The Thai Journal of Veterinary Medicine

Volume 49
Issue 1 *March, 2019*

Article 2

3-1-2019

Epidemiologic evaluation of feline urolithiasis in Thailand from 2010 to 2017

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Short Communication

Epidemiologic evaluation of feline urolithiasis in Thailand from 2010 to 2017

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Abstract

This cross-sectional study describes the epidemiological data of feline urolithiasis in Thailand. Information on 923 feline uroliths submitted from Thailand to the Minnesota Urolith Center between January 2010 and December 2017 was evaluated. The frequency of urolith types, the relationships between urolith type and breeds and sex, were analyzed. Calcium oxalate was the most common urolith (49.5%) and was commonly found in male cats (OR = 1.81; 95%CI: 1.39, 2.36) with a mean age of 6.3±3.2 years. Struvite was the second most common urolith (38%), more frequently found in females (OR = 1.46; 95%CI: 1.11, 1.91) with a mean age of 5.1±3.1 years. Persians were significantly associated with the formation of CaOx urolith (OR = 1.65; 95%CI: 1.21, 2.21). Urate, cystine, calcium phosphate, and silica urolith were less common. Compound urolith was found in 7.6% of which 3 compound uroliths contained suture material as a nidus. During the study period, the proportion of CaOx urolith significantly increased from 35% in 2010 to 54% in 2017 ($p < 0.01$). The proportion of struvite urolith decreased from 54% in 2010 to 28% in 2017 ($p < 0.01$). The result of this study can be used for predicting the mineral composition of urolith and assist veterinarians to select diagnostic tests and to initiate therapy prior to urolith removal.

Keywords: Epidemiology, Feline, Thailand, Urolithiasis

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Introduction

Urolithiasis is one of the most common diagnoses in cats. It is estimated for approximately 15% to 21% of cats with clinical signs of lower urinary tract disease (Buffington et al., 1997; Lekcharoensuk et al., 2001). The type of urolith may vary depending on age, breed, sex, the type of food consumed and geographic location (Cannon et al., 2007; Albasan et al., 2012). In urolith, once formed, the severity of clinical signs varies from mild to life-threatening due to urinary tract obstruction (Gerber et al., 2005; Gerber et al., 2008).

Accurate identification of urolith mineral composition before commencing treatment is essential. Even though radiographic findings can predict the mineral composition of urolith by its appearance and radiodensity, some urolith types are radiographically indistinguishable (Weichselbaum et al., 1999; Weichselbaum et al., 2001). The prevalence of the different types of uroliths and the likelihood with which they occur in particular breeds, sexes, and ages of cat can help veterinarians more accurately predict their mineral compositions.

In Thailand, however, there is only published epidemiologic information of canine urolithiasis but this is not available for feline urolithiasis (Detkalaya et al., 2017; Hunprasit et al., 2017). The results of feline urolithiasis prevalence information from different countries may not be applicable to feline urolithiasis in Thailand since there are geographic variations and diet and breed differences. The objective of this study is to evaluate epidemiological data from urolith forming-cats in Thailand to help veterinarians in Thailand to more effectively administer medical care.

Materials and Methods

Sample population: The electronical submission information of feline urolith submitted from Thailand to the Minnesota Urolith Center between January 1, 2010 and December 31, 2017 was retrieved. The information for each record including the quantitative mineral composition of the urolith, year of submission, breed, sex, age and anatomical location of urolith within the urinary tract were evaluated from the submitted questionnaire.

Urolith analyses: Each submitted urolith was quantitatively analyzed primarily by means of polarization microscopy and infrared spectroscopy (Ulrich et al., 1996). The type of urolith was classified by its mineral composition when the urolith was composed of single layers and contained ≥70% of a single mineral. Mixed urolith to referred a single layer urolith which contained < 70% of any single mineral. Compound uroliths were defined as multiple layered urolith in which each layer contained ≥ 70% of a single mineral and minerals were different in each layer.

Statistical analyses: Descriptive statistics for categorical variables, including mineral composition, breed, sex and anatomic location were presented in percentages and age as a mean ± standard deviation. The difference between the average age of dogs with CaOx and the struvite urolith was evaluated using Student's t-test. Odds ratios (OR) and 95% confidence interval (95%CI) were calculated for measuring the relationship between urolith type and breed and sex. The change of the annual submission percentage for each urolith type was evaluated by chi-square test of trend (Armitage, 1955). Statistical analyses were performed using SPSS (IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp). The level of statistical significance was set at 0.05.

Results and Discussion

During the study period, a total of 923 feline uroliths from Thailand were analyzed. The distribution of urolith in cats is presented in Table 1. The annual proportion for CaOx urolith submissions significantly increased from 35.0% in 2010 to 54.4% in 2017 ($p < 0.01$) whereas the annual proportion for struvite submission decreased from 53.7% in 2010 to 27.9% in 2017 ($p < 0.01$). Struvite was the most common composition of the central core in a group of 70 compound uroliths (Table 2).

Of this number of uroliths, the majority of uroliths were from the lower urinary tract (96.9%) (Table 2). Nineteen uroliths were retrieved from the upper urinary tract of which CaOx was a major mineral composition (14; 73.7%), followed by struvite (3; 15.8%). The information on age was recorded in 789 cats. The average age of urolith forming cats was 5.9±3.3 years ranging from 2 months to 19 years. Regardless of sex, cats with CaOx urolith were significantly older than cats with struvite urolith ($p < 0.01$) (Table 1)

Table 1 Epidemiological data: type, sex, neuter status, age, and anatomic location distribution of the uroliths

Urolith type	n	Sex			Age (y)	Location of urolith	
		Male[a]	Female[a]	no report		Upper urinary tract	Lower urinary tract
CaOx	457	272 (102/170)	178 (93/85)	7	6.3±3.2	15	442
Struvite	351	160 (96/64)	185 (92/93)	6	5.1±3.1	3	348
Compound	70	21 (12/9)	45 (20/25)	4	6.8±3.4	0	70
Urate	18	6 (5/1)	12 (7/5)	0	5.7±4.7	0	18
Cystine	7	4 (3/1)	3 (3/0)	0	5.4±1.1	0	7
CaP	6	2 (1/1)	3 (2/1)	1	6.8±4.8	0	6
Silica	2	2 (0/2)	0	0	8.0±1.4	0	2
Xanthine	1	1 (1/0)	0	0	1.5±NA	0	1
Others	11	7 (5/2)	3 (1/2)	1	5.2±4.0	2	7
Total	923	475 (225/250)	429 (218/211)	19	5.9±3.3	19	904

Table 2 Distribution of 70 feline compound uroliths submitted from Thailand between 2010 and 2017.

Core mineral	Mineral composition of outer layer[a]							
	CaOx	Struvite	Urate	CaP	Cystine	Silica	Other	Total
CaOx	NA	3	1	3	0	0	3	10
Struvite	5	NA	5	5	0	0	10	25
Urate	5	2	NA	0	0	0	0	7
CaP	3	1	0	NA	0	0	3	7
Cystine	0	0	0	0	NA	0	0	0
Silica	0	0	0	0	0	NA	0	0
Foreign body	1	2	0	0	0	0	0	3
Other	5	8	3	1	0	0	1	18

Sex was determined in 904 cats. Urolithiasis occurred more frequently in males (475; 52.5%) than in females (429; 47.5%). In males, uroliths were commonly found in neutered cats (52.6%) whereas a slightly higher proportion of urolith submission from intact females was reported (50.8%). The distributions of sex and neutered status in each urolith type are presented in Table 1. There were associations between sex and urolith types. Male cats were over-represented in CaOx urolith (OR = 1.81; 95%CI: 1.39, 2.36; $p < 0.01$) whereas females were most common in struvite urolith (OR = 1.46; 95%CI: 1.11, 1.91; $p < 0.01$). There was no sex association with the other urolith types.

A total of fifteen breeds including mixed breeds were identified in a group of 874 cats with documented breeds. Most feline urolith submissions were from domestic cats (509; 55.1%) and Persians (244; 26.4%). The absolute number of urolith submissions for each urolith type is presented in Table 3. There was a significant association between Persian and CaOx urolith (OR = 1.65; 95%CI: 1.21, 2.21; $p < 0.01$) using domestic cats as a reference group while no other breed association for the remaining urolith types was observed.

Table 3 Distribution of urolith types in most affected feline breeds

Breed	CaOx	Struvite	Compound	Urate	Cystine	CaP	Total
Domestic cat	263	234	52	14	6	4	581
Persian	145	80	11	4	1	0	244
American Shorthair	10	4	1	0	0	0	15
Exotic Shorthair	6	2	1	0	0	0	10
Scottish Fold	6	2	0	0	0	0	8
Siamese	3	2	1	0	0	0	7
Total	457	351	70	18	7	6	923

CaOx urolith was the most common urolith identified in cats in Thailand for which similar results were reported from other regions in the world, (Houston et al., 2003; Cannon et al., 2007; Gerber et al., 2016; Houston et al., 2016). The mechanism of CaOx urolith formation in cats is not well understood and is multifactorial. Diet causing hypercalciuria, hyperoxaluria and urine acidity is believed to be one of the important causes (Lekcharoensuk et al., 2001). Sex is another risk factor. Males were commonly affected from CaOx urolith more than females (Cannon et al., 2007; Houston and Moore, 2009; Gerber et al., 2016; Houston et al., 2016). However, the formation mechanism for CaOx urolith and sex difference in cats has been less investigated.

Struvite urolith is more prevalent in females as has been previously published (Houston et al., 2003; Cannon et al., 2007; Houston and Moore, 2009; Gerber et al., 2016; Houston et al., 2016). Unlike in dogs, most struvite uroliths in cats are sterile so the predisposition of the anatomy of the urethra for urinary tract infection and struvite formation does not appear to be as important in cats (Seguin et al., 2003). The underlying causes that make sterile struvite uroliths more common in females than in males are not known and require further investigation.

The observed differences in the proportions of CaOx and struvite urolith are similar to that previously reported (Cannon et al., 2007; Houston and Moore, 2009; Houston et al., 2016). A reciprocal trend of CaOx and struvite urolith over the study period may have been caused by the relative ease of diagnosing struvite uroliths on survey radiographs and the efficacy and availability of diets that facilitate the dissolution of struvite uroliths (Houston et al., 2011; Lulich et al., 2013).

Struvite uroliths can be medically dissolved leading to an increase of uroliths that cannot be medically managed for which similar observations were reported in dogs (Picavet et al., 2007). Among pure bred cats in the present study, Persians were the most common breed encountered with urolithiasis. This is similar to other studies where Persians were one of the most affected breeds for urolithiasis (Cannon et al., 2007; Houston et al., 2016). In addition, Persians were significantly associated with CaOx urolith formation in the present study which is similar to previous studies (Cannon et al., 2007; Houston et al., 2016). The predisposition for CaOx urolithiasis in this breed may result from several factors. Genetics may play a role in CaOx urolith formation in humans (Goodman et al., 1995) and it is possible that Persian in Thailand are highly inbred. Breed popularity is another factor that contributes to the high CaOx urolith submission. The previous study in dogs found that the trend of urate urolith decreased due to the decreased Dalmatian population in Hungary (Bende et al., 2015). However, there is no information of breed popularity in Thailand so we cannot explain why Persians are most commonly affected breed.

The result of the study showed that urate urolith was commonly found in females which was different from the previous study where male cats were presenting with urate urolith more than females (Albasan et al., 2012). In Thailand, urate urolith was found in domestic cats and Persian cats which differed from previous studies that identified several breeds (Cannon et al., 2007; Albasan et al., 2012; Houston et al., 2016). The etiology of urate urolith formation has been investigated in Dalmatian dogs (Bannasch et al., 2004; Bannasch et al., 2008), but little information exists regarding the pathogenesis of these uroliths in cats. In non-Dalmatian dogs, an acquired urolith formation from porto-vascular anomaly can often be detected (Caporali et al., 2015). Unfortunately, we did not obtain the information of disease screening for each urate urolith former cats and the further study should be performed on the detection of underlying disease in these cats.

The recommendation on treatment and prevention of feline urolithiasis has been published. Only three urolith types can be medically dissolved, namely, struvite, urate and cystine urolith (Lulich et al., 2016). The achievement of medical treatment depends on the accurate prediction of mineral type. For uroliths that fail to be dissolved, surgical treatment is the method of choice. However, a minimally invasive removal method such as voiding urohydropropulsion, laser lithotripsy and basket retrieval has been recommended for minimizing surgical complications and suture nidus urolith recurrence (Lulich et al., 2016). Three uroliths with a central core composed of a suture nidus were reported in the present study and also reported in other species (Ulrich et al., 2009; Hunprasit et al., 2017). In dogs, 9% of recurrent urolith contained suture material as a nidus and the uroliths were associated with decreased time to recurrence (Appel et al., 2008). This type of urolith can alert the veterinarian to using appropriate urinary bladder closer technique or considering non-surgical methods for the management of urolithiasis.

The recurrence of urolith in cats is not uncommon. In one study the resubmission rate of initial urate, CaOx, and struvite urolith was 13.1%, 7.1%, and 2.7% respectively (Albasan et al., 2009). However, in this study, the recurrence history was not obtained. The prevention strategy of urolith recurrence depends on the result of quantitative urolith analysis. The proper prevention strategy can prolong recurrence time which the recommendation suggests to perform periodic monitoring such as abdominal radiography to detect a recurrent urolith early so it can be removed by minimally invasive method (Lulich et al., 2016)

In conclusion, accurately predicting the urolith mineral composition before commencing the treatment can help in selecting a safe and effective urolith-removal procedure and management as well as the prevention of recurrence. Veterinarian in Thailand can use prevalence data in the present study for prediction of urolith type and deciding the appropriate therapy in urolith-forming cats.

Conflict of Interest: The authors declare they have no conflict of interest

Acknowledgements

The authors thank the staff at the Minnesota Urolith Center for their technical assistance and veterinarians in Thailand who submitted uroliths for analysis.

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