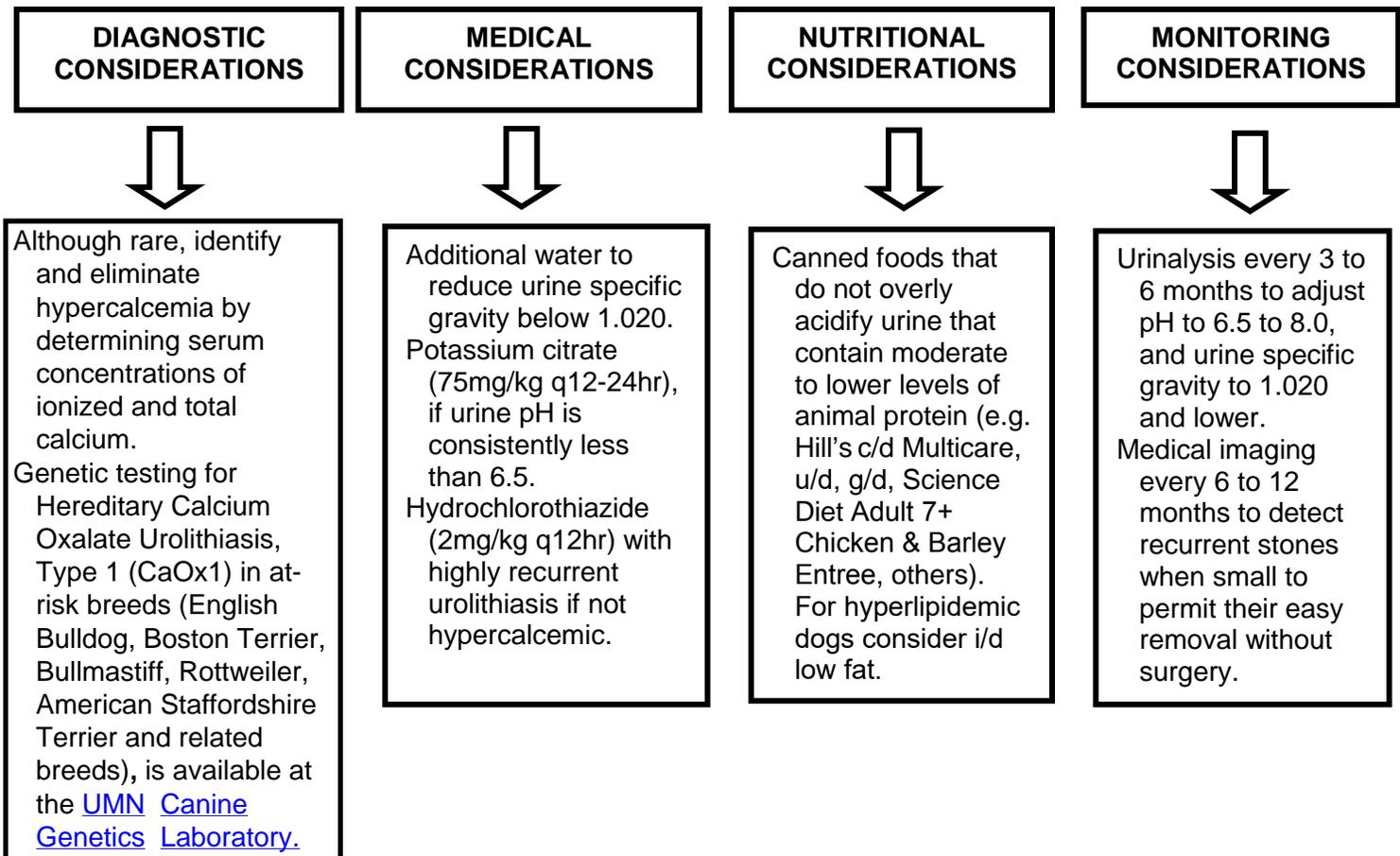




CANINE CALCIUM OXALATE UROLITHS

Calcium oxalate (CaOx) is a common and difficult stone to prevent because factors responsible for formation are incompletely understood. It is accepted that crystal growth and possibly initial crystal formation are at least partly a reflection of urine supersaturation. Therefore, controlling risk factors promoting urine CaOx supersaturation (e.g. hypercalciuria, hyperoxaluria, hyperaciduria, hypocitraturia, and highly concentrated urine) should minimize urolith recurrence.

Risk Management



** Review manufacturer's therapeutic food literature to determine indications/contraindications. For pets with multiple health concerns, consult a veterinary nutritionist to select an optimal food.



Support from veterinarians, pet owners, and Hill's Pet Nutrition, make our work possible.





► **CANINE CALCIUM OXALATE - SUPPLEMENTAL INFORMATION**

NEW: The Canine Genetics Laboratory at the University of Minnesota's College of Veterinary Medicine discovered a mutation that is strongly associated with risk for calcium oxalate stones. The mutation was first identified in English Bulldogs but is also present in related breeds (e.g. Boston Terrier, Bullmastiff, Havanese, Rottweiler, American Staffordshire Terrier). The condition associated with this mutation is being referred to as: Hereditary Calcium Oxalate Urolithiasis, Type 1 (CaOx1). A genetic test for CaOx1 is now available through the [Canine Genetics Lab](#). We are now conducting research to determine which therapies are most likely to reduce stone risk specifically for dogs with hereditary CaOx1.

We are actively working to discover additional genetic risk factors for CaOx stones in dogs. If you own a dog that has formed CaOx stones and are interested in helping with this research, please visit our [CaOx study website](#) for details.

DIET QUESTIONS

Calcium oxalate (CaOx) is a common and difficult urolith to prevent because factors responsible for formation are incompletely understood. Selecting the most effective diet is challenging because appropriate studies (prospective, case-controlled, ≥ 3 yr) evaluating recurrence have not yet been performed. Therefore, strategies to minimize risk factors are based on physiology of calcium and oxalate excretion, surrogate endpoints (e.g. RSS) and identification of risk factor in retrospective studies. In general, ~50% of dogs reform CaOx uroliths within 2 years.

SOME FEATURES TO CONSIDER WHEN SELECTING A DIET:

1. **Select Moist Foods**-canned foods contain a lot of water. Water consumption increases urine volume and decreases urine concentrations of calcium and oxalate. More water = less mineral precipitation.
2. **Avoid Over-Acidifying Foods**-over acidification of urine is a risk factor for calcium oxalate partly because it increases calcium excretion. It is likely that other protective factors are also altered (decreases inhibitors, precipitates proteins, etc.)
3. **Avoid High Sodium Foods**- As the body gets rid of unwanted sodium, calcium is lost in urine.
4. **Avoid High Protein Foods**-animal protein consumption promotes acidic urine. Lower protein promotes diuresis and minimizes calcium and oxalate concentrations in urine.
5. **Avoid Phosphorus Restricted Foods**-Pyrophosphate is an inhibitor of calcium oxalate. Low phosphorus foods may stimulate vitamin D production and promote calcium absorption.

SOME KEY POINTS

- Recommendations for CaOx risk management can be found at urolithcenter.org under the Resources tab.
- Listed diet selections are those that we have evaluated and published results, researched in the literature, or have experience with in managing our clinical patients.
- We avoid some marketed preventative diets because they are overly acidifying or too high in sodium.
- Some over-the counter diets (eg. Science Diet Adult 7+ Chicken & Barley, others) may have suitable nutritional profiles similar to our recommended dietary features for CaOx prevention but lack efficacy studies.
- Feed moist diets, or add water to dry formulations.
- Minimize vitamin and mineral supplements without documented deficiencies.
- Monitor urine: Goal = specific gravity ≤ 1.020 and pH ≥ 6.5 (add potassium citrate to \uparrow urine pH if needed).
- Image dogs every 6 to 12 months to allow non-surgical removal by voiding urohydropropulsion or basket retrieval.

These general recommendations are based on urolith analysis and may not be appropriate for all pets. We advise reviewing manufacturer's literature regarding selected therapeutic foods to determine indications and contraindications. For pets with multiple health concerns, we suggest that the selection of diet should take into consideration all health needs of the pet, and prioritize nutritional needs on the most serious disease, which is not always the stone disease.



CANINE CALCIUM OXALATE UROLITHS

Calcium oxalate (CaOx) is one of the most common stones in the urinary tract of dogs.¹ Although formation of CaOx uroliths is associated with a complex and incompletely understood sequence of events, it is accepted that initial crystal formation and subsequent crystal growth are at least partly a reflection of urine supersaturation. Therefore, controlling risk factors promoting urine CaOx supersaturation (e.g. hypercalciuria, hyperoxaluria, hyperaciduria, hypocitraturia, and highly concentrated urine) should minimize urolith recurrence.

Medical Considerations:

- Hypercalciuria, a risk factor for CaOx urolithiasis, has resulted from hypercalcemia, metabolic acidosis, high sodium consumption, and vitamin D excess. Avoid these risk factors.

Nutritional Considerations:

- Avoid calcium supplements independent of meals & high oxalate foods (e.g. chocolate, nuts, rhubarb, spinach).
- High moisture foods (i.e. canned formulations) are more effective because increased water consumption is associated with decreased urine concentrations of calculogenic minerals. Feed canned foods and/or add increasing amounts of water to food until urine specific gravity is less than 1.020.

Pharmacological Considerations:

- Consider potassium citrate (75mg/kg q12-24hr), if urine pH is consistently less than 6.5.
- Consider vitamin B6 (2 to 4mg/kg q 24 to 48 hr) in patients consuming primarily human food or diets with insufficient B6 content.
- Consider hydrochlorothiazide (2mg/kg q12hr) with highly recurrent urolithiasis in dogs without hypercalcemia.

Consider These Facts:

Experienced surgeons failed to remove all uroliths in 15 - 20% of dogs.^{2,3} Therefore, be diligent during surgery, and perform medical imaging immediately following surgery to verify complete urolith removal. Studies have confirmed the ability of diets to reduce urine CaOx saturation and/or crystallization when tested

in vitro. However, selecting the best diet is challenging because diet efficacy determined using clinically relevant endpoints (i.e. urolith recurrence), has yet to be published. Of the diets marketed to prevent CaOx, Prescription Diet® c/d® Multicare results in the greatest reduction in CaOx crystallization. Prescription Diet® i/d® Low Fat is a suitable choice for hyperglyceridemic dogs with CaOx stones; this diet has exhibited lower CaOx crystallization, consistent with CaOx prevention diets.

Epidemiologic studies indicated that the strongest association between CaOx urolith formation and diet was the diets' propensity to over-acidify urine; diets promoting urine pH less than 6.5 were at highest risk.⁵

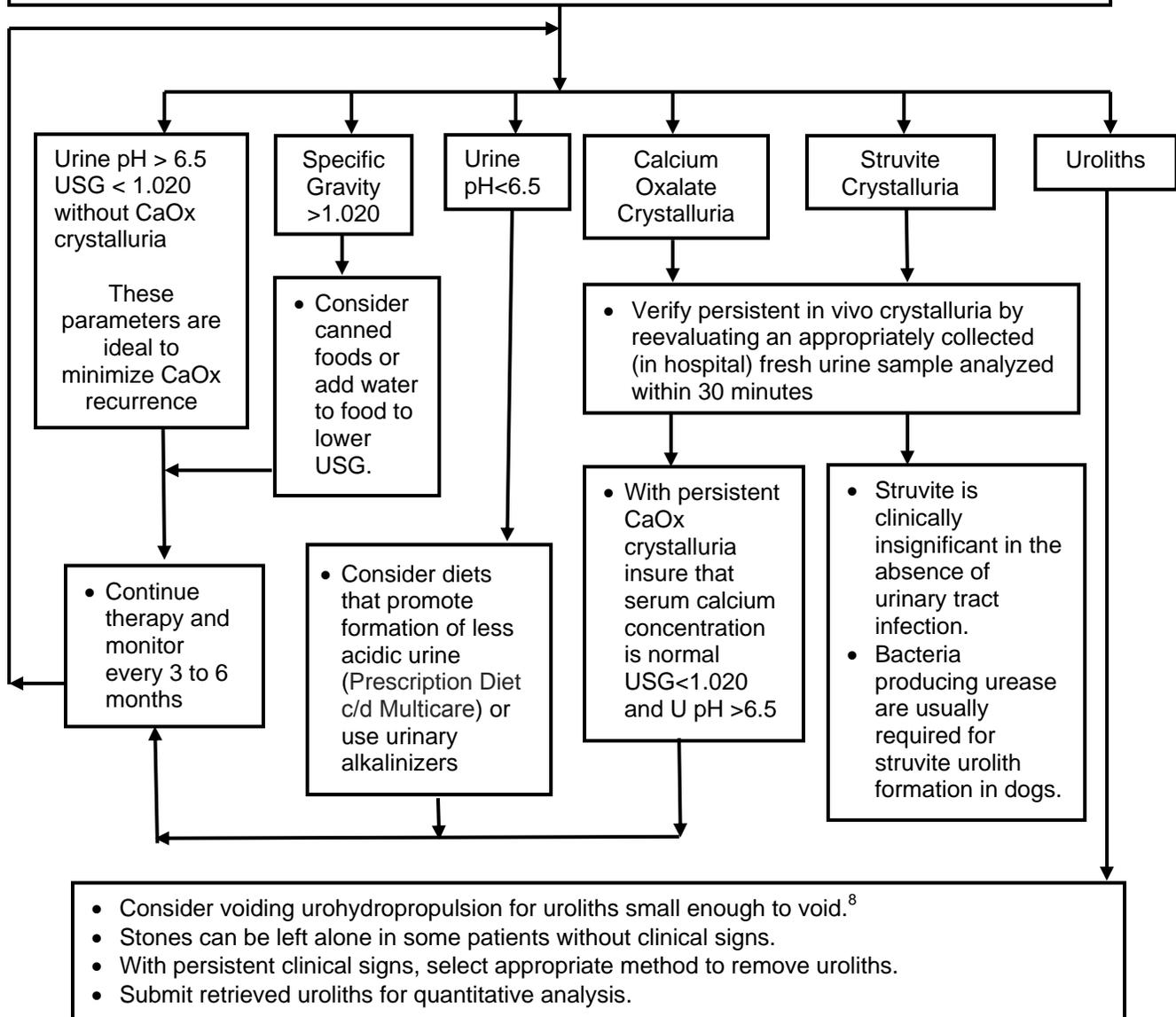
Oxalobacter formigenes is an intestinal bacterium that ingests oxalate as its sole nutrient.⁶ By consuming dietary oxalate in the intestine, less oxalic acid is available for absorption and less is excreted in urine. To preserve healthy populations of intestinal *Oxalobacter*, avoid indiscriminant use of antimicrobics.

In a retrospective study of uroliths formed around a suture nidus, the majority were composed of calcium oxalate.⁷ To minimize iatrogenic urolith formation, use suture patterns that minimize suture exposure to the bladder lumen.

MINIMIZING CALCIUM OXALATE UROLITH RECURRENCE IN DOGS

Therapy: Long-term use of diets specially formulated with reduced levels of calcium and oxalate that promote formation of neutral to alkaline urine are essential to prevent these highly recurrent uroliths. Prescription Diet c/d Multicare and some diets for senior dogs fit these criteria.

Monitor: Urinalysis and medical imaging in 1 month and then every 3 to 6 months. Sooner in patients with recurrent urinary signs.



** Review manufacturer's therapeutic food literature to determine indications/contraindications. For pets with multiple health concerns, consult a veterinary nutritionist to select an optimal food.

- Osborne C. Analysis of 451,891 canine uroliths, feline uroliths and feline urethral plugs from 1981 to 2007. *VCNA:SAP*. 2009;39:183.
- Lulich J. Incomplete removal of canine and feline urocystoliths by cystotomy. *JVIM*. 1993;7:124.
- Grant D. Frequency of incomplete urolith removal...in dogs. *JAVMA*. 2010;210:763
- Lulich J. Calcium oxalate: biologic behavior and risk factor management. *ACVIM Forum Proceedings*, 2009,
- Lekcharoensuk C. Associations dry dietary factors and canine calcium oxalate uroliths: *AJVR* 2002; 63: 330.
- Weese J. Presence of Oxalobacter formigenes in the stool of healthy dogs. *Vet Microbiol Letter to editor*. 2009;137:412.
- Appel S. Evaluation of risk factors associated with suture-nidus cystoliths in dogs and cats. *JAVMA*. 2008;233:1889.
- Lulich J. Voiding urohydropropulsion a nonsurgical technique. *Current Veterinary Therapy XII, SAP*. 1995, p1003