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RESEARCH ARTICLE

Clinicopathological Characteristics of Cats with Obstructive Lower Urinary Tract Disease in the Aydın Province (Turkey)

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ABSTRACT

The aim of this study was to retrospectively investigate the clinicopathological characteristics of cats with obstructive FLUTD in Aydin Province (Turkey) and the relationship of these features with short- (<36 hours) and long-term (≥36 hours) obstructions. A total of 27 adult cats of different breeds and ages with obstructive FLUTD were included in the study. Of these, 19 had short-term (Group 1), and 8 had long-term (Group 2) urethral obstruction history and clinical findings. Most of the cats with urethral obstruction were male, a mean age of 4.32±0.6 and cross-breed. Regarding the baseline characteristics, no obvious differences between the two groups. Besides localized symptoms such as dysuria, stranguria, oliguria/anuria, polysystemic findings such as dehydration, vomiting, and lethargy were statistically more frequent in the Group 2 cats compared to the Group 1. Pyuria, haematuria and proteinuria were the most common findings in the urinalysis. In cats with long-term obstruction (Group 2), azotemia and hyperkalemia were relatively severe and common. In conclusion, this study demonstrated that clinicopathological changes in cats with urethral obstruction are related to the duration of the obstruction. Considering the severity of both clinical findings and metabolic changes, emergency intervention in cats with urethral obstruction is of great importance.

Keywords: *Azotemia, Clinicopathology, Feline lower urinary tract disease, Urethral obstruction*

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Aydın İlinde (Türkiye) Obstrüktif Alt İdrar Yolu Hastalıklı Kedilerin Klinikopatolojik Özellikleri

ÖZ

Bu çalışmanın amacı, Aydın ilinde (Türkiye) obstrüktif FLUTD'li kedilerin klinikopatolojik özelliklerini ve bu özelliklerin kısa (<36 saat) ve uzun süreli (≥36 saat) tıkanıklıklarla ilişkisini retrospektif olarak araştırmaktı. Çalışmaya obstrüktif FLUTD'li farklı ırk ve yaşlarda toplam 27 yetişkin kedi dahil edildi. Bunlardan 19'u kısa süreli (Grup 1) ve 8'i uzun süreli (Grup 2) üretral obstrüksiyon öyküsü ve klinik bulgularına sahipti. Üretral obstrüksiyonu olan kedilerin çoğu erkek, genç-orta yaşlı (ortalama 4.32±0.6) ve melezdi ve iki grup arasında temel özellikler açısından belirgin bir fark yoktu. Disüri, strangüri, oligüri/anüri gibi lokalize semptomların yanı sıra dehidratasyon, kusma ve letarji gibi polisistemik bulgular Grup 2'deki kedilerde Grup 1'deki kedilere göre istatistiksel olarak daha sıktı. . Piyüri, hematüri ve proteinüri idrar tahlilinde en sık görülen bulgulardı. Uzun süreli obstrüksiyonu olan kedilerde (Grup 2) azotemi ve hiperkalemi nispeten şiddetli ve yaygındı. Sonuç olarak, bu çalışma üretral obstrüksiyonu olan kedilerde klinikopatolojik değişikliklerin obstrüksiyonun süresi ile ilişkili olduğunu göstermiştir. Hem klinik bulguların hem de metabolik değişikliklerin ciddiyeti dikkate alındığında üretra tıkanıklığı olan kedilerde acil müdahale büyük önem taşımaktadır.

Anahtar Kelimeler: *Azotemi, Klinikopatoloji, Kedi alt idrar yolu hastalığı, Üretral obstrüksiyon*

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INTRODUCTION

Feline lower urinary tract disease (FLUTD) is one of the common diseases in cats and includes disorders affecting the urinary bladder and/or urethra (Neri et al. 2016, Lew-Kojrys et al. 2017). Urinary tract infections, urethral plugs, uroliths, neoplasms, malformations and idiopathic diseases (ie, feline idiopathic cystitis) can result in FLUTD (Segev et al. 2010, Sævik et al. 2011). Regardless of the cause, it can have life-threatening consequences in cats. Urethral obstruction, a common (18-58%) consequence of FLUTD, is reported as a potentially life-threatening emergency in veterinary practice (Gerber et al. 2008, Segev et al. 2010, Fröhlich et al. 2016).

Although the most common causes of obstructive FLUTD are physical factors such as urethral plaques and uroliths, detrusor and urethral dysfunction can also cause it (Joseph et al. 1996, Segev et al. 2010). Clinical findings of obstructive FLUTD vary considerably depending on several factors, including the degree of urine outflow reduction, duration of the obstruction, and presence of secondary bacterial infection (Joseph et al. 1996). Obstructive FLUTD may cause localized lower urinary tract symptoms such as dysuria, hematuria, pollakiuria, and pain, as well as polysystemic findings associated with uremia and electrolyte disturbances, such as loss of appetite, vomiting, dehydration, and lethargy. Even the cases with delayed intervention may result in death. (Segev et al. 2010, Fröhlich et al. 2016). For all that, these findings in cats with obstructive FLUTD are often reversible with appropriate treatment and management (Neri el al. 2016). Survival is related to the clinician's immediate intervention by anticipating the vital metabolic and hemodynamic disturbances that may occur in the patient.

The clinicopathological features of cats with obstructive and/or non-obstructive FLUTD have been presented in regional studies (Gerber et al. 2005, Neri et al. 2016, Lew-Kojrys et al. 2017, Kovarikova et al. 2020). However, it is well known that climatic, environmental, dietary and behavioural factors play a role in the etiopathogenesis of this disease (Sumner and Rishniw 2017). To the best of our knowledge, no study examining the clinicopathological features of cats with obstructive FLUTD under considering the duration of obstruction in Turkey. This study aimed therefore to describe the signalment, clinical findings, and results of the urinalysis and blood biochemical analysis of cats with obstructive FLUTD in the Aydın province (Turkey) and to evaluate the clinicopathological characteristics under the short- (<36 h) and the long-term (≥36 h) urethral obstruction.

MATERIAL and METHODS

Animals

This study was carried out retrospectively using the data records of the cats treated for obstructive FLUTD in Aydin Adnan Menderes University Veterinary Teaching Hospital during the period 2018-2021. Urethral obstruction was diagnosed on the basis of clinical history of strangury, pain at abdominal palpation (central hypogastric region), and distension of the urinary bladder associated with ischuria. Obstruction was also diagnosed when the bladder size was normal, but calculi were seen in the urethra, or obvious resistance was experienced with urethral catheterization. Cats were excluded from the study if they had other known concurrent diseases such as diabetes mellitus, liver disease or chronic kidney disease, or had been treated with any medication such as steroids or diuretics. A total of 27 cats with obstructive FLUTD were assessed in this study. The cats enrolled in the study were evaluated as for the effect of the duration of obstruction on clinical and laboratory parameters and divided into 2 groups. According to the medical history and clinical findings, cats with signs of urethral obstruction for up to 36 hours were defined as Group 1 (n=19), and cats with signs of obstruction for more than 36 hours as Group 2 (n=8).

Procedures

Medical history data including the signalment and complaints (pollakiuria, dysuria, hematuria, stranguria and vomiting) of the cats obtained from the owner, were recorded. Vital signs (dehydration, lethargy, and collapse) of the patient were evaluated with a detailed physical examination. All the evaluation procedures were performed without any sedation or anaesthesia.

Urine and blood samples were collected on the patient admission, with initial IV catheter placement and prior to medical intervention. Urine samples were taken with a urinary catheter from all cats in the Group 1. Except for 3 cats with cystocentesis, urine samples were obtained by urinary catheter in the Group 2 cats. Urinalysis included determining urine specific gravity (SG) by refractometer, dipstick chemistry (Combur-Test; Roche Diagnostics, Germany), and urine sediment cytology. In the cytological examination of the urine sediment, epithelial cells, struvite crystals and bacteria were noted.

Blood samples were taken into a 2 ml serum separation tube (Vacutainer, Beckton, Dickenson) and into a 2 ml heparinized blood gas injector during IV catheterization. Blood gas analysis was performed with Irma Trupoint Blood Analysis System (USA). These blood gas analysis outputs obtained the blood potassium (K) data discussed in this study. Blood samples in serum separation tubes were centrifuged after clot retraction at 2000 x g for 10 min to obtain sera. Serum creatinine (CREA) and blood urea

nitrogen (BUN) concentrations were measured with the Spotchem EZ SP-4430 device (Japan). Azotemia was defined as mild (BUN 30–50 mg/dL and CREA 2-3 mg/dL) and moderate-severe (BUN ≥ 50 mg/dL and CREA ≥ 3 mg/dL). Hyperkalemia that can be seen in cats with obstruction was also classified as mild (5–6 mmol/L) and moderate-severe (>6 mmol/L) (Mauro et al. 2020).

Statistical Analysis

Statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) version 19.0 (IBM Corporation, Armonk, USA). All the graphics were drawn using GraphPad 8.0.2 (San Diego, CA, USA). The distributions of all continuous variables were evaluated by the Shapiro–Wilk test. Accordingly, urine SG and pH, and blood Na and K values were normally distributed, while serum BUN and CREA concentrations were not normally distributed despite log transformation. Means, standard error of means (SEM), medians and interquartile ranges (IQR) for each continuous parameter were calculated using descriptive statistics. Independent sample *t*-test or Mann–Whitney test was used to compare continuous variables between the Groups. Categorical variables (clinical signs and results of urinalysis) were described using percentages (%). The Chi-Square test (Fisher's exact test or Pearson Chi-Square test) was used to compare these variables. All analyses were considered statistically significant at $P< 0.05$.

RESULTS

The baseline characteristics, clinical findings, urinalysis results and azotemia-hyperkalemia evaluations of cats with obstructive FLUTD examined in this study are presented in Table 1, Table 2, Table 3 and Table 4, respectively. The blood biochemical results of the study groups, including BUN (A), CREA (B), and K (C), are shown in Figure 1.

A total of 27 cats with obstructive FLUTD were included in the study. Of these, 19 had short-term (Group 1), and 8 had long-term (Group 2) urethral obstruction history and clinical findings. Twenty-three (85.18%) of the cats were male. Although the ages of the cats evaluated in this study ranged from 8 months to 10 years, obstructive FLUTD was more common in cats aged 2-6 years. Thirteen (48.1%) of 27 patients examined were cross-breed followed by Persian cats with 14.81% (Table 1). There were no significant differences between the Group 1 and Group 2 regarding age, sex and breed.

All cats with obstructive FLUTD had dysuria, stranguria, oliguria/anuria, abdominal pain, and distended bladder findings in the medical history and clinical examination. Additionally, polysystemic findings such as dehydration, vomiting, and lethargy were statistically more frequent in the Group 2 cats compared to the cats of Group 1. Only 1 of the Group 2 cats died, and thus the total mortality was determined as 3.70% (Table 2).

Urinary catheterization was used to obtain the urine sample as part of the therapeutic protocol in cats with obstructive FLUTD. However, necessary cystocentesis was performed in 3 cats in Group 2 as part of the emergency response. The urine specific gravity ranged from 1.005 to 1.060 (mean 1021.29±2.94). The urine pH ranged from 6 to 9 (mean 8.01±0.13). Different degrees of positive reaction for protein (96.29%), blood (96.29%) and leukocytes (100%) in the urinary dipstick was seen in almost all urine samples. Pyuria was seen more intensely in the urine of the Group 2 cats compared to the Group 1 cats. Microscopic examination of urine sediments revealed epithelial cells in 85%, bacteria in 74% and struvite crystals in 14% (Table 3).

Serum BUN, CREA and whole blood K concentrations were measured in terms of the risk of postrenal azotemia and hyperkalemia. Accordingly, of the 27 cats with obstructive FLUTD evaluated, 14 were azotemic (51.85%). Moderate-severe azotemia was determined in almost all cats (7; 87.5%) in the Group 2, while it was present only 1 (3.70%) of the cats in the Group 1. Mild hyperkalemia in five (4 in Group 1 and 1 in Group 2) and moderate-severe hyperkalemia in four cats (all in Group 2) of the 27 patients with obstructive FLUTD were determined (Table 4.) Blood BUN, CREA and K concentrations of the Group 2 cats were found to be higher ($P<0.001$) than those of the cats in the Group 1 (Figure 1).

Table 1. Baseline characteristics of cats with obstructive FLUTD in this study.

	Total	Group 1	Group 2
Number of cats (%)	27	19	8
Age (mean ± SEM)	4.32±0.6	4.96±0.82	3.56±0.84
Sex			
Males	23 (85.1%)	15 (78.9%)	8 (100%)
Females	4 (14.81%)	4 (21.05%)	0
Breed			
British Shorthair	3 (11.11%)	1 (5.2%)	2 (25%)
Persian	4 (14.81%)	2 (10.52%)	2 (25%)
Scottish Fold	3 (11.11%)	2 (10.52%)	1 (12.5%)
Siamese	3 (11.11%)	3 (15.78%)	0
Angora	1 (3.70%)	1 (5.2%)	0
Cross-breed	13 (48.1%)	10 (52.6%)	3 (37.5%)

Group 1 and Group 2 describe cats with FLUTD showing signs of short (<36 hours) and long-term (≥36 hours) urethral obstruction, respectively.

Table 2. The clinical signs of cats with obstructive FLUTD in this study.

	Total	Group 1	Group 2	P
Number of cats (%)	27	19	8	
Dysuria	27 (100%)	19 (100%)	8 (100%)	-
Oliguria/anuria	27 (100%)	19 (100%)	8 (100%)	-
Pollakiuria	7 (25.92%)	6 (31.57%)	1 (12.5%)	0.301
Vomiting	10 (37.03%)	4 (25.05%)	6 (75%)	**0.014**
Haematuria	22 (81.48%)	15 (78.94%)	7 (87.5%)	0.528
Dehydration	15 (55.55%)	8 (42.10%)	7 (87.5%)	**0.038**
Lethargy	9 (33.33%)	4 (25.05%)	5 (62.55%)	**0.049**
Inappetence	20 (74.07%)	12 (63.15%)	8 (100%)	0.057
Mortality	1 (3.70%)	0	1 (12.5%)	-

Group 1 and Group 2 describe cats with FLUTD showing signs of short (<36 hours) and long-term (≥36 hours) urethral obstruction, respectively.

Table 3. The results of the urinalysis of cats with obstructive FLUTD in this study.

	Total	Group 1	Group 2	P
Number of cats (%)	27	19	8	
SG (mean±SEM)	1021.29±2.94	1022.36±3.27	1018.75±6.46	0.585
PH (mean±SEM)	8.01±0.13	7.92±0.12	8.25±0.35	0.273
Dipstick – protein	26 (96.29%)			0.815
0	1 (3.70%)	1 (5.25%)	0	
1+	3 (11.11%)	2 (10.52%)	1 (12.5%)	
2+	11 (40.74%)	8 (42.10%)	3 (37.5%)	
3+	12 (44.44%)	8 (42.10%)	4 (50%)	
Dipstick – blood	26 (96.29%)			0.810
0	1 (3.70%)	1 (5.25%)	0	
1+	7 (25.92%)	5 (26.31%)	2 (25%)	
2+	7 (25.92%)	5 (26.31%)	2 (25%)	
3+	12 (44.44%)	8 (42.10%)	4 (50%)	
Dipstick- leukocytes	27 (100%)			**0.006**
0	0	0	0	
1+	1 (3.70%)	1 (5.25%)	0	
2+	6 (22.22%)	5 (26.31%)	1 (12.5%)	
3+	20 (74.07%)	13 (68.42%)	7 (87.5%)	
Urine sediment				
Epithelial cells	23 (85.18%)	16 (84.21%)	7 (87.5%)	0.663
Struvite crystals	4 (14.81%)	2 (10.52%)	2 (25%)	0.337
Bacteria	20 (74.07%)	13 (68.42%)	7 (87.5%)	0.301

Group 1 and Group 2 describe cats with FLUTD showing signs of short (<36 hours) and long-term (≥36 hours) urethral obstruction, respectively.

Table 4. Evaluation of azotemia and hyperkalemia in cats with obstructive FLUTD in this study.

	Total	Group 1	Group 2
Number of cats (%)	27	19	8
Azotemia	14 (51.85%)	5 (26.31%)	8 (100%)
Mild	6 (22.22%)	4 (21.05%)	1 (12.5%)
Moderate-severe	8 (29.62%)	2 (10.52%)	7 (87.5%)
Hyperkalemia	9 (33.3%)	4 (21.05%)	5 (62.5%)
Mild	5 (18.51%)	4 (21.05%)	1 (12.5%)
Moderate-severe	4 (14.81%)	0	4 (50%)

Group 1 and Group 2 describe cats with FLUTD showing signs of short (<36 hours) and long-term (≥36 hours) urethral obstruction, respectively.

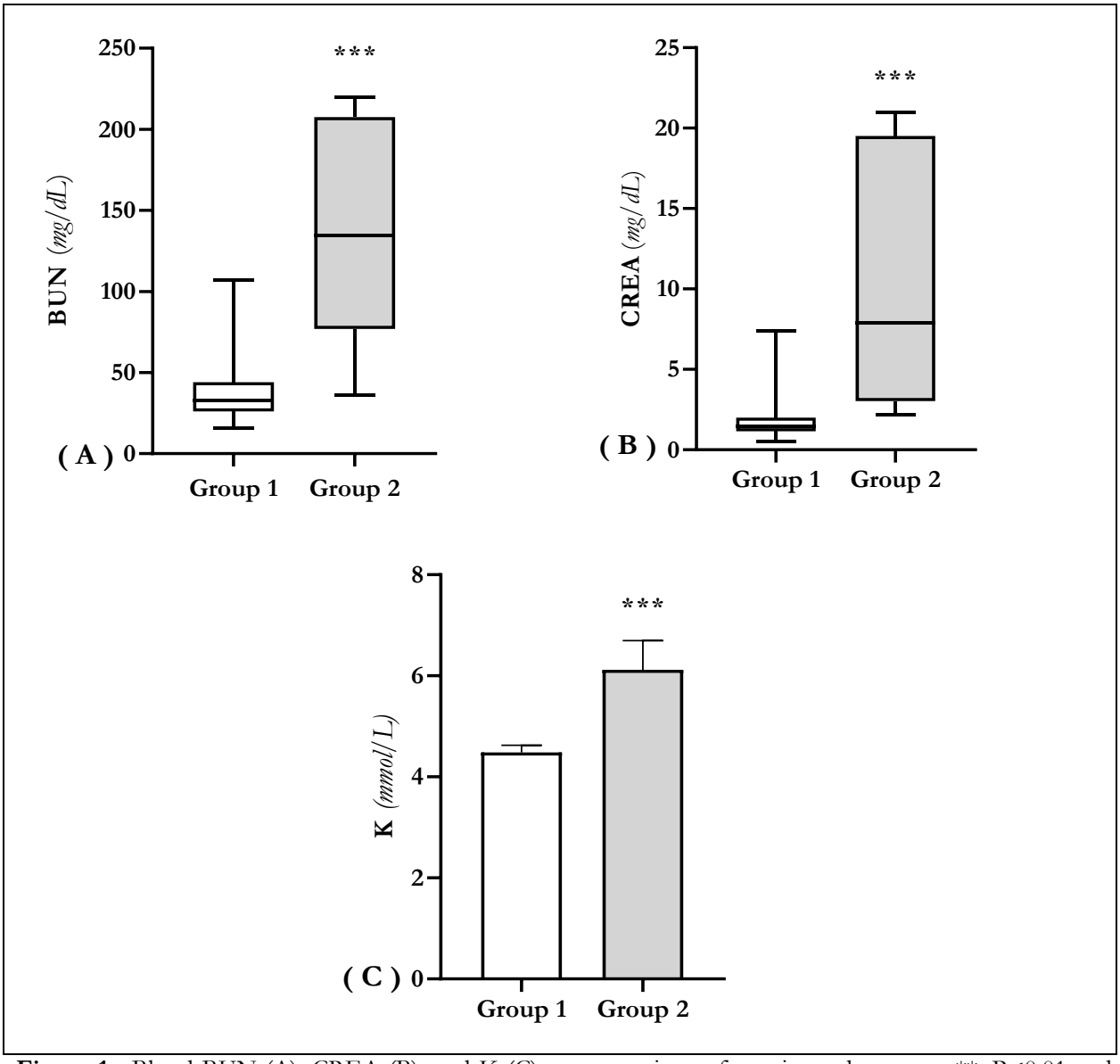

Figure 1: Blood BUN (A), CREA (B), and K (C) concentrations of cats in study groups. **: P<0.01 and ***:P<0.001

DISCUSSION

Urethral obstruction is a life-threatening complication reported to occur in 18-58% of cats with FLUTD (Gerber et al. 2005, Gerber et al. 2008). In this study, clinicopathological characteristics of cats with obstructive FLUTD in Aydın province (Turkey) and the relationship of these features with short (<36 h) and long-term (≥36 h) obstructions were evaluated retrospectively.

The incidence and causes of FLUTD are affected by age, sex, and breed. A gradual decrease in the frequency of idiopathic cystitis and urethral obstruction and an increase in the frequency of urinary tract infections with age are reported (Lekcharoensuk et al. 2001, Segev et al. 2011, Kovarikova et al. 2020). The fact that most of the cats evaluated in this study consisted of young and middle-aged (2-6 years) is consistent with previous data (Lekcharoensuk et al. 2001, Segev et al. 2011). On the other hand, in a study (Mauro et al. 2020) evaluating post-mortem urinary tract changes in cats with urethral obstruction, the mean (7.4 years) age was older and this is attributable to the fact that chronic diseases such as chronic kidney disease and cystitis may increase the risk of urethral obstruction. The age-related difference between the studies may be explained by the variety in the cat population evaluated for the purposes. In this context, cats with diseases such as chronic kidney disease or diabetes mellitus that are considered increasing risk factor for urethral obstruction was not enrolled in our study. Urethral obstruction are reported almost exclusively in male cats due to their relatively long and narrow

urethra, similar to our results in Table 1 (Lee and Drobatz 2003, Segev et al. 2011, Sumner and Rishniw 2017). The most cat breed affected by obstructive FLUTD in this study were cross-breed which are the most common cats in Turkey. The second was Persian cats. Lekcharoensuk et al. (2001) described that the risk of FLUTD may be higher in Persian and Himalayan cats, although no breed predisposition has been determined (Lekcharoensuk et al. 2001, Saevik et al. 2011, Kovarikova et al. 2020). There are no obvious differences in the baseline characteristics of cats between the Group 1 and Group 2 in this study (Table 1). The duration of obstruction may be related to the owner's interest and early recognition of the signs rather than the baseline characteristics of the cats.

Clinical findings in cats with obstructive FLUTD vary depending on the extent of inflammation of the urinary system, the degree and duration of the obstruction (Joseph et al. 1996). Affected cats may present with symptoms localized to the urinary system such as dysuria, stranguria, oliguria/anuria, distended bladder and abdominal pain, and/or polysystemic findings such as dehydration, vomiting, lethargy, and collapse (Segev et al. 2011, Neri et al. 2016). The clinical signs observed in all the study cats were in agreement with previous above-mentioned reports. Polysystemic findings such as dehydration, vomiting, and lethargy were higher proportion in the Group 2 cats compared to the Group 1 (Table 2). In fact that no patient died in the Group 1, while one cat of the Group 2 died due to collapse. One explanation for this may be that the clinical severity of the disease and mortality are closely related to the duration of the obstruction.

Hematuria, proteinuria, and pyuria are the most observed findings in urinalysis (Fischer et al. 2009, Kovarikova et al. 2020). The pressure in the bladder increases because the urine flow cannot be fully ensured in urethral obstruction. Hematuria may be associated with submucosal bleeding due to high intravesical pressure. Submucosal haemorrhage and necrosis of the epithelium within 10 hours after obstruction occur (Fischer et al. 2009, Kovarikova et al. 2020). The origin of the proteinuria in cats with obstructive FLUTD is most likely post-renal (Segev et al. 2011). Inflammatory processes both as a cause and a consequence of the obstruction result in varying degrees of pyuria (Segev et al. 2011). The most common findings in the urinalysis of this study cats (Table 3) were haematuria (96.29%), proteinuria (96.29%) and pyuria (100%). The changes and frequency observed in urinalysis in our study are in concordance with previous studies and can be explained by similar reasons. However, it must be noted that dipsticks may cause false readings, especially in the presence of severe hematuria. Therefore, the high proportion of proteinuria and pyuria should be interpreted with caution. These parameters in urine were analyzed only by dipstick.

Obstructive FLUTD is the most common and vital cause of post-renal acute kidney injury. Acute kidney injury results from increased pressure within the renal pelvis and ureter that decreases renal blood flow and glomerular filtration rate. Loss of renal function and acute renal injury have been reported within 24 hours of the obstructive event. The primary biochemical changes of acute kidney injury are azotemia and hyperkalemia (Joseph et al. 1996, Fischer et al. 2009). Previous studies have highlighted these biochemical changes associated with acute renal injury in cats with obstructive FLUTD. In a retrospective study (Kyles et al. 2005), 83% of cats with 163 urethral stones had azotemia, and 35% had hyperkalemia. Similarly, Segev et al. (2011) reported that the most common biochemical abnormalities in cats with urethral obstruction are azotemia (85%), hyperkalemia (48%), hypercalcemia (56%), and hyponatremia (55%). However, the evaluation in these studies has not been performed by the duration of urethral obstruction. The changes in serum BUN and CREA, and blood K concentration are shown in Figure 1. Azotemia was found to be 26% and 100% of cats with FLUTD showing signs of short-term (Group 1) and long-term (Group 2) obstruction, respectively. Similarly, moderate-to-severe hyperkalemia was not detected in any of the cats in Group 1, whereas moderate-severe hyperkalemia was detected in half of the cats in Group 2. More severe and polysystemic clinical manifestations in cats with long-term obstruction are closely related to azotemia and hyperkalemia, as noted in previous studies (Joseph et al. 1996, Fischer et al. 2009, Neri et al. 2016).

CONCLUSION

This is the first study to assess the clinicopathological features of cats with obstructive FLUTD in Aydın province. The clinicopathological changes in cats with urethral obstruction for more than 36 hours were more severe compared to the cats with urethral obstruction for less than 36 hours; however, these changes are mostly reversible with early intervention and appropriate treatment. Therefore, it is crucial to predict the complications that may occur in cats short and long term urethral obstructions and to intervene immediately by veterinary clinicians.

Conflict of Interest: The authors declare that there is no conflict of interest for this article and no financial support has been received

Ethical Permission: This study was carried out retrospectively using the data records of the cats that were treated for obstructive FLUTD in Aydın Adnan Menderes University Veterinary Teaching Hospital. No animal material was used.

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