotic – enrofloxacin and meloxicam. A follow-up visit in 10 days and a change of diet to a urine-acidifying diet were recommended. Meals should be low in protein, magnesium, and phosphorus but high in sodium (Rinkardt and Houston 2004). In the meantime, the result of the stone composition was obtained (Table 3). The result showed struvite stones.

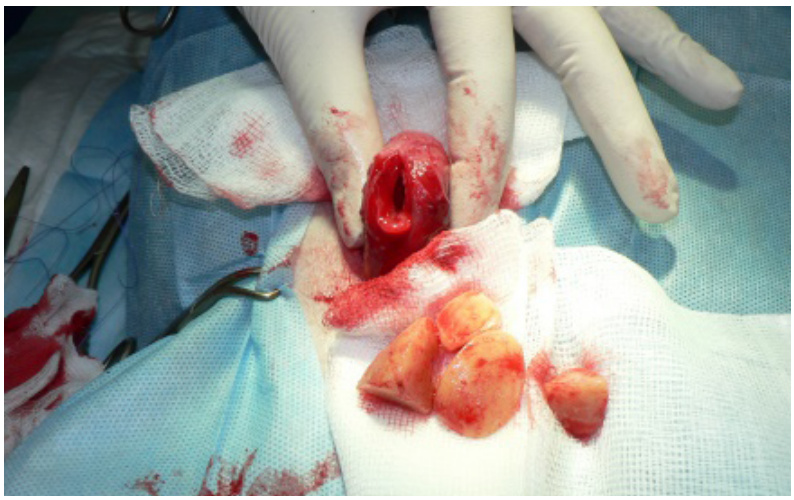

Fig. 1. Stones removed from the bladder (source: Veterinary Clinic „Mokrynos")

Fig. 2. The size of urinary stones (source: Veterinary Clinic „Mokrynos")

Table 1. Urine test result

Parameter	Value
Color	reddish
Clarity	cloud
Specific gravity	1,040
pH	6,5
Protein	100 mg/dL
Urobilinogen	normal
Glucose	not found
Red blood cells	50 ery/µL
White blood cells	not found
Crystals	many struvites

Table 2. Blood test result

Parameter	Value	Unit	Min.	Max.	
Blood count					
MCV	75,2	Fl	62	72	⬆
MCH	25,2	Pg	20	25	⬆
MCHC	335	g/l	300	380	**ok**
Erythrocytes	9,03	T/l	5,5	8,5	⬆
Hematocrit	67,9	%	39	56	⬆
Hemoglobin	228	a/l	110	190	⬆
Leukocytes	9,5	G/l	6	17	**ok**
Thrombocytes	271	G/l	200	500	**ok**
Limphocytes	1,4	10^9/l	1	4,8	**ok**
Monocytes	0,5	x 10^9/l	0	1,8	**ok**
Eosinophiles	0,6	%	2	10	⬆
Limphocytes %	14,9	%	12	30	**ok**
Monocytes %	0,5	%	2	9	⬆
Granulocytes %	80	%	60	83	**ok**
MPV	10,2	fL	7	12,9	**ok**
Blood biochemistry					
ALT	80,454	U/l	3	50	⬆
AST	35,13	U/l	0	40	**ok**
AP	45,663	U/l	20	155	**ok**
Urea	32,421	mg/dl	20	45	**ok**

Table 3. Analysis of compositions of urinary stones

Parameter	Result
Carbonates	not found
Calcium	not found
Oxalate	not found
Ammonium	**present**
Phosphates	**present**
Magnesium	**present**
Urisacid	not found
Cystine	not found

RESULTS

On the day of the inspection there was a significant improvement in health. According to the owner's account, the female dog is urinating properly, no unproductive urge to urinate.

Urinalysis was performed twice, 3 months and 4 years after the operation to remove urinary stones (Table 4). The owners admitted that after a year of maintaining a proper acidifying diet, they went back to standard commercial dog food. The results indicate that urate stones do not form despite the failure to maintain the nutritional regime. To date, the owners have not reported any recurrence of bladder stones.

Table 4. Urine control test result

Parameter	Value „0"	Value after 3 months	Value after 4 years
Color	**reddish**	yellow	dark yellow
Clarity	**cloud**	clear	clear
Specific gravity	1.040	1,040	1,020
pH	6.5	5	6,5
Protein	**100 mg/dl**	not found	not found
Glucose	not found	not found	not found
Bilirubin	not found	untested	not found
Urobilinogen	normal	normal	normal
Ketones	not found	not found	not found
Red blood cells	**50 ery/ uL**	not found	not found
White blood cells	not found	not found	not found
Nitrites	found	not found	untested
Crystals	**many struvites**	fewstruvites	fewstruvites

DISCUSION

The presented case discusse a nine years old female dog. However, the scientific literature indicates that the formation of urate stones is not exclusive to older dogs (>7 years of age). Low's team in 2010 published results showing that 55.2% of struvite stones affected dogs under the age of 7 years. Another case is bladder stones in a 6-year-old mix-corgi (Houston and Eaglesome 1999). The case is unusual because the center of crystallization turned out to be a 3 cm sewing needle, which was probably brought to the bladder from the digestive tract. The resulting stone consisted of 80% ammonium magnesium phosphate minerals, 10% CaOx and 10% calcium phosphate, and hematuria was the only major symptom. Another interesting case was obstructive struvite ureteral calculi in a 4-month-old male Bernese Mountain dog (Ho and Lavallée 2022). Urolithiasis in such young dogs is most often associated with anatomical predisposition to the development of inflammation of the lower urinary tract, such as ureteral diverticula (Lulichet al. 1989; Visser et al. 2020) or patent ureter (Visser et al. 2020), but there were no anatomical abnormalities in the presented puppy. After surgical removal of the stones, there was no recurrence for a year, i.e. until the end of the study.

Struvite stones in dogs are formed primarily under the influence of *Staphylococcus* intermedius bacteria, less often by *Proteus mirabilis* (Osborne 1999b; Winiarczyk and Milczak 2022). These bacteria can hydrolyze urea to ammonia and carbon dioxide. This reaction causes an increase in urine pH, which promotes the formation of ammonium-magnesium

triphosphates (Winiarczyk and Milczak 2022). The normal pH of dog urine is slightly acidic, it should be in the range of 5.5–7 pH (Sink and Weinstein 2014). In the described case of a nine years old female urine parameters, i.e. pH and specific gravity, were normal. Leukocytes and bacterial cells were not found. This would suggest sterile urolithiasis, which is quite rare in dogs (Bartges et al. 1992). In this case, the formation of stones is responsible for the oversaturation of urine with compounds that form deposits which become the focus of crystallization. Such a situation may occur in patients who are not properly fed (dietary errors) or dehydrated (Winiarczyk and Milczak 2022). In turn, turbidity of the urine is associated with the presence of numerous struvite crystals and an increased amount of protein. The color of urine is caused by the presence of erythrocytes (Sink and Weinstein 2014; Jackowska-Pejko 2019). The increased amount of protein, the presence of erythrocytes and the condition of the bladder wall confirmed intraoperatively indicate a strong inflammation of the bladder, which was probably caused by irritation of the mucous membranes by stones filling the bladder. With sterile urolithiasis, it is enough to maintain a low pH to prevent recurrence (Bartges et al. 1992).

Treatment in this case included surgical intervention and removal of stones by cystotomy and antibiotic therapy. Cystotomy is commonly used to remove uroliths from the bladder (Grant et al. 2010). Other treatments available could include nonsurgical techniques such as urohydropropulsion or lithotripsy (Langston et al. 2010). Urohydropropulsion (like urination) is used to evacuate small urocystoliths by flushing them out through the urethra (Lulich et al. 1999; Langston et al. 2010). This technique can be used to remove uroliths <5 mm in diameter from male and female dogs weighing more than 8 kg, and uroliths <3 mm from another. Laser Lithotripsy involves using a laser in direct contact with uroliths for their fragmentation. With large uroliths the time required for this procedure may be lengthy (Adams 2006; Langston et al. 2010). The choice of treatment method depends on the size of stones and general condition of individual.

On the other hand, with struvite stones with features of bacterial infection, antibiotics (at least 1 month) and an appropriate diet can be used to dissolve the stones. Research on the effectiveness of this solution was carried out in 2019 by a research team by Dear's on a sample of 10 dogs of different breeds (2 crossbreeds, 2 boxers and 1 Great Pyrenees, miniature poodle, Chihuahua, Shih Tzu, Pomeranian, and Newfoundland). The weight range of these dogs ranged from 6.1 to 46.3 kg, and the mean age was 5 years (dogs from 2 to 10.5 years). For 5 out of 10 dogs with urolithiasis and inflammation of the lower urinary tract, a positive result of the therapy was obtained. The stones were able to dissolve in an average of 31 days (range 19–103 days). The remaining 5 dogs required surgical removal of the stones. Antibiotic therapy is needed because dissolution of stones may result in additional release of bacteria, even in the case of apparently sterile stones (Osborne et al. 1999b; Seaman and Bartges 2001). When attempting to dissolve struvite stones, control X-ray examinations are important to show whether the size of the stones is decreasing.

CONCLUSIONS

Correct diagnosis of bladder stones is usually not difficult for a veterinarian, but non-specific symptoms may go unnoticed for a long time by the owner. As in the described case, before the dog got to the veterinary clinic, the stones already filled a significant part of the bladder and significantly hindered voiding. Over time, a dog's health can get worse, and often surgery is the only solution at this stage. Another difficulty in the described case is the fact that some stones may not be visible in abdominal ultrasonography (Nelson and Counto 2010) and eliminate of bladder stones from differential diagnosis. The solution would be to use doppler examination (Kosiec-Tworus 2019) or take an X-ray picture of this area.

After all, the main recommendation for all animal owners is to make regular periodic examinations that will allow to notice irregularities at their initial stage, and in the case of struvite stones additionally strictly adhere to the recommended diet (Rinkardt and Houston 2004), especially that relapses occur in about 25% of dogs (Nelson and Counto 2010).

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KAMICA PĘCHERZA MOCZOWEGO U DZIEWIĘCIOLETNIEJ SUKI – OPIS PRZYPADKU

Streszczenie. Dziewięcioletnia suczka, mieszaniec, wykastrowana, trafiła do kliniki weterynaryjnej z problemem układu moczowego. Objawy narastały powoli przez ok. 6 miesięcy. W domu pies zachowywał się normalnie, nie wykazywał oznak bólu. W klinice wykonano badanie USG jamy brzusznej, które wykazało, że ściana pęcherza była pogrubiona. Nie stwierdzono innych cieniujących struktur. Podjęto decyzję o wykonaniu diagnostycznej laparotomii. W wyniku operacji usunięto 4 kamienie z pęcherza moczowego. Owalne kamienie o tępych krawędziach osiągały ok. 2 cm średnicy. Niespecyficzne objawy kamicy mogą pozostać niezauważone przez właściciela przez długi czas. Gdy pies trafi w końcu do kliniki weterynaryjnej, jedynym rozwiązaniem jest często chirurgicznie usunięcie kamieni, zwłaszcza jeśli kamica moczowa jest jałową kamicą moczową.

Słowa kluczowe: kamica moczowa, struwity, pies.