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Risk Factors for Feline Lower Urinary Tract Diseases in Thailand

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Original Article

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Abstract

Feline lower urinary tract diseases (FLUTD) is a diagnostic term for cats with hematuria, dysuria, pollakiuria, and partial or complete urethral obstruction. The aim of the present study was to identify risk factors for cats with LUTD. Cats with LUTD were evaluated by history, physical examination, urinalysis, radiography, and contrast radiography. Clinically normal cats consisted of vaccinated cats without clinical signs of LUTD admitted to the same veterinary hospital. Cats with a history of urinary tract disease, and those received special treatment for LUTD were excluded. All cats' owners filled out standardized questionnaires about breed, gender, age, environmental factors, and diet of their cats to identify the risk and protective factors for LUTD. Chi-square analysis was used to assess significant association between urolith formation and categorical risk factors. In case of small expected frequencies, Fisher's exact test was used. The Mantel-Haenszel test was used to calculate odds ratios (OR_{MH}) and 95% confidence interval. This estimation of relative risk considered significant if 95% confidence intervals for odds ratios did not include 1.0. The proportional morbidity ratio of Feline LUTD in Thai cats was 2.22%. Cats eating canned food had lower risk of developing LUTD (OR_{MH} = 0.12, 95% CI, 0.05 to 0.29) than cats eating dry food (OR_{MH} = 0.29, 95% CI, 0.10 to 0.88). Multivariate Logistic Regression was performed using backward elimination. The results demonstrated that overweight cats were four times at higher risks of developing LUTD than cats with ideal body weight (OR = 4.68, 95% CI, 1.75 to 12.46).

Keywords: cats, FLUTD, overweight, risk factors

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บทคัดย่อ

ปัจจัยเสี่ยงที่ทำให้เกิดโรคทางเดินปัสสาวะส่วนล่างผิดปกติของแมวในประเทศไทย

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โรคทางเดินปัสสาวะส่วนล่างผิดปกติ (Feline Lower urinary tract; FLUTD) เป็นความผิดปกติที่พบได้บ่อยในแมว อาการผิดปกติที่สำคัญคือ ปัสสาวะปนเลือด ปัสสาวะขัด ปัสสาวะบ่อยและ/หรือปัสสาวะอุดตัน ทำการศึกษาเพื่อหาปัจจัยเสี่ยงของโรค FLUTD ในแมวป่วยจากการวินิจฉัยของสัตวแพทย์ประจำโรงพยาบาลสัตว์ จากการซักประวัติ ตรวจร่างกาย การตรวจปัสสาวะ การถ่ายภาพรังสีวินิจฉัย และ/หรือการทำอัลตราซาวน์ ส่วนแมวปกติเป็นแมวที่เข้ารับการฉีดวัคซีนที่โรงพยาบาลสัตว์ในช่วงเวลาเดียวกับแมวป่วย เจ้าของแมวป่วยและแมวปกติให้ข้อมูลเกี่ยวกับการเลี้ยงแมวโดยการตอบแบบสอบถามในแบบฟอร์มข้อมูลเกี่ยวกับตัวสัตว์ เช่น อายุ เพศ พันธุ์ การเลี้ยงดู สิ่งแวดล้อมและการให้อาหาร ข้อมูลที่ได้จากสัตว์ทั้งสองกลุ่มจะถูกทดสอบด้วยการทดสอบไคสแควร์ ในรายที่มีข้อมูลน้อยจะใช้การทดสอบแบบ Fisher's Exact จากนั้นใช้การทดสอบด้วย Mantel-Haenszel เพื่อคำนวณหา odds ratios ที่ความเชื่อมั่น 95% ผลการศึกษาพบว่า proportional morbidity ratio ของแมวไทยที่ป่วยด้วยโรคทางเดินปัสสาวะส่วนล่างผิดปกติเท่ากับร้อยละ 2.22 แมวกินอาหารสำเร็จรูปชนิดเปียกมีโอกาสเป็นโรคทางเดินปัสสาวะส่วนล่างน้อยกว่าแมวกินอาหารสำเร็จรูปชนิดเม็ด และแมวที่มีน้ำหนักตัวเกินมาตรฐานมีโอกาสเป็น 4 เท่าของแมวที่มีน้ำหนักตัวปกติที่จะป่วยด้วยโรคทางเดินปัสสาวะส่วนล่างผิดปกติ

คำสำคัญ: แมว โรคทางเดินปัสสาวะส่วนล่างผิดปกติ น้ำหนักตัวเกิน ปัจจัยเสี่ยง

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Introduction

Feline lower urinary tract diseases (FLUTD) or Feline Urologic Syndrome (FUS) are diagnostic terms describing abnormalities in cats with hematuria, dysuria, pollakiuria, and partial or complete urethral obstruction. The causes may be single, multiple and interacting, or unrelated (Osborne et al., 1989). Many causes of FLUTD have been postulated such as metabolic disorders (uroliths and urethral plugs), inflammatory disorders (infectious agents and noninfectious agents), trauma, neurogenic disorders, anatomical abnormalities, neoplasia. One important cause of feline LUTD is idiopathic (Osborne et al., 1996).

Between 1980 and 1997, a total of 221,447 cats were examined at veterinary colleges in North America. Of 680,240 cats, feline LUTD was diagnosed in 22,908 (3.4%) cats (Lekcharoensuk et al., 2001). In 1996, lower urinary tract diseases were reported as one of the 25 most common feline abnormality examined at private veterinary clinics in the United States (Lulich and Osborne, 1996). In Thailand, the same trend was also observed. This problem is a frequent cause of concern to cats' owners in Thailand. Renal disease frequently develops in older cats previously affected with LUTD. To date, there have been no controlled studies to determine the cause and frequency of hematuria, dysuria, and pollakiuria in cats in Thailand. In the USA, uroliths were found in 24% of cats with LUTD (Kruger, 1991). It remains to be investigated whether the same phenomenon exists in Thailand. The objective of the present study was to determine the risk factors such as age, breed, gender, diets and environment factors for cats with LUTD.

Materials and Methods

Cats included in the present study were pure-breed and Thai mixed breed from Chulalongkorn University Veterinary Teaching Hospital and two other private veterinary hospitals in Bangkok. All cats with the history of hematuria, dysuria, pollakiuria, and/or urethral obstruction were included. Cats with chronic renal disease and other diseases were excluded. Chulalongkorn University Veterinary Teaching Hospital was chosen as the principle investigating center of the study, whereas the other two private veterinary hospitals were chosen as representative of regional veterinary hospitals. A total of 140 cats were included consisting of 70 cases and 70 clinically normal cats.

Criteria for selection of cases: Cats with LUTD were evaluated by history, physical examination, urinalysis, radiography, and contrast radiography.

Criteria for selection of clinically normal cats: Clinically normal cats consisted of those without

hematuria, dysuria, pollakiuria, and urethral obstruction admitted to the same veterinary hospital as the LUTD cats coming to the veterinary hospitals for vaccination. Health status of clinically normal cats were determined by history, physical examination, and if necessary, urinalysis and radiography. Cats with a history of urinary tract disease, and those with a history of receiving special treatment for LUTD were excluded.

Methods of Evaluation of Cats: Cats with LUTD were examined by survey radiography, pneumocystography, and/or double contrast urocystography. If uroliths were detected, they were removed by surgery or voiding urohydropropulsion. The mineral composition of uroliths were analyzed quantitatively by optical crystallography, and when necessary, by infrared spectroscopy at Minnesota Uroth Center.[a] A primary mineral type was assigned to uroliths consisting of at least 70% of a single mineral type. Uroliths containing <70% of a single mineral component and without a nucleus or shell were classified as mixed uroliths. All cats' owners filled out standardized questionnaires about breed, gender, age, environmental factors, and diet of each cat to identify the risk and protective factors for LUTD.

To study the rate of urolith recurrence, cats that develop signs of LUTD for 1 1/2 years were evaluated by history and physical examination monthly or sooner. Urine and blood samples were collected at four month intervals. Urinalysis was performed on samples obtained by cystocentesis or catheterization. Survey radiograph performed at 8 months intervals, or sooner if cats developed signs of LUTD. Quantitative bacterial urine culture and antimicrobial susceptibility tests were performed if cats were suspected of having bacterial urinary tract infection (UTI). Blood samples were evaluated for complete blood count (CBC), and blood chemistry profile [aspartate aminotransferase (AST), alanine aminotransferase (ALT), blood urea nitrogen (BUN), and serum creatinine levels] to assess health status and degree of feline lower urinary tract abnormalities.

Statistical analysis: Descriptive statistics including frequency distributions, means, and standard deviations were determined for continuous variables. Differences in the means between case and clinically normal cats were tested using Student's *t*-test.

Relative frequencies were used to describe breed, gender, and age of cats that develop LUTD. Chi-square analysis was used to assess significant association between FLUTD and categorical risk factors. In case of small expected frequencies, Fisher's exact test was used. The Mantel-Haenszel test was used to calculate odds ratios (OR_{MH}) and 95% confidence interval. This estimation of relative risk was considered significant if 95% confidence intervals for odds ratios did not include 1.0.

Results

For one and a half year period, the present study included 140 cats into the study. Seventy cats with FLUTD were selected as cases that were followed up prospectively. The study also collected seventy vaccinated cats as clinically normal cats. The results of the study of 70 cats with feline LUTD at Chulalongkorn University Veterinary Teaching Hospital indicated that the proportional morbidity ratio of FLUTD in Thai cats was 2.22%. Most cats with FLUTD in the present study were Siamese-mixed breed (81.4%). The mean age of cats with LUTD was 54.75 +/- 5.50 months old and the mean age of clinically normal cats was 28.89+/-3.47 months old. The affected cats were intact male (41.4%), neutered male (30.0%), intact female (17.1%), and neutered female (11.4%). The mean weight for cats with LUTD was 4.09 +/- 1.10 kg but the mean weight for clinically normal cats was 3.24+/-0.14 kg. The mean weight of LUTD cats was statistically different from the mean weight of clinically normal cats ($p< 0.01$). Commercial cat food was consumed by 74.3% of the affected cats. Urine culture was performed in 42 cats and indicated the urinary tract infection with *Pseudomonas aeruginosa* (20.0%), *E. coli* (60%), and mixed infection (20%). Uroliths were observed in 16 cats but were retrieved only in 4 cats and submitted for analysis. The quantitative analysis of the uroliths revealed that they were composed of magnesium ammonium phosphate (struvite) (100%). Urethral Plug was also found in 8 cats. Crude and adjusted odds ratios were calculated to identify risk and protective factors for cats with LUTD. The results of our study showed that cats eating canned food had lower risk of developing LUTD (OR_{MH} = 0.19, 95% CI, 0.06 to 0.54) than cats eating dry food (OR_{MH} = 0.89, 95% CI, 0.43 to 1.83). Multivariate Logistic Regression was also performed using backward elimination. The results of Logistic Regression demonstrated that overweight cats had statistically higher risks of developing LUTD than other cats (OR = 4.68, 95% CI, 1.75 to 12.46). The causes of feline LUTD were idiopathic (27.1%), calculi (22.9%), urinary tract infection (14.3%), urethral plug (11.4%), anatomical disorders (2.9%), and trauma (2.9%).

Discussion

The results of the present study revealed that the proportional morbidity ratio of Thai cats with LUTD was 2.22%; much lower than that previously reported to be as high as 10.0% in the United States in 1970s, but closer to the percentage reported in the United States in 1980s which was between 1.0 % to 6.0% (Willeberg 1984; Osborne et al., 1995). In 1999, LUTD in cats was reported to be 1.3-1.7% in cats examined at private veterinary practices in the United States (Lund et al., 1999). The age of Thai cats with LUTD ranged from 2 months old to 16 years old. Most LUTD cats were 2 years old at the time of first presentation to the veterinary hospital. Data from cats admitted to 24 colleges of Veterinary Medicine in North America from 1980-1997 indicated that the age-

Table 1 Odds ratios (OR) and 95% confidence intervals (CI) of breed, age, sex, type of diet, frequency of feeding, and duration of food given in 70 cats with LUTD and 70 clinically normal cat

Characteristic	No. of case cats n/N (%)	No. of clinically normal cats n/N (%)	OR	95% CI
Breed				
Mixed	57/70 (81.4%)	59/70 (84.2%)	0.82	0.31-2.14
Siamese	4/70 (5.7%)	6/70 (8.6%)	0.65	0.14-2.75
Persian	1/70 (1.4%)	2/70 (2.9%)	0.49	0.02-7.16
Unknown	8/70 (11.4%)	3/70 (4.3%)	2.88	0.65-14.43
Age (year)				
<1	3/70 (4.3%)	22/70 (31.4%)	0.10 *	0.02-0.37
1 to 3	30/70 (42.8%)	29/70 (41.5%)	1.06	0.51-2.19
4 to 6	20/70 (28.6%)	15/70 (21.4%)	1.47	0.63-3.41
>7	14/70 (20.0%)	3/70 (5.7%)	5.58 *	1.44-31.46
Unknown	3/70 (4.3%)	0/70 (0%)	NC	NC
Sex				
Male intact	29/70 (41.4%)	32/70 (45.7%)	0.84	0.41-1.73
Male neutered	21/70 (30.0%)	19/70 (27.1%)	1.15	0.52-2.56
Male neutered	12/70 (17.1%)	13/70 (18.6%)	0.91	0.35-2.34
Female neutered	8/70 (11.4%)	6/70 (8.6%)	1.38	0.40-4.79
Type of Diet				
Dry food only	30/70(42.9%)	32/70(45.7%)	0.89	0.43-1.83
Can food only	6/70 (8.5%)	23/70(3.2%)	0.19*	0.06-0.54
Can and dry food	16/70(22.9%)	7/70(10.0%)	2.67	0.95-8.21
Unknown	18/70(25.7%)	8/70(11.4%)	2.68	1.00-7.69
Frequency of Feeding				
Twice a day	34/70(48.6%)	37/70(52.9%)	0.84	0.41-1.72
Three times a day	5/70 (7.2%)	19/70(27.1%)	0.21*	0.06-0.63
> three times a day	4/70 (5.7%)	2/70 (2.9%)	2.06	0.28-23.39
Ad libitum	16/70(22.8%)	11/70(15.7%)	1.59	0.63-4.14
Unknown	11/70(15.7%)	1/70(1.4%)	12.86*	1.75-561.6
Duration of Food Given (year)				
< 1	0/70 (0%)	12/70(17.1%)	0.00*	0.00-0.32
1 to 3	19/70(27.1%)	25/70(35.7%)	0.67	0.31-1.46
4 to 6	12/70(17.1%)	9/70(12.9%)	1.40	0.50-4.06
>7	6/70(8.6%)	4/70(5.7%)	1.55	0.35-7.79
>7	6/70(8.6%)	4/70(5.7%)	1.55	0.35-7.79

* p< 0.05 Fisher's exact test was used when 95% C.I. were not valid.
n: Number of cats in each characteristic, N: Total number of cats with LUTD or clinically normal cats, NC: Not calculated

Table 2 Odds ratios (OR) and 95% confidence intervals (CI) of source of water, and frequency of water given in 70 cats with LUTD and 70 clinically normal cats.

Characteristic	Number of cases cats (n/N) (%)	Number of clinically normal cats (n/N) (%)	OR	95% CI
Source of Water				
Tap water	40/70 (57.0%)	38/70 (54.3%)	1.12	0.55-2.31
Well water	3/70 (4.3%)	0/70 (0%)	NC	NC
Filtered water	7/70 (10.0%)	14/70 (20.0%)	0.44	0.14-1.28
Distilled water	1/70 (1.4%)	0/70 (0%)	NC	NC
Boiled water	5/70 (7.2%)	16/70(22.9%)	0.26 *	0.07-0.81
Unknown	14/70 (20.0%)	2/70 (2.0%)	8.50 *	1.81-79.17
Frequency of water given				
On certain period	37/70(52.9%)	35/70(50.0%)	1.12	0.55-2.29
Ad libitum	23/70(32.8%)	28/70(40.0%)	0.73	0.35-1.55
Unknown	10/70(14.3%)	7/70(10.0%)	1.50	0.48-4.95

* p< 0.05 Fisher's exact test was used when 95% CI were not valid.
n: Number of cats in each characteristic, N: Total number of cats with LUTD or clinically normal cats, NC: Not calculated

specific proportional morbidity rate of cats with LUTD was between 2 to 7 years old (Osborne et al., 2000). The low proportional morbidity ratio in the present study may be due partly to the fact that Siamese cats had significantly lower risks of developing magnesium ammonium phosphate and calcium oxalate uroliths (Lekcharoensuk et al., 2000). The affected cats were intact male (41.4%), neutered male (30.0%), intact female (17.1%), and neutered female (11.4%). However, the data from 24 colleges of Veterinary Medicine in North America indicated that 52% of cats with LUTD were neutered male (Osborne et al., 2000). Both studies demonstrated that LUTD affected males twice as often as females. However, no gender or breed predispositions were noted in one study (Buffington et al., 2006). The present study also indicated that cats eating canned food had lower risk of developing LUTD (OR_{MH} = 0.19, 95% CI, 0.06 to 0.54) than cats eating dry food (OR_{MH} = 0.89, 95% CI, 0.43 to 1.83). One author had suggested that cats fed dry diets develop FUS more often than those fed canned diets (Osborne et al., 1984). The result of

Multivariate Logistic Regression Analysis demonstrated that overweight cats was four times at higher risk of developing LUTD than cats with ideal body weight. Inactivity, obesity, and having restricted access to outdoor have all been implicated as predisposing factors of causing FUS (Gaskell, 1981; Buffington et al., 2006) and feline calcium oxalate urolithiasis (Thumchai, 1996). From our study with 70 cats with feline LUTD, the causes of LUTD in Thai cats were idiopathic (27.1%), calculi (22.9%), urinary tract infection (14.3%), urethral plug (11.4%), anatomical disorders (2.9%), and trauma (2.9%).

Table 3 Odds ratios (OR) and 95% confidence intervals (CI) of type of birth control, and type of vaccination in 70 cats with LUTD and 70 clinically normal cats.

Characteristic	No. of case cats (n/N) (%)	No. of clinically normal cats (n/N) (%)	OR	95% CI
Type of Birth Control				
Hormonal Injection	3/70 (4.3%)	0/70(0%)	NC	NC
Castration / OVH	14/70 (4.3%)	0/70 (0%)	NC	NC
Restricted area	10/70 (14.3%)	2/70 (2.9%)	5.67 *	1.13-54.63
No birth control	43/70 (61.4%)	16/70 (22.9%)	5.38 *	2.43-12.06
Unknown	0/70 (0%)	52/70 (74.3%)	0.00 *	0.00-0.02
Type of Vaccination				
Rabies	20/70 (28.6%)	12/70 (17.1%)	1.93	0.80-4.78
Rabies, Feline Rhinotracheitis	10/70 (14.3%)	17/70 (24.3%)	0.52	0.20-1.33
Rabies, Feline Leukemia	0/70 (0%)	2/70 (2.9%)	0.00	0.00-5.31
Rabies, Feline Rhinotracheitis, Feline Leukemia	8/70 (11.4%)	24/70 (34.3%)	0.25 *	0.09-0.64
Feline Rhinotracheitis	0/70 (0%)	1/70 (4.3%)	0.00	0.00-39.00
Feline Rhinotracheitis, Feline Leukemia	0/70 (0%)	11/70 (15.7%)	0.00 *	0.00-0.36
No previous history of vaccination	3/70 (4.3%)	0/70 (0%)	NC	NC
Unknown	29/70 (41.4%)	3/70 (0%)	15.08*	4.39-84.53

* p< 0.05 Fisher's exact test was used when 95% C.I. were not valid
n: Number of cats in each characteristic, N: Total number of cats with LUTD or clinically normal cats, NC: Not calculated

Table 4 Odds ratios (OR) and 95% confidence interval (CI) of number of family member, and whether any of the family member had feline LUTD in 70 cats with LUTD and 70 clinically normal cats.

Characteristic	Number of cases cats (n/N) (%)	Number of clinically normal cats (n/N) (%)	OR	95% CI
Number of family Member (number of cats)				
None	2/70 (2.9%)	5/70 (7.1%	0.38	0.04-2.45
1 to 3	24/70 (34.5%)	29/70 (41.5%)	0.74	0.35-1.55
4 to 6	4/70 (5.7%)	18/70 (25.7%)	0.18 *	0.04-0.58
>7	1/70 (1.4%)	0/70 (0%)	NC	NC
Unknown	39/70 (55.7%)	18/70 (25.7%)	3.63 *	1.68-7.93
Did any of the family member (cats) have FLUTD?				
Yes	2/70 (2.9%)	0/70 (0%)	NC	NC
No	28/70 (40.0%)	59/70 (84.3%)	0.12 *	0.05-0.29
Unknown	40/70 (57.1%)	11/70 (15.7%)	7.15 *	3.03-17.51

* p< 0.05 Fisher's exact test was used when 95% CI were not valid.
n: Number of cats in each characteristic, N: Total number of cats with LUTD or clinically normal cats, NC: Not calculated

Table 5 Odds ratios (OR) and 95% confidence interval (CI) of type of environment in 70 cats with LUTD and 70 clinically normal cats.

Charac-teristic	Number of cases cats (n/N)(%)	Number of clinically normal cats (n/N)(%)	OR	95 % CI
Environ-ment				
Hot	0/70 (0%)	14/70 (20%)	0.00 *	0.00-0.26
Humid	32/70 (45.7%)	44/70 (62.9%)	0.50	0.24-1.03
Cold	2/70 (4.3%)	1/70 (1.3%)	2.03	0.10-121.44
Others	0/70 (0%)	2/70 (2.9%)	0.00	0.00-5.31
Unknown	35/70 (50.0%)	9/70 (12.9%)	6.78 *	2.75-17.73

* p< 0.05 Fisher's exact test was used when 95% CI were not valid.
n: Number of cats in each characteristic, N: Total number of cats with LUTD or clinically normal cats

Table 6 Parameter estimates, OR, and 95% CI from multivariate analysis of all risk factors by using backward elimination logistic regression

Variables	Parameter estimate (B)	OR	95 % CI
Weight	1.54	4.675*	1.75-12.46
Canfood	-5.79	0.003*	0.00-0.06
Seasoning	3.09	0.045*	0.01-0.33
Age	0.02	1.018*	1.01-1.03

* p < 0.05

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