UNIVERSITI PUTRA MALAYSIA

PATTERN OF CLINICOPATHOLOGICAL PARAMETERS OF CATS WITH LOWER URINARY TRACT DISEASES PRESENTED TO UNIVERSITY VETERINARY HOSPITAL, UPM

SITI AISYAH JEINIE @ JAMAL

lp
FPV 2017 27

PATTERN OF CLINICOPATHOLOGICAL PARAMETERS OF CATS WITH LOWER URINARY TRACT DISEASES PRESENTED TO UNIVERSITY VETERINARY HOSPITAL, UPM

SITI AISYAH JEINIE @ JAMAL

A project paper submitted to the Faculty of Veterinary Medicine, Universiti Putra Malaysia

In partial fulfilment of the requirement for the

DEGREE OF DOCTOR OF VETERINARY MEDICINE

Universiti Putra Malaysia

Serdang, Selangor Darul Ehsan

2017

It is hereby certified that I have read this project paper entitled "Pattern of Clinicopathological Parameters of Cats with Lower Urinary Tract Diseases Presented to University Veterinary Hospital, UPM", by Siti Aisyah Jeinie @ Jamal and in my opinion it is satisfactory in terms of scope, quality, and presentation as partial fulfilment of the requirement for the course VPD 4999 – Final Year Project.

……

ASSOC. PROF. DR. HAZILAWATI HAMZAH

DVM (UPM), MSC (UPM), PhD (MURDOCH, AUS)

Lecturer,

Faculty of Veterinary Medicine

Universiti Putra Malaysia

(Supervisor)

……

PROF. DR. MOHAMED ARIFF OMAR

BSC (LSU, USA), MSC (OSU, USA), PhD (TA&MU, USA)

Lecturer,

Faculty of Veterinary Medicine

Universiti Putra Malaysia

(Co-Supervisor)

DEDICATION

My beloved,

Mdm. Fadzilah bt Ab. Halim

&

Mr. Jeinie @ Jamal b Alias

...for without them I won't be here.

ACKNOWLEDGEMENTS

Alhamdulillah, all praise to the Almighty One, for only with HIS blessing and permission am I able to accomplish everything in this borrowed life.

My deepest gratitude to my supervisor, Assoc. Prof. Dr. Hazilawati Hj. Hamzah, who was very considerate, caring and the key person in making this project a possibility. I am also thankful to Prof. Dr. Mohamed Ariff Omar, my co-supervisor for his guidance and encouragement to me to conduct this project. To all other lecturers and teachers, thank you for imparting precious knowledge.

I would like to express my appreciation to the staff of Clinical Pathology Laboratory and University Veterinary Hospital (UVH) for their assistance, patience, and guidance throughout my project, thank you.

My beloved parents love had propelled me in my worst moments, I am forever grateful for their love. To my dearest friends, Dayang Rakhmioktalea Watty Yusop, Nurul Syahirah Husna Sulaima, Sarah Helmy, Nur Farah Athirah Ismail, and Rashidah Rahmat, my special thanks for your endless help, encouragement and support.

Thanks are also due to those who had helped me directly and indirectly, thank you for your helping hands, which had helped me to be where I am now.

Only HIM could repay all of you in full and fairness.

CONTENTS

LIST OF FIGURES **Page**

ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan kursus VPD 4999 – Projek Ilmiah Tahun Akhir

POLA PARAMETER KLINIKOPATOLOGI BAGI KUCING YANG MENGHIDAPI PENYAKIT SALURAN KENCING BAWAH YANG DIBAWA KE HOSPITAL VETERINAR UNIVERSITI, UPM

oleh

Siti Aisyah Jeinie @ Jamal

2017

Penyelia: Prof. Madya Hazilawati Hj. Hamzah

Penyelia Bersama: Prof. Dr. Mohamed Ariff Omar

Penyakit saluran kencing bawah kucing (FLUTD) merupakan antara penyakit yang kerap dihidapi oleh kucing di serata dunia. Sebuah kajian kohort retrospektif telah dijalankan berdasarkan sejumlah 173 kes yang telah direkodkan pada 2016 di Makmal Klinikal Patologi, Fakulti Perubatan Veterinar, UPM yang seterusnya diikuti dengan pemeriksaan profil kes di Hospital Veterinar Universiti, UPM. Data yang telah dikumpul termasuk signalmen pesakit, serta keputusan hematologi, biokemia serum dan analisa urin. Parameter khusus adalah umur,

baka, jantina, cara hidup, diet, petanda klinikal, leukogram (kiraan sel darah putih), biokimia serum (aras globulin, urea dan kreatinin) dan analisa urin (pH, hematuria, proteinuria, piuria, dan bakteriuria) yang akan dianalisa menggunakan perisian SPSS 22.0. Keputusan menunjukkan bahawa kucing bulu pendek domestik jantan, seberat 3.00-3.99 kg dengan purata skor kondisi badan 3, tinggal di dalam rumah bersama kucing lain, memakan diet bukan preskripsi kering merupakan atribut ketara bagi profil paling umum FLUTD. Petanda klinikal umum adalah, '*stanguria'* (42.2%), hematuria (38.7%), pundi kencing segah (37%), pundi kencing mampat (28.9%) dan muntah (28.3%). Daripada 173 kes, hanya 124 kes telah memesan analisa hematologi, 32.4% mempunyai leukogram normal, dengan 15% kes hiperglobulinemia. Analisa urin menunjukkan hematuria teruk, dengan piuria surih hingga ringan, proteiuria sederhana, dan bakteriuria surih. Diagnosis paling umum ialah sistitis bakteria. Dalam pengendalian FLUTD, faktor risiko penting pada taraf kebimbangan lebih tinggi adalah kucing jantan yang tinggal di dalam rumah bersama kucing lain yang diberi makanan kering bukan preskripsi.

Kata kunci: penyakit saluran kencing bawah kucing, parameter klinikopatologi, '*stranguria'*, hematuria, and sistitis bakteria.

ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfilment of the course VPD 4999 – Final Year Project.

PATTERN OF CLINICOPATHOLOGICAL PARAMETERS OF CATS WITH LOWER URINARY TRACT DISEASES PRESENTED TO UNIVERSITY VETERINARY HOSPITAL, UPM

By

Siti Aisyah Jeinie @ Jamal

2017

Supervisor: Assoc. Prof. Hazilawati Hj. Hamzah

Co-supervisor: Prof. Dr. Mohamed Ariff Omar

Feline Lower Urinary Tract Disease (FLUTD) is among the most common diseases reported in cats in various countries globally. A retrospective cohort study was conducted based on 173 FLUTD cases recorded in 2016 at the Clinical Pathology Laboratory, Faculty of Veterinary Medicine, UPM and followed by examination of the case profiles at the University Veterinary Hospital, UPM. Data collected included patient signalments, haematological, serum biochemical and urinalysis results. The specific risk parameters were age, breed, sex, lifestyle, diet,

weight, clinical signs, leukogram (white blood cells (WBC) count), serum biochemistry (globulin, urea and creatinine levels) and urinalysis (pH, haematuria, proteinuria, pyuria, and bacteriuria) which were analysed using SPSS 22.0 software program. Results showed that Domestic Short Hair (DSH) male cat, weighing 3.00-3.99 kg with average body condition score (BCS) of 3, living indoor in a multicat household and eating non-prescription dry feed made up the significant attributes of the most common profile of FLUTD cases. The common clinical signs were stranguria (42.2%), haematuria (38.7%), turgid urinary bladder (37%), non-compressible urinary bladder (28.9%) and vomiting (28.3%). From the 173 cases, 124 cases ordered haematological analysis whereby 32.4% had normal leukogram, while 15% had mild hyperglobulinaemia. Urinalysis showed severe haematuria with trace to mild pyuria, moderate proteinuria, and mild bacteriuria. The most common diagnosis was bacterial cystitis. In FLUTD management, the important risk factors of higher concerns include male cats living indoor in a multicat household fed with dry non-prescription diet.

Keywords: feline lower urinary tract disease, clinicopathological parameters, stranguria, haematuria, and bacterial cystitis.

1.0 INTRODUCTION

Feline lower urinary tract disease (FLUTD) describes a collection of many diseases and conditions that can affect the bladder and/or urethra of cats which can lead to obstructive or non-obstructive FLUTD depending on whether urine was able to be compressed from the urinary bladder which could be due to feline idiopathic cystitis (FIC), bacterial urinary tract infections, urolithiasis, and urethral plugs. This disease is among the common diseases reported in cats in various countries globally. From the study by Brodbelt *et al*. (2011), in United Kingdom the most common reasons for consultations for cats included cat bite abscesses, FLUTD, hyperthyroidism, dental disease, lameness, anorexia. However, there are limited local studies done on FLUTD cases even though the disease is among the common diseases reported in cats in various countries globally.

There are many possible causes for FLUTD, but the signs exhibited are similar and recognisable such as stranguria, haematuria, dysuria, pollakiuria, periuria and urethral obstruction whereby according to Buffington (2011) the signs can be either acute or chronic. However, duration of the problem masks the actual number of cases presented to the hospital as acute cases may be missed (Longstaff, 2016). The clinical signs are rarely indicative of a particular disease among the many diseases in FLUTD (Gunn-Moore, 2003). Thus, a thorough medical examinations and laboratory testing are usually needed to identify the specific disease so that the treatments and management can be done properly to the cats that having FLUTD.

According to Jones (2009), idiopathic FLUTD is most commonly seen in young to middle-age cats while older cats more likely to develop urolithiasis, neoplasia and bacterial urinary tract infections. According to Defauw *et al.* (2011), Gerber *et al.* (2005) and, Hostutler, Chew and DiBartola (2005), FIC is the most common diagnosis of FLUTD.

1.1 Objectives

1. To determine the common pattern of clinicopathological parameters of cats presented with FLUTD at UVH, UPM,
2. To determine the common signalments of cats with FLUTD, and
3. To determine the most common disease or condition of the lower urinary tract among the FLUTD.

1.2 Hypotheses

1. H_A: The common pattern of clinicopathological parameters of cats presented with FLUTD are azotemia and haematuria.
2. H_A: More males compared to females are diagnosed with FLUTD.

2.0 Literature Reviews

2.1 Feline Idiopathic Cystitis

A hypothesis made by Buffington, Chew and DiBartola (1996) suggested that feline infectious cystitis (FIC) might be a result from alterations in the interaction between the neuronal supply to and from the bladder, the protective glycosaminoglycan (GAG) layer that lines the bladder, including the compounds of the urine itself (Gunn-Moore, 2003). Gunn-Moore (2003) also suggested that it is unclear whether or not the clinical signs of FLUTD are caused by a primary factor, or a secondary event whereby it might be triggered by an unidentified infectious agent.

2.2 Bacterial Cystitis

A study done by van Duijkeren, van Laar & Houwers (2004) found that the number of bacteria present in the bladder of cats with urinary tract infections could be low which might lead to underdiagnosis of urinary tract infections when interpreting culture results for voided and catheterized samples. In conclusion, cystocenthesis is the preferred method of sampling for the evaluation of cats with suspected urinary tract infection as the results tend to be of pure culture, sans cotaminants.

According to Defauw *et al.* (2011), Gerber *et al*. (2005), and Hostutler, Chew and DiBartola (2005), FIC is the most common diagnosis of FLUTD. However, a

study done previously on FLUTD in Norwegian cats showed higher prevalence of bacterial cystitis (Lund, Skogtun, Sørum, & Eggertsdóttir, 2015).

2.3 Urethral Plug

According to Jones (2009) urethral plugs were composed of mucoproteins, cellular material, blood clots, and sometimes crystals. She also reported that not all urethral plugs had a mineral component whereby some were composed solely of colloid. Gerber *et al.* (2005) stated that the diagnosis of urethral plugs was only made when the plug-forming material obstructing the urethra could be clearly identified which might be repulsed into the bladder during urethral catheterisation and thus lost. This situation might lead to mis- or under-diagnosis of urethral plug cases.

2.4 Urolithiasis

Urolithiasis is defined as the formation of calculi (uroliths or stones) within the urinary tract, which can vary in their mineral composition, with struvite and oxalate forms being seen most commonly in cats (Gunn-Moore, 2003).

Before the late 1980s, sterile struvite was the most common urolith however according to Buffington and Chew (1999) 40% of feline uroliths were of calcium oxalate. Uroliths' size range from sand-like material to large individual stones that might grow to fill the entire cavity in which they form (Tion, Dvorska, & Saganuwan, 2015).

2.5 Clinical Signs

Usually, clinical signs resolved within 7 days and if clinical signs persisted or recurred repeatedly, further diagnostics and referral to an internist or behaviorist may be indicated (Hostutler, Chew & DiBartola, 2005).

Among the signs of FLUTD are pollakiuria, stranguria, periuria and haematuria (Westropp, Buffington, & Chew, 2005). The signs could be categorised into frequency of urine voidance (i.e. pollakiuria, anuresis), amount of urine production (i.e. anuria, oliguria, polyuria) and behavioural change (i.e. dysuria and periuria).

2.6 Laboratory Diagnostics

Due to all forms of FLUTD have a very similar clinical presentation with no pathognomonic sign, laboratory tests and diagnostic imaging are required in each case to establish a diagnosis (Gerber, 2008). He also stressed that urinalysis is an important component of the laboratory tests that needed to be carried out however, it should be done before any therapy is started as the therapy would affect the urinalysis result thus causing misdiagnosis. He also clarified that the urinalysis should include measurement of the specific gravity, a dip-stick analysis, analysis of the urine sediment and a urine culture. A concurrent serum biochemical analysis can provide information about underlying diseases, which should be put into consideration for

treatment and management. According to Hostutler, Chew and DiBartola (2005) urinalysis with sediment evaluation should be performed if there were presence of recurrence of clinical signs, the evidence of chronic renal failure, or urinary catheterisation or perineal urethrostomy were done before.

Other diagnostics that the authors recommended were plain abdominal radiographs that include the pelvic and penile urethra, contrast radiography, cystography, urethrography, and urethrocystography.

3.0 Materials and Methods

3.1 Methodology

A total of 173 FLUTD cases recorded in 2016 were analysed from the records at the Clinical Pathology Laboratory, Faculty of Veterinary Medicine, UPM, and followed by examination of the case profiles at the University Veterinary Hospital, UPM. Four main components of the data collected were patient signalments, haematological, serum biochemical and urinalysis results. The specific risk parameters were age, breed, sex, lifestyle, diet, weight, clinical signs, leukogram (white blood cells (WBC) count), serum biochemistry (urea, creatinine and globulin levels) and urinalysis (pH, haematuria, proteinuria, pyuria, and bacteriuria).

3.2 Statistical analysis

Statistical Package for the Social Science (SPSS) 22.0 was used to analyse the data. The data were assessed using frequency distribution analysis followed by

cross-tabulation analysis using the Chi-square test to determine association between the risk factors to either the binary category (obstructive and non-obstructive) or quinary category (the five targeted diseases urolithiasis, urethral plug, bacterial cystitis, FIC and mix) of FLUTD.

4.0 Results and Discussions

The patient signalments, haematological, serum biochemical and urinalysis data were analysed using frequency distribution analysis, cross-tabulation and chi-square test to determine the common pattern of clinicopathological parameters, the common signalments of cats and the most common disease or condition of the lower urinary tract of FLUTD.

Based on Figure 1, the most cases were presented during May (12.1%) with the least during July (2.9%). There was no specific pattern for the case distribution over the months of 2016. However, the dip of the number of cases on June and July were possibly due to Ramadan and Aidilfitri celebrations where owners would be travelling.

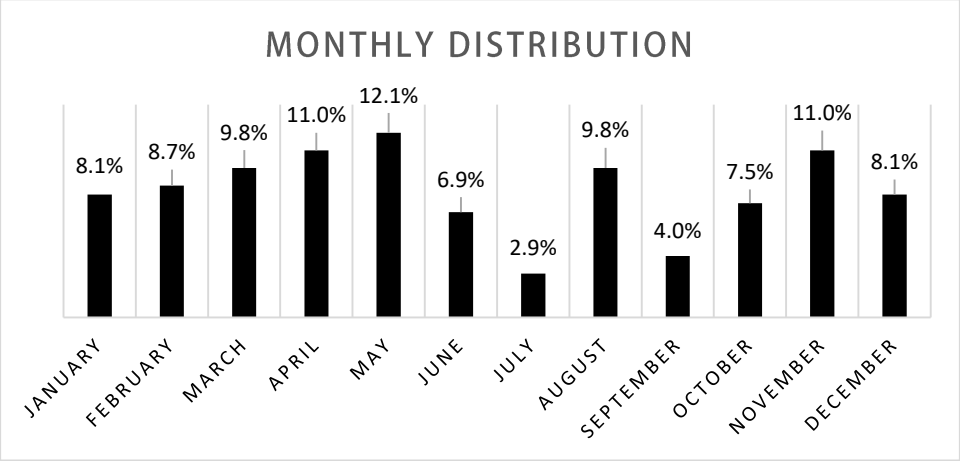

Figure 1: Monthly distribution of FLUTD cases in 2016

4.1 Diagnosis

Among the FLUTD cases, the most common diagnosis was bacterial cystitis (31%) (Figure 2), which was similar to studies in Norwegian cats which had shown higher prevalence of bacterial cystitis (Lund, Skogtun, Sørum, & Eggertsdóttir, 2015). For the binary category, 61% were non-obstructive FLUTD and 39% obstructive FLUTD. There was significant difference within the quinary category ($p<0.01$), predomination of bacterial cystitis and FIC for non-obstructive FLUTD while urethral plug, urolithiasis and mix diagnosis in the obstructive FLUTD.

The diagnosis of FIC is done by exclusion of other diseases, there is a possibility of the specific cause being overlooked (Gerber *et al*., 2005). Therefore, difference in the range of types of FLUTD diagnosed was a possibility.

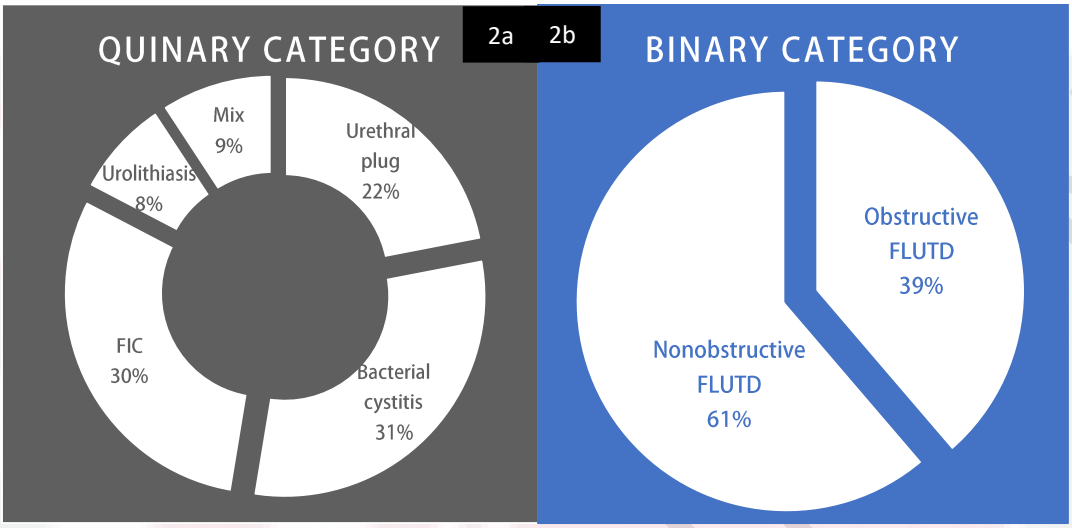

Figure 2: Categories of FLUTD. Distribution of FLUTD within the quinary category (2a) and distribution of FLUTD within the binary category (2b).

4.2 Patient Signalments

The life stage was derived from Feline Life Stage Guidelines (Vogt *et al.*, 2010). Birth to 6 months were kitten, 7 months to 2 years old were junior, 3 to 6 years old were prime, 7 to 10 years old were mature, 11 to 14 years old were senior and 15 years old and above were geriatric (Figure 3).

The age category distribution was prime (37%) and junior (32.9%) with urethral plug predominating both of this category ($p<0.05$). Urethral plugs were significantly more common causes of FLUTD in cats <10 years old compared to ≥10 years old (Dorsch, Remer, Sauter-Louis & Hartmann, 2014) which was similarly found in this study.

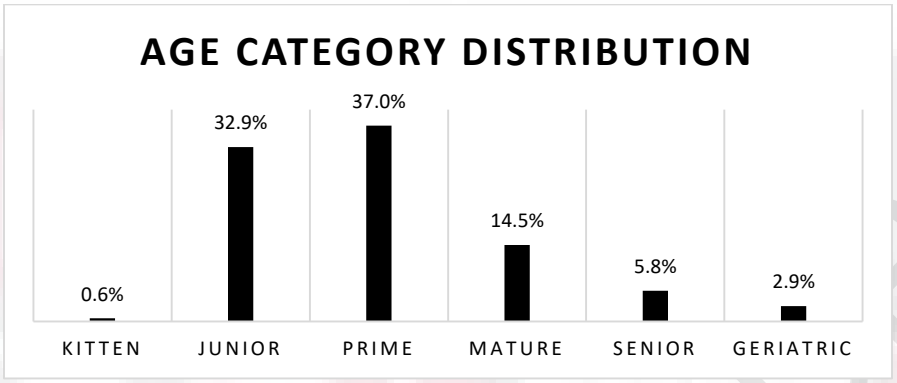

Figure 3: Distribution of FLUTD cases within the age category. Age were categorized according to AAFP/AAHA feline life stage (Vogt *et al*., 2010).

The most common breed recorded with FLUTD was DSH, but this might be due to population biased (Figure 4). There was no significant difference amongst the quinary category of FLUTD ($p>0.05$) which meant that DSH cats dominated all categories. To further understand whether Malaysian DSH cats had a genetic predisposition towards FLUTD instead of just due to the local demographic, a study testing the genetic predilections should be done.

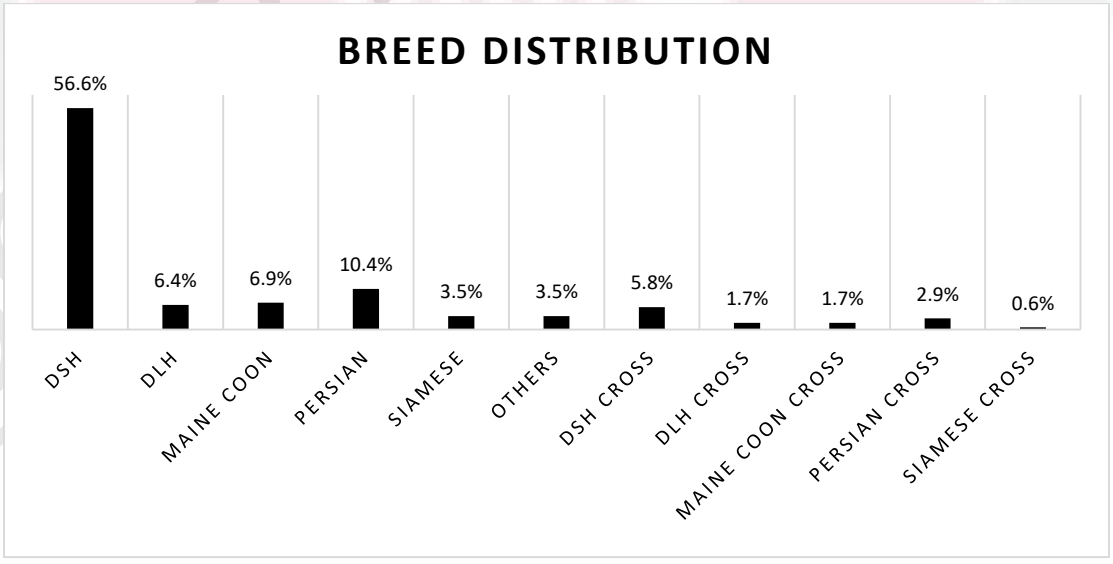

Figure 4: Distribution of FLUTD cases within the breed category.

For sex distribution, male (49%) followed by castrated male (34%) had FLUTD (Figure 5). Obstructive FLUTD was more in males while non-obstructive disease FLUTD had equal frequency in male and female cats ($p<0.05$). There was 6.4% missing data.

Obstructive FLUTD was more in males with non-obstructive FLUTD had equal frequency in male and female cats (Hostutler, Chew & DiBartola, 2005) shared the same result as this study. This was due to the anatomy of the urinary tract because male cats having longer and thinner urethra compared to female thus any clots or clumps would easily lodged within the thin urethra.

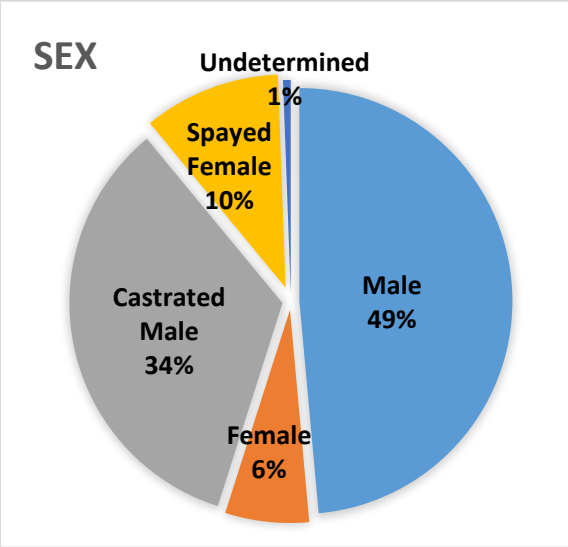

Figure 5: Distribution of FLUTD cases within the sex category.

Figure 6 shows valid percentage, household 41 missing data and lifestyle 32 missing data. There were none significant difference against the quinary FLUTD for these to categories, $p>0.05$. All 5 targeted FLUTD showed similar findings of having

a higher distribution of cats coming from a multicats household while living indoor as shown in Figure 6a and 6b.

Cats are territorial animals and living in a multicat household is stressful due to the power and territorial struggle. Veranic & Jezernik (2000), showed that comparable urothelial injury could occur in healthy animals exposed to stressful external events. The stress would be further exacerbated when multicats were living in a confined, small territory such as being kept strictly indoor. Tariq *et al*. (2014) also had similar findings of cats living indoor showing greater frequency of suffering from FLUTD. Furthermore, constant stress would impair the immune system thus providing opportunity for ascending infection to take place by opportunistic normaflora (Griffin, 1989).

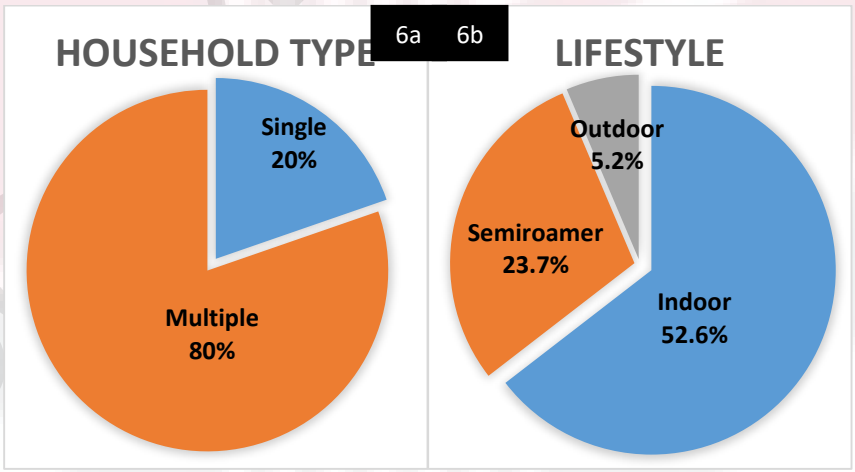

Figure 6: Living managements of FLUTD. Distribution of FLUTD within the household type category (4a) and distribution of FLUTD within the lifestyle category (4b).

Figure 7 shows valid percentage, diet 81 missing data, diet type 40 missing data.

From Figure 7, cats fed with dry (46%) non-precription (83%) diet made up the common cause of FLUTD. The mix diet (36%) being second highest might be likely due to the dry feed component in it.

This finding was in agreement with the study done by Hostutler, Chew and DiBartola (2005) stating dry diet are among the risk factor for FLUTD. This is due to the water and mineral contents in the different type of feeds.

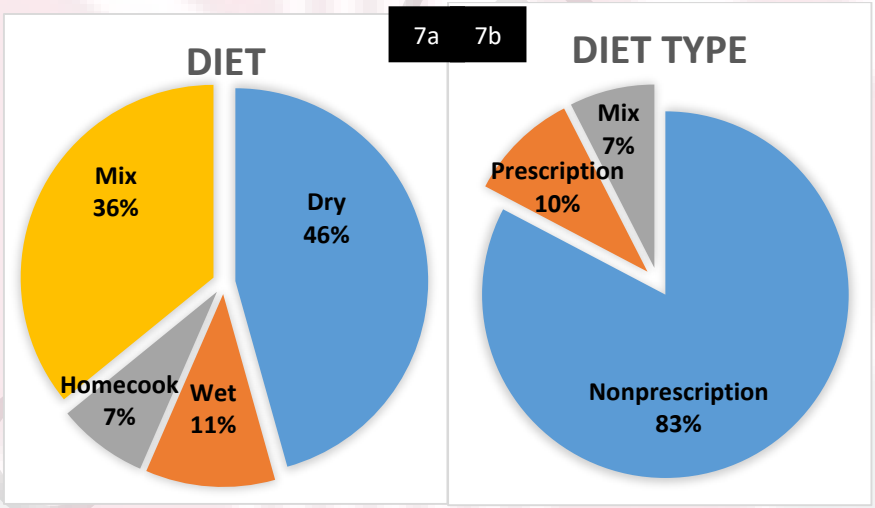

Figure 7: Feed managements of FLUTD. Distribution of FLUTD within the diet category (7a) and distribution of FLUTD within the diet type category (7b).

Figure 8 excludes 0.6% cases for weight, and 21.4% cases for BCS which are missing data. Though there was no significant difference ($p>0.05$) between the weight and BCS distribution within the quinary category, cats weighing 3.00-4.99 kg (65.9%) with ideal BCS 3 (39.3%) were of higher risks of developing FLUTD (Figure 8). This was a disagreement towards the studies done by Westropp (2011) stating obesity may play a role in both urolithiasis and FIC, and Bailiff *et al*. (2008) stating increased frequency of UTI in cats with lower body weight. However, Gerber *et al*. (2005) showed similar findings of cats not in the obesity category having a higher percentage of FLUTD. Therefore, further study should be done on local cats to unveil the reason of the disagreement of this study with the studies aforementioned.

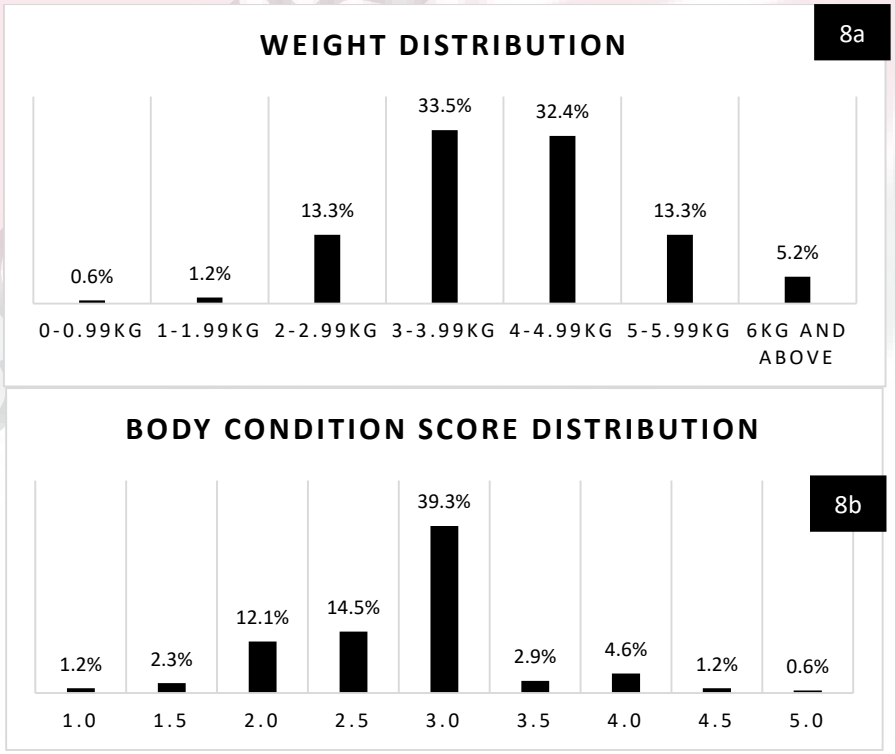

Figure 8: Distribution of the weight (8a) and BCS (8b) of FLUTD cases.

4.3 Clinical Signs

The top five clinical signs recorded in the cases presented were stranguria (42.2%), haematuria (38.7%), turgid urinary bladder (37%), non-compressible urinary bladder (28.9%), and vomiting (28.3%) (Figure 9). These percentages were not completely representative of the population's true clinical signs as there were inconsistencies found. The signs might have not been noticed by the owners thus they did not report the findings doing consultation. Furthermore, the information retrieved might have not been recorded.

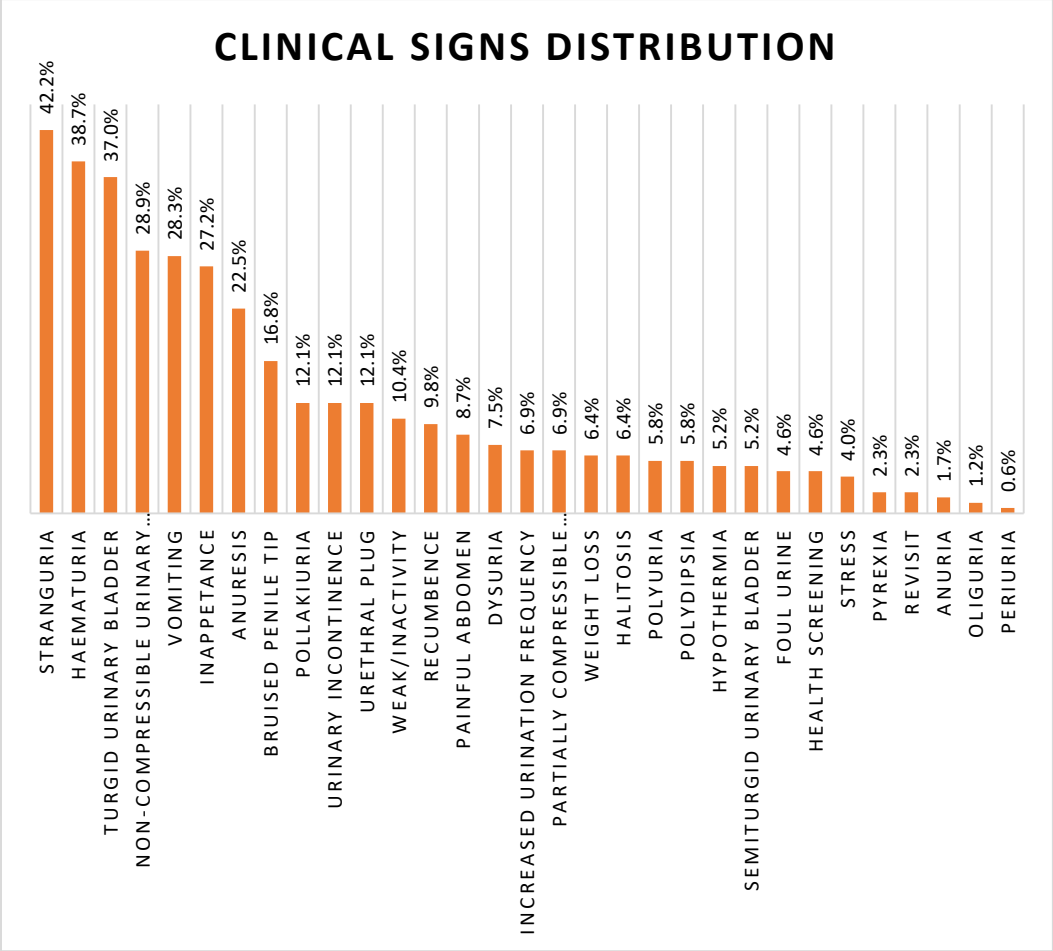

Figure 9: Distribution of the recorded clinical signs of FLUTD cases.

4.4 Haematological analyses

Of the 173 cases studied, only 124 cases ordered haematological analysis. According to Figure 10a, localisation of FLUTD cases predominated with 32.4% normal WBC count while 31.8% of the cases showed leukocytosis, possibly due to systemic reaction of ascending infection or concurrent diseases. There was 3.5% cases having leukemoid reaction which was a sign for closed infection however some of the cases did not have other disease diagnosed during the bout of FLUTD which might suggest that the kidney might have been having the closed infection.

The level of globulin showed 52.6% of the cases had hyperglobulinaemia with the most within the mild hyperglobulinaemia category (15%) (Figure 10b). This suggested that the cases sent for consultations were likely of chronic cases because to elevate the globulin levels require some time. Duration of the problem masks the actual number of cases presented to the hospital (Longstaff, 2016). Thus, acute cases might be missed.

There was no significant difference to the quinary category for both WBC and globulin levels ($p>0.05$). WBC had 4.6% missing, and globulin had 5.2% missing which is excluded from Figure 10.

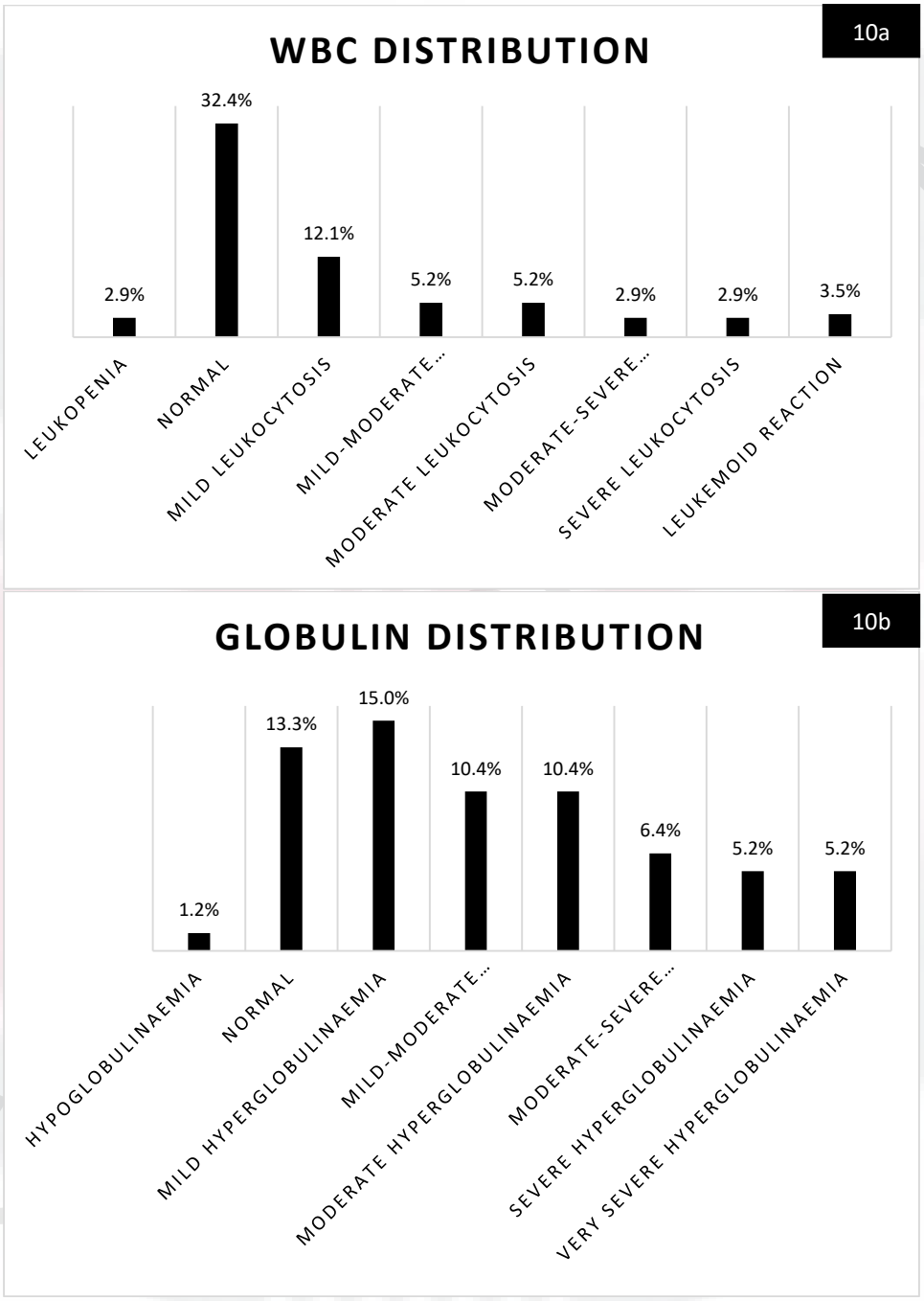

Figure 10: Distribution of white blood cells of FLUTD cases (10a). Distribution of globulin of FLUTD cases (10b).

Figure 11 shows valid percentage, creatinine and urea, both had 1.7% missing. There was no significant differences between the quinary category or binary category of FLUTD ($p>0.05$), thus FLUTD shared hypercreatinaemia and hyperuraemia as the common characteristics. Both these components translate into being azotaemic.

From this study, the non-obstructive cases that have azotaemia indicates a possible renal injury. Further diagnostics should be done to clarify the true condition of the kidney.

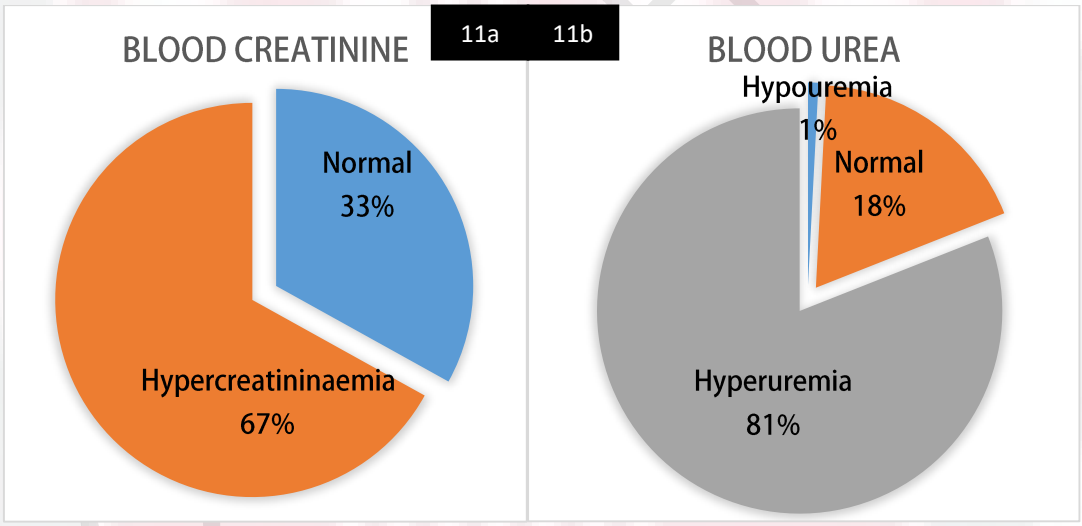

Figure 11: Azotaemia. Distribution of blood creatinine level in FLUTD cases (11a). Distribution of blood urea level in FLUTD cases (11b).

4.5 Urinalysis

Urinalysis, 35% cases had pH7 whilst 29% cases had pH6 which were within normal range according to Cottam *et al.* (2002) (Figure 12). Obstructive FLUTD was predominated by pH7, neutral, while non-obstructive was predominated by pH6, acidic ($p<0.01$). Skoch *et al.* (1991) stated that their urine pH data support the recommendation to maintain urine pH of adult cats between 6.0 and 6.4, has been shown that the potential for struvite ($MgNH_4PO_4 \cdot 6H_2O$) crystal formation is reduced if urine pH is <6.6, whereas calcium oxalate crystal formation is less likely to occur at a higher urinary pH (Hesse, Steffes & Graf, 1998). As such, from this study it could be that the uroliths were likely to be of struvite nature due to the higher pH.

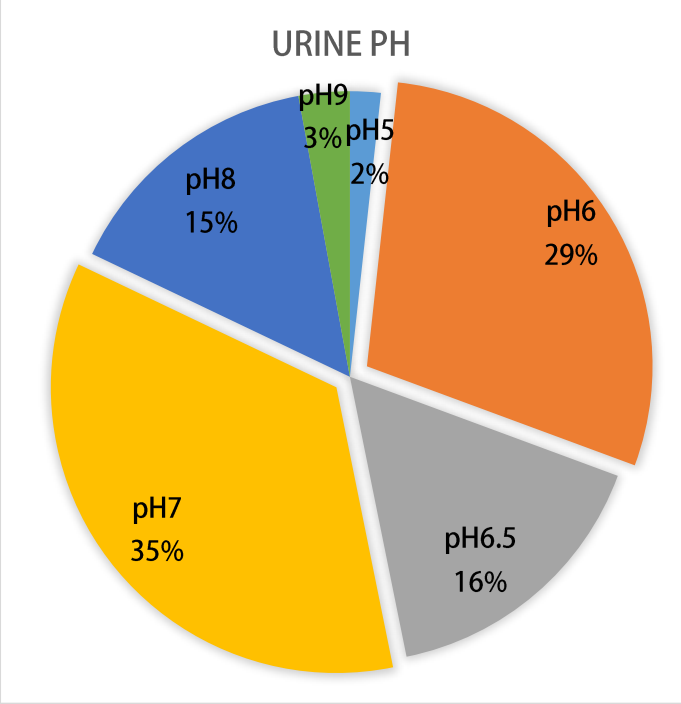

Figure 12: Distribution of the pH of urine of FLUTD cases.

For erythrocytes/hpf evaluation, 50.3% cases had severe haematuria (Figure 13a). Urethral plug had no cases recorded with moderate haematuria but predominated severe haematuria ($p<0.01$). For proteinuria, 36.4% cases had moderate proteinuria (Figure 13b). Within proteinuria, urethral predominated the moderate level while FIC predominated the severe level ($p<0.05$).

Any amount of haematuria increased the odds ratio for bacterial UTI irrespective of disease category (Bailiff *et al*., 2008). Urethral plug predominates moderate proteinuria which, was in accordance the composition of urethral plugs, containing large quantities of matrix (mucoprotein, consisting of mucous and inflammatory debris) with varying quantities of minerals. The high prevalence of haematuria was most likely a result of urinary bladder bleeding due to inflammation which was induced by increased permeability of the tissue and high pressure within the bladder especially in cases of anuresis, but less likely due to previous cystocentesis and catheterization attempts (Segev *et al.*, 2011).

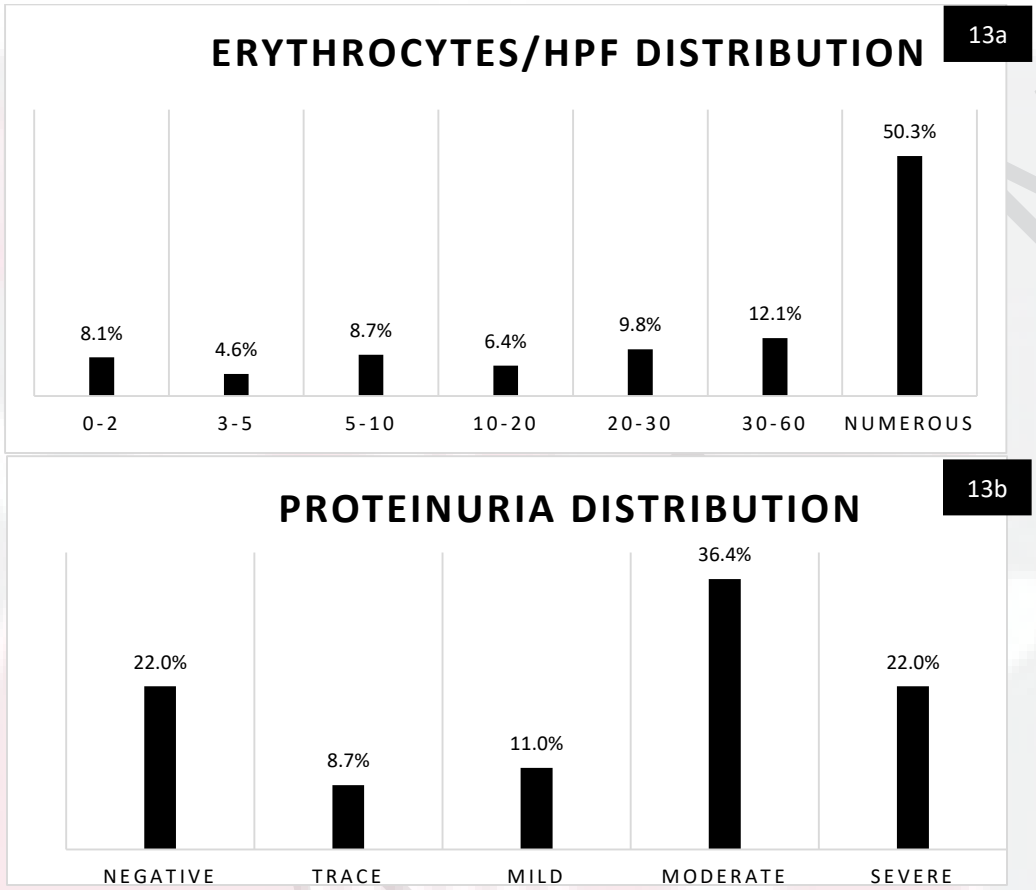

Figure 13: Distribution of haematuria (13a) and proteinuria (13b) in FLUTD cases.

It was found that 41.6% cases had mild pyuria with 36.4% had mild bacteriuria (Figure 14a). However, these didn't directly interpret into having bacterial cystitis, method of sampling must be considered together. Any bacteria found during cystocentesis were considered to have bacterial cystitis due to the aseptic technique. However, in cases of spontaneous micturition or urinary catheterisation, the possible introduction of contaminants must be considered as such on in cases of concurrent pyuria would the cases be considered bacterial cystitis (Figure 14b).

Pyuria increased in the urine sediment, the odds ratios increased over 40-fold for infections (Bailiff *et al*., 2008). The high proportion of pyuria supported the inflammation.

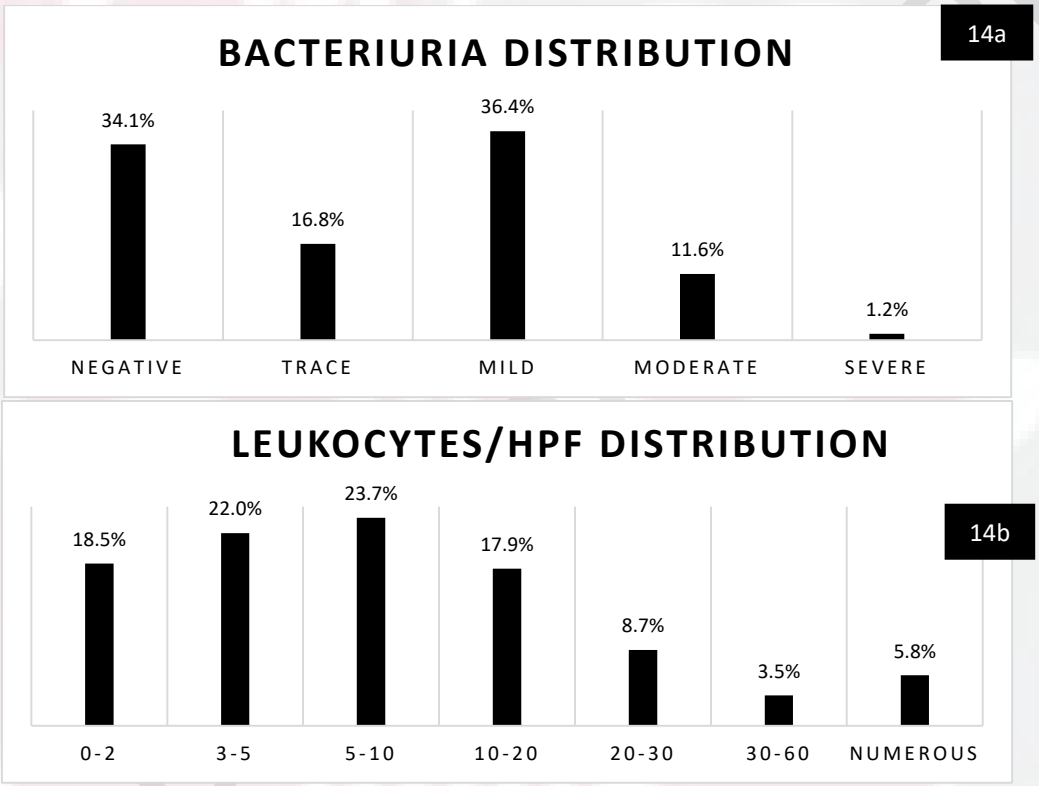

Figure 14: Distribution of the bacteriuria (14a) and pyuria (14b) of FLUTD cases

5.0 CONCLUSION

The common pattern of clinicopathological parameters of cats presented with FLUTD to UVH, UPM were mild hyperglobinuria, azotemia**,** severe haematuria with trace to mild pyuria, moderate proteinuria, and mild bacteriuria. The important risk factors of higher concern included male cats living indoor in a multicat household fed with dry non-prescription diet. The most common diagnosis was bacterial cystitis followed closely by FIC

6.0 RECOMMENDATION

Further study should be carried out targeting specific disease or condition among the FLUTD in order to clarify a more detailed pattern for the clinicopathological parameters with an addition of severity assessments. By doing a single disease, a pattern specific to the disease would be clearer.

It is also recommended that a standardised protocol for history taking and physical examination were made for FLUTD cases to provide a homogenized data for further study.

References

Buffington C.A.T., Chew D.J. & DiBartola S.P. (1996). Interstitial cystitis in cats. *Veterinary Clinics of North America*, 26 (2), 317–326.

Buffington, C. & Chew, D. (1999). Calcium oxalate urolithiasis in cats. *Journal of Endourology*, *13*(9), 659-663.

Defauw, P., Van de Maele, I., Duchateau, L., Polis, I., Saunders, J. & Daminet, S. (2011). Risk Factors and Clinical Presentation of Cats with Feline Idiopathic Cystitis. *Journal of Feline Medicine and Surgery*, *13*(12), 967-975.

Gerber, B., Boretti, F., Kley, S., Laluha, P., Muller, C., Sieber, N., Unterer, S., Wenger, M., Fluckiger, M., Glaus, T. & 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 disease (FLUTD). In *Proceedings of 59th International Congress of the Italian Association of Companion Animal Veterinarians*, Rimini, Italy. pp. 201-203.

Griffin, J. (1989). Stress and immunity: A unifying concept. *Veterinary Immunology and Immunopathology*, 20(3), 263-312.

Gunn-Moore, D. (2003). Feline lower urinary tract disease. *Journal of Feline Medicine and Surgery*, 5(2), 133-138.

Hesse, A., Steffes, H.-J. & Graf, C. (1998) Pathogenic factors of urinary stone formation in animals. *Journal of Animal Physiology and Animal Nutrition*, 80, 108-119

Hostutler, R., Chew, D., & DiBartola, S. (2005). Recent concepts in feline lower urinary tract disease. *Veterinary Clinics of North America: Small Animal Practice*, 35(1), 147-170.

Jones, A. (2009). Feline Lower Urinary Tract Disease (FLUTD): an overview. *Veterinary Nursing Journal*, 24(3), 21-24.

Lund, H., Skogtun, G., Sørum, H., & Eggertsdóttir, A. (2015). Antimicrobial susceptibility in bacterial isolates from Norwegian cats with lower urinary tract disease. *Journal of Feline Medicine and Surgery*, 17(6), 507-515.

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

Skoch, E. R., Chandler, E. A., Douglas, G. M. & Richardson, D. P. (1991) Influence of diet on urine pH and the feline urological syndrome. *Journal of Small Animal Practitioner*. 32, 413-419.

Tariq, A., Rafique, R., Abbas, S., Khan, M., Huma, I., Perveen, S., & Kamran, M. (2014). Feline Lower Urinary Tract Disease (Flutd) – An Emerging Problem of Recent Era. *Journal of Veterinary Science and Animal Husbandry*, 1(5).

Tion, M., Dvorska, J., & Saganuwan, S. (2015). A review on urolithiasis in dogs and cats. *Bulgarian Journal of Veterinary Medicine*, 18(1), 1-18.

van Duijkeren E., van Laar P. & Houwers D.J. (2004). Cystocentesis is essential for reliable diagnosis of urinary tract infections in cats, *Tijdschrift voor Diergeneeskunde*, 129(12), 394–396.

Vogt, A. H., Rodan, I., Brown, M., Brown, S., Buffington, C. A. T., Forman, M. J. L., Neilson, J. & Sparkes, A. (2010). AAFP-AAHA Feline Life Stage Guidelines. *Journal of Feline Medicine and Surgery*, 12(1), 43-54.

Westropp J.L., Buffington C.A.T. & Chew D. (2005) Feline lower urinary tract disease. In *Ettinger SJ, Feldman EC, editors. Textbook of Veterinary Internal Medicine*. pp: 1828-1850. St. Louis: Elsevier Saunders.