ORIGINAL ARTICLE

Analysis of 4495 canine and feline uroliths in the Benelux. A retrospective study: 1994–2004

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Summary

From 1994 to 2004, Hill's Pet Nutrition received 4495 canine (65%) and feline (35%) uroliths from Benelux veterinary practitioners. They were sent to the Minnesota Urolith Center, USA for analysis. In 1994, 110 uroliths were analysed – 85% from dogs – and in 2003, 1067 uroliths were analysed – 59% from dogs. During this period, substantial changes were observed in composition. In 1994, 77% of the cats had uroliths composed of struvite, and 12% had uroliths composed of calcium oxalate. In 2003, feline uroliths were composed of 32% struvite, and 61% calcium oxalate. The same evolution was observed in the dogs. In 1994, 51% of canine uroliths were composed of struvite, and 33% of calcium oxalate. In 2003, 40% had struvite uroliths, and 46% had calcium oxalate uroliths. A significant effect of the size, the breed, and the gender were noticed in the dogs. The mean age of uroliths appearance was 7.3 years in the dogs and 7.2 years in the cats. The findings are similar to those previously published in the USA.

Introduction

Uroliths are a common and recurrent problem in dogs and cats (Bartges, 1998). Surgical removal of uroliths has been the main treatment modality, although in some cases, dietary and/or medical measures to prevent their recurrence have been advocated. Effective long-term management of urolithiasis depends on identification and manipulation of factors contributing to the initial stone formation which, in turn, is dependent on accurate identification of the mineral composition of the urolith involved. Microscopic evaluation of crystals present in urine sediment provides only a tentative index of suspicion of the composition of any urolith present, because of the variable conditions associated with their formation, growth and dissolution. Definitive identification of urolith composition requires their analysis by polarizing light-microscopy, infrared spectroscopy, X-ray diffraction, and other methods of quantitative analysis (Osborne et al., 1990).

The purpose of the study reported here was to compile and analyse data from a large number of canine and feline uroliths submitted for quantitative analysis from animals residing in the Benelux countries. Variables of particular interest included the mineral composition of the urolith, its location in the urinary tract, and the age, breed and gender of the animal.

Materials and methods

The records of all canine and feline uroliths submitted for analysis to Hill's Pet Nutrition Benelux

(Belgium, The Netherlands and Luxemburg) between January 1994 and September 2004 were reviewed and included in this study. Each urolith submitted by a veterinary surgeon was accompanied by a standard questionnaire about the animal, providing its background details. The uroliths were submitted to the Minnesota Urolith Center (College of Veterinary Medicine, University of Minnesota, St Paul, MN, USA) for quantitative and qualitative analysis (polarizing light-microscopy, infrared spectroscopy, and chemical composition). A database containing the results of the quantitative analysis and data about animals – age, breed, gender, the location of the urolith (kidney, ureter, bladder, urethra), the number of previous episodes of urolithiasis and results of urinalysis was compiled. When urinary pH was measured and reported on the questionnaire, the measurement method was not defined.

For purpose of this study, the term 'calcium oxalate' (CaOx) included calcium oxalate monohydrate or calcium oxalate dehydrate (or both), and the term 'urate' included salts of uric acid.

Statistical analyses

Various categories were assigned to analyse the data of interest. In dogs, the breed was divided into five categories: small, medium, large, giant and unknown. Gender categories were: male or female, neutered or entire, and unknown.

The data were analysed for each species by logistic regression using SAS system software (SAS® 9; SAS Institute, SAS Campus Drive, Cary, NC, USA.). Additionally, differences between factors influencing the formation of uroliths were analysed by the chi-squared test. Summary data are presented as the mean ± SD. In all analyses, a p-value of <0.05 was considered significant.

Results

During the study period, uroliths were analysed from 2900 dogs (65%) and 1595 cats (35%). During the 10 year period of this study, the number of uroliths analysed annually increased dramatically (from 110 in 1994 to 1067 in 2003) and the proportion received from cats also increased markedly (from 15% in 1994 to 41% in 2003) see Fig. 1.

During this period, substantial changes were also observed in the composition of the uroliths analysed from both species. In 1994, 77% of the cats had struvite uroliths and 12% had CaOx uroliths whereas in 2003, 32% were struvite and 61% CaOx (Fig. 2).

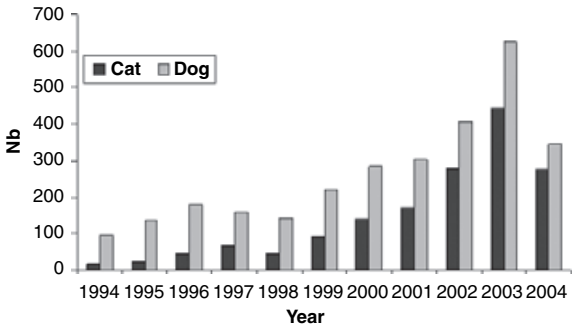

Fig. 1 Annual submissions of canine and feline uroliths from January 1994 to September 2004 Nb, number.

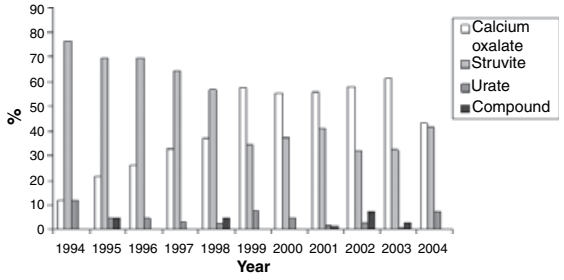

Fig. 2 Annual frequencies of the urolith composition from cats – January 1994 to September 2004.

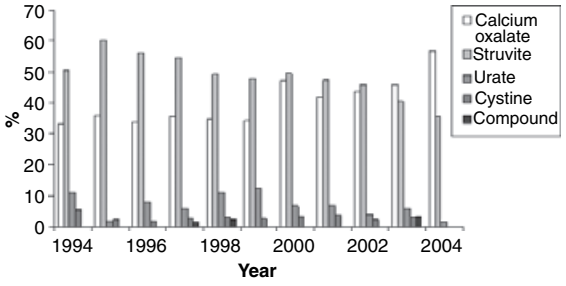

Fig. 3 Annual frequencies of the urolith composition from dogs – January 1994 to September 2004.

A similar trend was also observed in dogs, where in 1994 51% of uroliths were struvite and 33% CaOx, compared with 40% and 46% respectively in 2003 (Fig. 3). The ratio struvite:CaOx uroliths became inverted (CaOx became the dominant urolith type) in 1999 for cats, and in 2003 for dogs.

There were 91 canine breeds recorded in the database, but the six most frequent ones–Bichon Frise, Schnauzer, Shih Tzu, Dalmatian, Yorkshire terrier and Poodle – accounted for 36% of all canine uroliths analysed (Table 1). There was a significant

Table 1 Distribution of urolith composition in the six major breeds of dog

	n	Struvite (%)	Calcium oxalate (%)	Urate (%)	Compound (%)	Others (%)	p-value*
Schnauzer	74	43	55	1	1	0	NS
Shi Tzu	51	74	21	5	0	0	<0.01
Bichon	240	42	49	3	3	3	NS
Poodle	47	49	47	4	0	0	NS
Yorkshire	247	22	69	6	0	3	<0.01
Dalmatian	51	6	4	82	0	8	<0.01

NS, not significant.

*chi-squared test for comparison between struvite and CaOx uroliths in all breeds but the Dalmatian (urate compared with total of other uroliths).

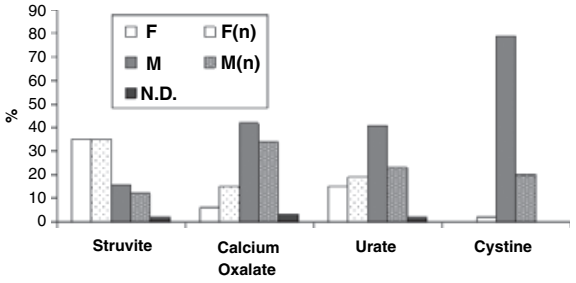

Fig. 4 Relationship between gender and urolith composition in dogs F, female; M, Male; n, neutered; N., not determined.

difference in the frequency of different types of uroliths among the six most common breeds. In the Schnauzer, Bichon Frise and Poodle breeds, CaOx and struvite accounted for 91–96% of uroliths and ratio of CaOx to struvite was approximately equal. In the Shih Tzu and Yorkshire terrier breeds, CaOx and struvite made up 91–95% of the total uroliths. However, Shih Tzu's had a significantly higher proportion of struvite (74% of the total) uroliths while the Yorkshire terrier had a significantly higher proportion of CaOx (69% of total) uroliths ($p < 0.01$). In contrast, in Dalmatians 82% of uroliths were urate, and this breed had a 4.7-fold higher risk of having urate calculi compared with other uroliths.

Analysis of the data by breed size showed that 56% of all uroliths were removed from small breed dogs. Furthermore, a significant association was observed between breed size and urolith composition with 51% of the small breed dogs having CaOx uroliths and 64% of the giant breeds having struvite uroliths.

Fifteen different breeds of cat were represented in this study; 77% were domestic shorthair and 11% were Persian. An additional 13 breeds accounted for the remaining 12% of cases. However, in cats, a significant association between breed and urolith composition was not detected.

In dogs, the mean age of affected animals was 7.3 ± 3.0 years, with a significantly younger mean for those with struvite (6.7 ± 2.7 years) rather than CaOx (8.6 ± 3.0 years) uroliths. In cats, the overall mean age was 7.2 ± 3.2 years, and similarly the mean for those with struvite (6.5 ± 2.9 years) was younger than for those with CaOx (7.8 ± 2.6 years.)

Gender was significantly associated with urolith composition in dogs (Fig. 4). Significantly higher proportions struvite uroliths were found in females (71%), whereas significantly higher proportions of CaOx were found in males (60%). In the dog, 63% of urate uroliths were removed from males. In the population, 47% were neutered.

Compared with dogs, a higher proportion (85%) of cats were neutered, and neutered cats (irrespective of gender) had an 8.3-fold increased risk of having uroliths than entire animals. Gender itself had no significant effect on urolith composition in the cats.

The urinary pH at the time of urolith removal was measured in 78% of dogs and 92% of cats. Of these samples, 89% of dogs and 85% of cats had a urinary pH between 5 and 6, but no significant relation was found between the urine pH and the urolith composition.

Analysis of the anatomical site of the uroliths revealed that the majority (78% in dogs and 81% in cats) were removed from the bladder. The proportion of animals that were suffering from recurrent urolithiasis was 7% of the dogs and 8%, of the cats.

Discussion

During the period of this study, we found that the number of uroliths submitted for analysis each year steadily increased. The urolith analysis service offered by Hills Pet Nutrition is provided free of charge to veterinary surgeons, and the increasing number of submissions may reflect a greater awareness and interest in quantitative urolith analysis and its importance in long-term control of urolithiasis, No conclusions can be drawn on the incidence of urolithiasis in dogs and cats from this data.

In both dogs and cats, the prevalence of CaOx uroliths increased during the period of this study together with a concomitant reduction in the proportion of struvite uroliths. Calcium oxalate became the main urolith analysed in 1999 for the cats and

in 2003 for the dogs in the Benelux. These figures are similar to results previously documented elsewhere in Europe and in the USA (Hoppe, 1998; Osborne et al., 1999).

We found a strong statistical association between the urolith composition and the breed (Shi Tsu, Yorkshire terrier and Dalmatian), breed size category and gender among the dogs. Genetic factors are known to be important in urolithiasis as the disease is very common in certain dog breeds, and it is particularly well recognized for urate urolithiasis (eg. Dalmatians) (Bartges et al., 1999). Lulich et al. (1999), in a study from the USA, reported that 58% of all CaOx uroliths occurred in only six breeds of dog, and with the exception of the Lhasa Apso, our results were very similar to that study. It has been reported previously that Persian cats have an increased risk of urolithiasis compared with a control population (Kirk et al., 1995). In our study, 11% of the cats with uroliths were Persians, but whether this represents a breed predisposition could not be determined as an appropriate control population was not studied. However, in contrast to dogs, we did not find a significant difference in the distribution of urolith compositions between different cat breeds.

Some breeds of dogs (Schnauzer, Bichon Frise and Poodle) with a high proportion of struvite uroliths also had a high proportion of CaOx and it may be that some animals and some breeds may be at increased risk for forming all types of uroliths (Lulich et al., 1999). The risk of CaOx urolithiasis increased with age in our study, as has been reported previously (Hesse et al., 1998; Lulich et al., 1999). This fact may help explain why some animals in which struvite uroliths were formed previously subsequently tended to form CaOx uroliths. However, this situation may be complicated by the use of struvite-preventing foods which may both reduce the likelihood of recurrent struvite uroliths and may also potentially concomitantly increase the risk of CaOx.

In a study by Lekcharoensuk et al. (2000), an increased risk for CaOx uroliths was reported in purebred vs. mixed breeds dogs, in dogs >8 years old vs. dogs <8 years old, in males vs. females, in neutered vs. intact dogs, and in overweight vs. non-overweight dogs. Unfortunately, data about body condition scores were lacking in most cases in the current study so this could not be evaluated, although similar associations were seen in relation to the age, sex and neutered status of dogs with CaOx uroliths in our study. The location of uroliths, being mainly in the bladder for both dogs and cats, was also similar to epidemiological studies previously published (Hesse et al., 1998; Ling et al., 1998).

Conclusions

The findings in this study from the Benelux are similar to those previously reported from other countries (Osborne et al., 1999). During the last decade, in the Benelux, the relative proportion of CaOx uroliths has increased as the proportion of struvite uroliths has decreased in both dogs and cats. As the number of uroliths submitted for quantitative analysis has increased markedly over the 10 years of this study, it can be concluded that there has been a growing interest and concern for a good-quality analysis of uroliths removed from pets by veterinarians. An accurate knowledge of the urolith composition enables veterinarians to prescribe appropriate dietary and medical interventions for the subsequent management and prevention of recurrence of the uroliths.

As all animals that have formed a urolith are at increased risk for recurrence, the knowledge of risk factors in both species along with quantitative and qualitative analysis of calculi is essential to prevent efficiently recurrence of the disorder and the associated morbidity.

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