RESEARCH ARTICLE Agricultural Reviews, Volume 46 Issue 6: 1013-1017 (December 2025)

Preliminary Management of Feline Lower Urinary Tract Diseases in Egypt Cat Population

Shimaa Ayoub[1], Mohamed Mostafa[1], Ahmed Abdelgalil[1]

10.18805/ag.RF-316

ABSTRACT

Background: The aim of this study was to determine the preliminary management efficacy of feline lower urinary disease (FLUTD) mainly urethral obstruction, feline idiopathic cystitis (FIC), urolithiasis and urinary tract infection (UTI).

Methods: The study was conducted on 56 cats admitted with clinical signs of FLUTD. Physical examination, hematologic, biochemical, urinalysis, diagnostic imaging, stone analysis surgical, dietary treatment outcomes were described.

Result: Decompressive cystocentesis, urethral catheterization and placement of an indwelling catheter combined with medical therapy and dietary management have apparent beneficial effects on increasing survival discharge rate (89.5%) and decreasing the recurrence of clinical signs (16.0%) in cats with FLUTD. FIC treatment were included reduce stress, non-steroid anti-inflammatory, oral glucosamine and dietary changes. Amoxicillin/clavulanic and ciprofloxacin drugs were the most appropriate for UTI.

Key words: Cats, Dietary changes, Indwelling catheter, Medical therapy, Urethral catheterization.

INTRODUCTION

The preliminary management included decompressive cystocentesis, urethral catheterization and placement of an indwelling catheter to restore urethral patency in combination with medical therapy and dietary changes. Therapies were based on eliminating pain, infection, hyperkalemia and electrolyte imbalance. Non-steroid anti-inflammatory; specific sensitive antimicrobials, oral glucosamine and dietary changes were applied. Dry foods were changed to moist foods. Dissolution therapy was recommended in struvite and urate uroliths. Surgical cystotomy and perineal urethrostomy were performed in urethral stones especially calcium oxalate. The protocol had apparent beneficial effect on increasing discharge rate from the hospital free FLUTD clinical signs and low recurrence rate. The data gives an encourage to owners and veterinarians to pursue treatment of cats with FLUTD. Obstructive urolithiasis of lower urinary tract is the most common condition affecting all domestic animals (Kinjavdekar *et al*., 2004). Urolithiasis is a very common condition of dogs and almost all breeds are affected (Parmar *et al.,* 2021). Feline lower urinary tract disease (FLUTD) includes urethral and/or bladder disorders (Yaser and Ozkan, 2017; Saevik *et al.,* 2011). The most clinical causes of the lower urinary tract reported in European cats were uroliths occurred in (22%), urethral plugs in (10%) and urinary tract infection in (8%) and (57%) with feline idiopathic cystitis (Gerber *et al.,* 2005). The common causes of FLUTD in Egypt (Ayoub *et al.,* 2024) were urolithiasis (37.5%), feline idiopathic cystitis (33.9%), (14.2%) urinary tract infection (UTI), urethral plugs in (10.7%) and Neoplasia in (3.5%).

Risk factors associated with FLUTD were included obesity, inactivity, in-door housing, litter hygiene, dry foods and multi cat households (Segev *et al*., 2011; Dorsch *et al*., 2014, Ayoub *et al*., 2024). Treatment of FLUTD is based on the specific cause and condition.

Urethral obstructions (UO) were classified in one study as urethral plugs (59%) and idiopathic (29%),uroliths (12%) (Kruger *et al.,*1991). The reported common causes of UO were urethral plugs, Urolithiasis and Feline Idiopathic cystitis (Saevik *et al*. 2011; Dorsch *et al*., 2014; Nururrozi *et al*., 2020; Ayoub *et al.,* 2024). Medical management consists of substitute electrolyte imbalances, reduce visceral pain, maintain adequate tissue perfusion, dissolving foods and alleviate urethral obstruction (Cooper *et al.* 2010; Hall *et al.* 2015).

Ongoing obstruction induced fatal hyperkalemia, dehydration, hypocalcaemia and acidosis that need to be corrected. Acidosis and hyperkalemia resolve well with using a balanced electrolyte intravenous solution such as lactated Ringer's solution for adequate rehydration and stabilizing the patient as well as Perineal urethrostomy and cystotomy were recommended. (Hostutler *et al*. 2005).

Gerber *et al*. (2008) found that 51% of cats with UO had recurrent signs of FLUTD, 36% re-obstructed and 23% were euthanized. Some studies reported that, 16% of cats

[1]Department of Veterinary Surgery Anaesthesiology and Radiology, Faculty of Veterinary Medicine, Cairo University, Giza, P.O. Box: 12211, Egypt.

Corresponding Author: Mohamed Mostafa, Department of Veterinary Surgery Anaesthesiology and Radiology, Faculty of Veterinary Medicine, Cairo University, Giza, P.O. Box: 12211, Egypt. Email: barakat1955@cu.edu.eg

How to cite this article: Ayoub, S., Mostafa, M. and Abdelgalil, A. (2025). Preliminary Management of Feline Lower Urinary Tract Diseases in Egypt Cat Population. *Agricultural Reviews*. **46(6):** 1013-1017. doi: 10.18805/ag.RF-316.

Submitted: 07-02-2024 **Accepted:** 09-12-2024 **Online:** 21-03-2025

died because of urethral obstruction and 35% suffered from recurrence of the obstruction (Bovee *et al*., 1979). Therefore, the objective of the study was to evaluate the preliminary management of FLUTD in cat population in Egypt.

MATERIALS AND METHODS

This study was conducted on 56 cats diagnosed with FLUTD of different ages. The ages were mean ±SD (8.56±3.23) collected from surgery clinics, Faculty of Veterinary Medicine, Cairo University. The population studied comprised 48 Persian, 4 Egyptian Mau, 3 Siamese and one Short hair scotch. All cats were in-door breeding and fed mainly dry food. Cats were diagnosed based on physical examination (body temperature, heart and respiratory rates), clinical signs (dysuria, hematuria, stanguria, pollikuria, periuria), abdominal radiography and ultrasonography, urine analysis, urine bacterial culture, blood hematology and biochemistry were determined (Ayoub *et al.,* 2024). Urinalysis included determination of urine pH, urine specific gravity by refractometer, urine sediment cytology and urine culture. Hematological and serum biochemical (serum creatinine concentration, blood urea nitrogen (BUN), serum calcium, phosphors and potassium were performed using (Analyzer, Sensozne (company) STAT LAB2 (model) 2018, Obour city, Cairo, Egypt).

Urinary calculi were analyzed by Fourier transformation infrared spectroscopy (FT-IR) to determine the mineral composition of the stone (Gomes *et al*. 2022).

Management of FLUTDs

Urethral obstruction and urolithiasis were included decompressive cystocentesis, cauterization and placement of an indwelling catheter, intravenous crystalloid fluids (lactated Ringer's solution or saline 0.9% at dose rate 10 to 30 mg/kg). Non steroid anti-inflammatory was given Alpha amylase (Maxilase®)[1] one spoon once daily for a week). Amoxicillin/clavulanic (Synloux®)[2] that was given S/C with a dose of 12.5 mg/kg body weight daily.

Dissolving diets (S/O ROYAL CANIN veterinary diet) containing balanced levels of protein and minerals to dissolve struvite stones. Calcium oxalate stones, feeding the cats with high moisture foods and diets high in sodium were recommended to increase water intake. Surgical Cystotomy to remove calcium oxalate calculi were performed in 8/17 cats. Perineal urethrostomy was performed in 4/4 cats with urethral stones. Management urate uroliths through given dietary modification low in protein and urine alkalization (Urofree®)[3] syrup (containing vitamin C, ammonium chloride, sodium acid phosphate, hexamine and horse tail extract) one spoon once daily for 3 weeks.

FIC management were included diet change from dry to moisture foods, increase water intake, reduce environmental stress and avoid multiple cat households. Oral glucosamine (Genuphil syrup®)[4] one spoon orally daily for 14 days. Non steroid anti-inflammatory was given (Alpha-amylase- Maxilase one spoon once daily for a week). Feline urinary tract infection (UTI) management was given Amoxicillin/clavulanic (Synloux 12.5 mg/kg bw daily S/C) or (ciprofloxacin®)[5] with dose of 20- 25 mg/kg daily 14 days.

Survival and recurrence

Survival successes were defined as cats discharged from the clinic free of FLUTD clinical signs (defined as spontaneous urination, normal urine stream and empty bladder after voiding and discharged from the hospital. Failure of treatment defined as failure to have spontaneous urination, unable to urinate or only voiding drops of urine with a distended bladder. Recurrence FLUTD defined as cats had signs of FLUTD and failure to have spontaneous urination associated with the recurrence obstruction after discharged. Recurrence of signs and UO were obtained from the owners by a telephone interview. The assessments of treatment were the follow-up period was 12 months.

Statistical analysis

Normality of distribution was assessed using the Shapiroe Wilk test. Data analyses were conducted using SPSS statistic pro-grams version 17 (IBM Corp., NY, USA). Descriptive statistics (mean, standard deviation and percentages) were calculated. The independent paired sample t-test was selected for comparison between recovered and recurrence groups followed by Mann-Whitney test has been used to compare the values obtained from recovered and recurrence groups. Significant was considered at ($P<0.05$).

RESULTS AND DISCUSSION

All cats with FLUTD were treated with a combination of medical treatment; re-establish a urethral patency through decompressive cystocentesis, urethral catheterisation and an indwelling catheters for up to 5 days in all cats. Intravenous crystalloid fluids (lactated Ringer's solution or saline 0.9%), anti-biotic, anti-inflammatory were given. Treatment success was defined as spontaneous urination, normal urine stream and empty bladder after voiding and discharged from the hospital. Successful survival to discharge rate was 89.2%.

Manufacturers' addresses

1 SANOFI AVENTIS, Egypt.

2 PFIZER, New York, USA.

3 MEDICINE, Elsadat, Egypt.

4 EVA pharma, Giza, Egypt.

5 FIDSON, ObanikoroLagos, Nigeria.

Table 1: Physical examination parameters between FLUTD groups in 56 cats in Egypt.

Parameters	FIC (n=19)	U plugs (n=6)	UTI (n=8)	Urolithiasis (n=21)	Neoplasia (n=2)	Reference range	P value
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD		
Temperature (°C)	38.33±0.29	38.2±1.06	39.5±0.71	39.1±0.88	38.1±0.9	38.1-39.2	0.421
Heart rate/min.	141.6±2.89	137.5±17.68	137.5±17.68	142.0± 3.65	144.2±5.13	120-140/min.	0.985
Respiratory rate/min	39.33±5.13	41.5±12.02	42.5±10.61	38.4 ± 4.2	38.1±5.06	15-30/min.	0.849

Significant at (P<0.05).

Feline Idiopathic cystitis (FIC); Urethral plugs (U plugs); Urinary tract infection (UTI).

Physical examination (body temperature, heart and respiratory rates) were recorded. Mild tachycardia was observed in FIC and urolithiasis diagnosed groups. Increased respiratory rates/min (tachypenia) were noticed in all groups of diagnosed FLUTD but did not reach significant (Table 1).

Complete recovery without recurrence after 12 months was 53.5% and the recurrence rate with clinical signs of FLUTD within 12 months follow up was 16.0%. Treatment failure was (12.5%) and defined as failure to have spontaneous urination, unable to urinate or only voiding drops of urine with a distended bladder (Table 2).

The clinicopatholgical comparison between complete recovery and recurrence FLUTD among cats (Table 3) displayed recurrence FLUTD had azotemia with high significant (P<0.001) increase in Serum creatinine and BUN concentrations compared with complete recovery cats. Cats with recurrence had hyperkalemia and high increase in serum potassium concentration (6.72±1.16 mg/dL). The reference range was 3.2 to 5.6 mg/dL. The serum potassium, calcium and phosphors concentrations were increased above the reference range but the difference did not reach statistical significance.

The recommendation for the owners was advised to add water to the food. Antibiotic treatment after discharge for 14 days. As well as reduce environmental stress, litter hygiene, access fresh water, increased contact between the owner and the cat.

Successful survival discharge rates was 89.2% after managed with dietary changes and medical therapy including de-compressive cystocentesis, urethral catheterization, placement of an indwelling catheter, intravenous balanced electrolyte solution, anti-inflammatory, Glucoseaminoglycan and specific feline antimicrobial drugs. Complete recurrence recovery was 53.5% after 12 months follow up. Similar findings have been previously reported (Cooper *et al.,* 2010; Gerber, 2011; Segav *et al*., 2011; Grauer, 2013; Hall *et al*., 2015).

Immediate treatment was successful with higher survival rates (89.2%) in the current study. This consistent with previously reported survival rates of 91.1% (Lee and Dbrobatz, 2003) and 94.2% (Gerber *et al*., 2008).

Urethral obstruction in cats in Egypt was reported 42.2% (Ayoub *et al.,* 2024). In this respect, urethral obstruction was reported 58.4%in Switzerland (Gerber

Table 2: Overview of follow up treatment percentages on 56 cats with FLUTD.

Parameters	Complete Recovery	Recurrence	Failure
Urolithiasis (n=21)	8	0	2
Urethral plugs (n=6)	6	2	2
FIC (n=19)	12	4	0
UTI (n=8)	4	3	1
Neoplasia (n=2)	0	0	2
Total	30 (53.5%)	9 (16.0%)	7 (12.5%)

Feline Idiopathic cystitis (FIC); Urinary tract infection (UTI).

et al., 2005), 52.6% in Germany (Dorsch *et al.,* 2014), 28.6% in Norway (Saevik *et al*., 2011). Urethral obstructions were mainly due to urethral spasm, intraluminal inflammation, inflammatory debris, consuming dry food, living in-doors and crystals formations. The same have been previously reported in FLUTD (Dorsch *et al.,* 2014; Kennedy and White, 2021). Moreover, it has been proposed that indoor cats are less active and presumably urinate less frequent (Houston *et al.,* 2003). In addition, Markwell *et al*. (1998) found that consuming a food with 75% moisture versus a food with 10% moisture was associated with increased urine volume and decreased urinary specific gravity (USG). Higher urination frequency and lower urinary crystal activity product are associated with increased urine volume and decreased USG (Segav *et al*., 2011).

Cats with urolithiasis had no recurrence signs of lower urinary tract disease than the other FLUTD groups in the present study. This could be due to uroliths are easily identified and usually treated right away. However, FIC and urethral plugs revealed recurrence signs of FLUTD due to there is no clear effective treatment or prophylaxis. The same findings have been reported previously (Lulich *et al.,* 1996; Gerber *et al.,* 2008 and Segav *et al.,* 2011).

Bass *et al*. (2005) found that, Perineal urethrostomy is considered a good safe successful treatment outcome in cats with urethral obstruction. Contrary, Gerber *et al.* (2008) reported that half of the cats had no recurrent clinical signs and half of the cats have recurrent clinical signs of urethral obstruction after urethrostomy.

Lee and Drobatz (2003), Bovee *et al.* (1979); Gerber *et al.* (2008) found that, the mortality rate of UO was 8.9%. The reported mortality rate in the current study was

Table 3: Descriptive statistics for the (Mean ± SD) creatinine, BUN, Calcium, phosphorus and potassium in both recovered and recurrence FLUTD groups.

Parameters	Recovered Mean±SD	Recurrence Mean±SD	Reference range	P value
Creatinine (mg/dl	2.38±4.63	6.33±4.57	0.9-2.2	d≤0.0001
BUN (mg/dl)	20.56±6.55	53.14±25.07	20-34	d≤0.0001
Calcium (mEq/L)	7.2±2.43	8.72±4.39	8.2-10.8	0.102
Phosphorus (mEq/L)	5.56±1.17	6.96±1.74	3.0-7.0	0.094
Potassium (mEq/L)	4.53±1.38	6.72±1.16	3.5-5.6	0.007

Blood urea nitrogen (BUN).

12.5%. The difference in the outcome may be attributed to the influence of the climate, housing, environment and food management (Segav *et al.,* 2011). Furthermore, several studies were performed in referral cases (Kruger *et al.* 1991; Lekcharoensuk *et al.,* 2001) and other studies were depended in referral cases as well as on the first opinion cases (Gerber *et al.,* 2005 and Saevik *et al.,* 2011; Dorsch *et al*., 2014). However, this study was depended mainly in first opinion cases.

The findings of failure of treatment in the present study were attributed to the hypothermia (rectal temperature <35.5), bradycardia (Heart rate <120), azotemia (Serum creatinine >4.4 mg/dl, serum BUN > 80 mg/dl). This goes parallel agreement with (Copper *et al.* 2010; Hall *et al*. 2015) in cats with urethral obstructions. Lee and Drobatz (2003) concluded that, systemic signs may be life threatening and occur mainly due to accumulation of uraemic toxins accompanied by electrolyte and acid base imbalances, all of which result from a sharp decrease in the glomerular filtration rate (GFR).

The recurrence rate of FLUTD signs in this study was relatively low (16.0%) within 12 months compared to the previously reported 58.1% within an observation period of 38 months (Bovee *et al*., 1979; Gerber *et al.,* 2008) and 35.3% within 6 months and 51.3% within 13 months (Kaul *et al.*, 2020). In the current study, the recurrence rate was low 16.0%, while 12.5% of the cats died. The same findings have been reported (Hall *et al.,* 2015).

The systemic signs and clinicopatholgical derangement in FLUTD were correlated with the severity and the duration of the obstructions (Segav *et al.,* 2011). Therefore, in the current study, the highly significant (P<0.0001) increase in the mean serum creatinine and BUN associated with increase in serum potassium (hyperkalemia), calcium and phosphorus were consistent with the common clinicopatholgical findings (Lee and Drobatz, 2003; Segav *et al*., 2011; Ayoub *et al.,* 2024).

The accumulation of uraemic toxins and electrolyte and acid base disorders in UO reflected a sharp reduction in the glomerular filtrate (Lee and Drobatz, 2003). Moreover, post-renal azotemia due to backpressure induced by the obstruction to outflow, impairing glomerular filtration, tubular function and renal blood flow (Osborne *et al.,* 1978).

The accumulation of ureamic toxins, azotaemia, pain, excitement and metabolic acidosis might be attributed to the observed tachypnea and mild tachycardia in urolithiasis in the present study (Segav *et al.* 2011).

FIC treatment were included reduce stress, non-steroid anti-inflammatory, oral glucosamine, diet changes from dry to moisture foods, increased contact between the owners and the patients were useful and the conditions were resolved within 5 to 7 days. Similar finding was noted in the current study (Hostutler *et al.,* 2005; Grauer, 2013; Kim *et al.,* 2017).

Furthermore, Gunn-Moore and Shenoy (2004) found that Food rich in water such as canned food can significantly reduce the proportion of cats with FIC that experience recurrence of clinical signs. In addition oral glucosamine covered the bladder urothelium that prevent microbes and crystals from sticking to the bladder lining and limits the transepithelial movement of urine proteins and other solutes.

Amoxicillin/clavulanic or Ciprofloxacin were successful for management of UTIs based on susceptibility testing. The same have been reported (Dorsch *et al.,* 2019). The analyzed stones mineral compositions in the present study were calcium oxalate 62.5%, struvite 50% and ammonium urate was 25% (Ayoub *et al.,* 2024). Consequently, cats feed moisture diets have lower recurrence rates and a usefulness high survival discharge rates.

CONCLUSION

The treatment protocol of feline lower urinary tract diseases was involved decompressive cystocentesis, urethral catheterization and placement of an indwelling catheter in combination with medical therapy and dietary changes. Medical therapy included fluid therapy, non-steroid anti-inflammatory and Amoxicillin/clavulanic and or ciprofloxacin were the most appropriate. Surgical cystotomy and urothrostomy were efficient in management of urinary tract uroliths. The study gives a higher survival to discharge rate 89.5%. Complete recovery without recurrence was 53.5%. While recurrence cases was 16.0% and 12.8% of cases failure of treatment. Consequently the preliminary protocol of management might be favorable for owners and veterinarians for treatment of cats with FLUTD.

ACKNOWLEDGEMENT

We are grateful for the help and assistance received from the staff members of Veterinary Teaching Hospital, Faculty of Veterinary Medicine, Cairo University, Egypt.

Conflict of interest

The authors have declared that no conflict of interest exists.

REFERENCES

Ayoub, S., Mostafa, M. and Abdelgalil, A. (2024). Studies on feline lower urinary tract disease in egypt cat population. *Journal of Applied Veterinary Sciences*. **9(1):** 1-12.

Bass, M., Howard, J., Gerber, B. and Messmer, M. (2005). Retrospective study of indications for and outcome of perineal urethrostomy in cats. *Journal of Small Animal Practice*. **46(5):** 227-231.

Bovee, K.C., Reif, J.S., Maguire, T.G., Gaskell, C.J. and Batt, R.M. (1979). Recurrence of feline urethral obstruction. *Journal of the American Veterinary Medical Association*. **174(1):** 93-96. https://pubmed.ncbi.nlm.nih.gov/457578/. .

Cooper, E.S., Owens, T.J., Chew, D.J. and Buffington, C.T. (2010). A protocol for managing urethral obstruction in male cats without urethral catheterization. *Journal of the American Veterinary Medical Association*. **237(11):** 1261-1266.

Dorsch, R., Remer, C., Sauter-Louis, C. and Hartmann, K. (2014). Feline lower urinary tract disease in a German cat population. *Tieraerztliche Praxis Ausgabe K: Kleintiere/Heimtiere*. **42(04):** 231-239.

Dorsch, R., Teichmann-Knorrn, S. and Lund, S.H. (2019). Urinary tract infection and subclinical bacteria in cats: A clinical update. *Journal of Feline Medicine and Surgery*. **21:** 1023-1038.

Gerber, B., Boretti, F.S., Kley, S., Laluha, P., Müller, C., Sieber, N., Unterer, S., Wenger, M., Flückiger, M., Glaus, T. and Reusch, C.E. (2005). Evaluation of clinical signs and causes of lower urinary tract disease in European cats. *Journal of Small Animal Practice*. **46(12):** 571-577.

Gerber, B. (2008). Feline Lower Urinary Tract Diseases (FLUTD). In The Proceedings: International Congress of the Italian Association of Companion Animal Vetenarians (SCIVAC). Rimini, Italy. pp. 201-203.

Gerber, B., Eichenberger, S. and Reusch, C.E. (2008). Guarded long-term prognosis in male cats with urethral obstruction. *Journal of Feline Medicine and Surgery*. **10(1):** 16-23.

Gerber, B. (2011). Idiopathic cystitis and urinary tract infection. In: 3rd Feline Medicine Symposium, Hotel Intercontinental Praha. 5 November. pp. 15-19.

Grauer, G.F. (2013). Current thoughts on pathophysiology and treatment of feline idiopathic cystitis. *Today's Veterinary Practice*. **3(6):** 38-41.

Gunn-Moore, D.N., Shenoy, C.M. (2004). Oral glucosamine and the management of feline idiopathic cystitis. *Journal of Feline Medicine and Surgery*. **6:** 219-225.

Gomes, V.D.R., Ariza, P.C., Queiroz, L.L.D. and Fioravanti, M.C.S. (2022). Physicochemical techniques for determining the composition of canine and feline uroliths: A literature review. *Ciência Rural*. **52(1):** e20201116.

Hall, J., Hall, K., Powell, L.L. and Lulich, J. (2015). Outcome of male cats managed for urethral obstruction with decompressive cystocentesis and urinary catheterization: 47 cats (2009 2012). *Journal of Veterinary Emergency and Critical Care*. **25(2):** 256-262.

Hostutler, R.A., Chew, D.J. and DiBartola, S.P. (2005). Recent concepts in feline lower urinary tract disease. *Veterinary Clinics of North America: Small Animal Practice*. **35(1):** 47-170.

Houston, D.M., Moore, A.E., Favrin, M.G. and Hoff, B. (2003). Feline urethral plugs and bladder uroliths: A review of 5484 submissions 1998-2003. *The Canadian Veterinary Journal*. **44(12):** 974-977. PMID: 14703082; PMCID: PMC387401.

Kaul, E., Hartmann, K., Reese, S.,and Dorsch, R. (2020). Recurrence rate and long-term course of cats with feline lower urinary tract disease. *Journal of Feline Medicine and Surgery*. **22(6):** 544-556.

Kim, Y., Kim, H., Pfeiffer, D. and Brodbelt, D. (2017). An epidemiological study of Feline idiopathic cystitis in cats attending a first-opinion veterinary practice. In: The Proceedings: British Small *Animal Veterinary Association Congress. Birmingham. England*. pp. 520-521.

Kim, Y., Seo, M.R., Kim, S.J., Kim, J., Wie, S.H., Cho, Y.K., Lim, S.K., Lee, J.S., Kwon, K.T., Lee, H. and Cheong, H.J. (2017). Usefulness of blood cultures and radiologic imaging studies in the management of patients with community-acquired acute pyelonephritis. *Infection and Chemotherapy*. **49(1):** 22-30.

Kinjavdekar, A.P., Aithal, H.P., Pawde, A.M., Singh, T. and Pratap, K. (2004). Incidence of urolithiasis: A retrospective study of five years. *Indian Journal of Animal Sciences*. **74(2):** 175-177.

Kruger, J.M., Osborne, C.A., Goyal, S.M., Wickstrom, S.L., Johnston, G.R., Fletcher, T.F. and Brown, P.A. (1991). Clinical evaluation of cats with lower urinary tract disease. *Journal of the American Veterinary Medical Association*. **199(2):** 211-216.

Lee, J.A. and Drobatz, K.J. (2003). Characterization of the clinical characteristics, electrolytes, acid-base and renal parameters in male cats with urethral obstruction. *Journal of Veterinary Emergency and Critical Care*. **13(4):** 227-233.

Lekcharoensuk, C., Osborne, C.A. and Lulich, J.P. (2001). Epidemiologic study of risk factors for lower urinary tract diseases in cats. *Journal of the American Veterinary Medical Association*. **218(9):** 1429-1435.

Lulich, J.P. and Osborne, C.A. (1996). Overview of diagnosis of feline lower urinary tract disorders.*Veterinary Clinics of North America: Small Animal Practice*. **26:** 339-352.

Markwell, P.J., Buffington, C.T. and Smith, B.H. (1998). The effect of diet on lower urinary tract diseases in cats. *The Journal of Nutrition*. **128(12):** 27538-27578.

Nururrozi, A., Yanuartono, Y., Sivananthan, P. and Indarjulianto, S. (2020). Evaluation of lower urinary tract disease in the Yogyakarta cat population, Indonesia. *Veterinary World*. **13(6):** 1182. www.doi.org/10.14202/vetworld.2020.1182-1186.

Osborne, C.A. and Lees, G.E. (1978). Feline cystitis, urethritis, urethral obstruction syndrome: Part I: Etiopathogenesis and clinical manifestations. *Modern Veterinary Practice*. **59:** 173-180.

Parmar, J.J., Parikh, P.V. Shah, J.A., Dabhi, P.B. (2021). Retrospective analysis of lower urinary tract disorders in dogs: Study of five years. *Indian Journal of Animal Research*. **55(8):** 941-945. doi: 10.18805/ijar.B-4146.

Sćvik, B.K., Trangerud, C., Ottesen, N., Sřrum, H. and Eggertsdóttir, A.V. (2011). Causes of lower urinary tract disease in Norwegian cats. *Journal of Feline Medicine and Surgery*. **13(6):** 410-417.

Segev, G., Livne, H., Ranen, E. and Lavy, E. (2011). Urethral obstruction in cats: Predisposing factors, clinical, clinicopathological characteristics and prognosis. *Journal of Feline Medicine and Surgery*. **13(2):** 101-108.

Yasar, T.O. and Ozkan, K. (2017). A urolithiasis case related to nutritional disorders in a male cat. *Indian Journal of Animal Research*. **51(6):** 1157-1158. doi: 10.18805/ijar.v0iOF. 7610.