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HOT TOPIC

Factors influencing urolithiasis in pets

In focus

Struvite and calcium oxalate (CaOx) are the most common uroliths in cats and dogs. What roles do the frequently considered factors of urine pH, diet, and urinary crystals play?

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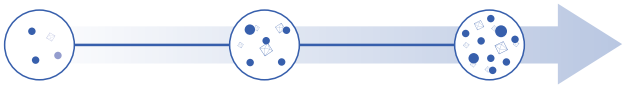
Urine saturation and urolith formation

Whether crystals dissolve or precipitate, aggregate, and grow into uroliths is affected by the degree of urine saturation with the mineral ions that form crystals.[1,2]

Increasing concentrations of minerals in urine



STABLE
New crystals do not form; existing crystals & stones dissolve

METASTABLE
New crystals do not form; existing crystals & stones may grow

UNSTABLE
New crystals & stones form; existing crystals & stones grow

Relationship between crystal concentration and stone formation. Adapted from Bartges et al. (2004).

Why is urine pH important?

Due to high solubility in acidic urine and lower solubility in alkaline urine, struvite uroliths tend to dissolve in acidic urine and form in alkaline urine.[3,4] While CaOx is less pH dependent than previously thought, very acidic urine (< 6.0) may favor its formation.[4,5]

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Urine pH is affected by proximity to meals due to a postprandial alkaline tide. In dogs, urine pH is lowest in the morning prior to eating and can increase by 1–2 units over the course of the day.[6] In cats, which typically graze throughout the day, variation is still present, although less.[7]

Urine pH variability over the course of the day. Cats were fed once daily at 8 am and, in this study, consumed approximately 2/3 of their food between 8 am and 2 pm. Dogs were fed twice a day at 8:30 am and 3:30 pm. Feline data adapted from Skoch et al. (1991) and canine data from Stevenson et al. (2001).

Due to this variability, a single pH measurement on a dipstick will not provide a full picture of the pet's urine pH. However, collecting multiple samples over 24 hours is not often feasible. Measuring pH in the first urine of the day collected before a meal avoids the postprandial alkaline tide, providing the most accurate measure with one sample.

Urine pH is, however, not the only factor influencing urolithiasis risk.

How is diet important?

In cats, foods that provide controlled minerals and induce a more acidic pH have been found to dissolve struvite uroliths.[8,9] In dogs, struvite urolith formation is almost always associated with urinary tract infections that lead to increased urine pH, facilitating crystal precipitation and stone growth.[10,11]

Therefore, antibiotic therapy based on urine culture is needed in conjunction with therapeutic urinary diets to facilitate dissolution.[11,12]

Calcium and oxalate excretion and urine concentrations of inhibitors and promoters of crystal aggregation affect the risk for CaOx urolithiasis, and are influenced by genetics, underlying disease causing hypercalcemia, and diet.[5,9]

Therapeutic urinary diets help dissolve struvite uroliths and reduce risk of struvite and CaOx recurrence. They are formulated to promote a urinary environment unsuitable for crystal formation by targeting a specific urine pH and producing a urine in the stable range for struvite and the metastable range for CaOx uroliths.

Increased water intake helps promote dilute urine and more frequent urination, presumably reducing risk of urolith formation.[9,13] Strategies to increase intake include feeding wet food, adding water to dry food, or moderately increasing dietary sodium content to encourage drinking.

What do urinary crystals mean?

Urinary crystals do not necessarily indicate urolithiasis. They may be an incidental finding in healthy pets.[14,15] Urine pH and temperature affect whether crystals form.[15] Crystals may form as artifacts in urine that is not analyzed immediately.[4,16]

In pets with urinary crystals but no clinical signs or other indication of urolithiasis, a change to a therapeutic urinary diet is not necessary. Pets should be monitored for development of clinical signs.

Uroliths may also occur without crystalluria.[15] When both uroliths and crystals are found, the type of crystal and urolith may not correspond. Radiographs are necessary to monitor for presence or growth of stones in pets with a history of urolithiasis.

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