

Calcium Oxalate Urolithiasis – Canine

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Definition

Urolithiasis is a condition in which crystals in the urine form stones or calculi called *uroliths*. In calcium oxalate urolithiasis uroliths are composed of calcium oxalate monohydrate, dihydrate, or both.

Key Diagnostic Tools and Measures

Obtain serum or plasma calcium concentration to evaluate for hypercalcemia; if present, determine blood ionized calcium, parathyroid hormone, and parathyroid hormone–related protein concentrations. Adrenal gland testing is recommended due to the association of hyperadrenocorticism and increased risk of calcium oxalate urolithiasis. Urinalysis should be done to evaluate urine pH and presence of calcium oxalate crystalluria. Abdominal radiography should reveal radiodense uroliths that often have an irregular surface contour. Calcium oxalate uroliths cannot be dissolved medically; therefore, they must be removed physically by surgery or voiding urohydropropulsion.

Pathophysiology

Calcium oxalate uroliths form when urine is oversaturated with calcium, oxalate, or both. They typically form in aciduria because the solubility of calcium oxalate is decreased when urine pH is <6.8. Hypercalcemia increases urinary calcium excretion and risk for calcium oxalate urolith formation. Approximately 4% of dogs with calcium oxalate urolithiasis have hypercalcemia. Malignant neoplasia is the most common cause of hypercalcemia in dogs; however, this is usually not associated with calcium oxalate urolith formation. Primary hyperparathyroidism is more commonly associated with canine calcium oxalate urolithiasis. In dogs with calcium oxalate uroliths and normocalcemia, the mechanism(s) for calcium oxalate urolith formation is not known. In one study of miniature schnauzers, increased absorption of calcium from the gastrointestinal tract relative to non-urolith-forming beagles was found. Hyperadrenocorticism is associated with calcium oxalate urolith formation because it promotes hypercalciuria, which results in urinary oversaturation for calcium oxalate and possibly urolith formation.

Signalment

Small-breed dogs such as miniature schnauzers, toy poodles, Lhasa Apsos, Shih Tzus, and Yorkshire terriers have breed predispositions to calcium oxalate urolithiasis. Uroliths are more common in middle-aged or older dogs, and there is a male-to-female ratio of 3:1.

Key Nutrient Modifications

Decreased dietary **calcium** may result in decreased degree of calciuresis. Decreased **protein** intake may decrease degree of calciuresis by decreasing calcium release from bone in response to acid load provided by dietary protein. High **fiber** may decrease absorption of calcium from the intestinal tract. Increased **sodium** intake may decrease urinary saturation for calcium oxalate by increasing urine volume. Dietary **potassium** citrate may decrease risk of calcium oxalate urolith formation by inducing alkaluria and by inhibiting calcium oxalate crystal and urolith formation.

Recommended Ranges of Key Nutrients

Nutrient	% DM	g/100 kcal	% DM	g/100 kcal
	Recommended dietary level		Minimum dietary requirement*	
Protein	12–22	3–6	18	5.1
Fiber	8–15	2–5	n/a	n/a
Calcium	0.4–1.2	0.15–0.35	0.6	0.17
Sodium	1.0–1.5	0.25–0.35	0.06	0.02

Modified intake of these nutrients may help address metabolic alterations induced by disease states. The recommended dietary composition is shown as percent of dietary dry matter (DM) and as g or mg per 100 kcal metabolizable energy. All other essential nutrients should meet normal requirements adjusted for life stage, lifestyle, and energy intake.

*Nutrient requirement for adult animals as determined by the Association of American Feed Control Officials

Increased water intake is recommended and dogs may benefit from either feeding a canned diet or adding water to dry food prior to feeding.

Therapeutic Feeding Principles

Inducing production of a greater volume of dilute urine may be beneficial. Mild to moderate dietary protein restriction is recommended, and some dogs respond to higher fiber intake. Feed a diet that induces alkiluria. If secondary to endocrine disease, management of that disease is the main treatment; dietary management of calcium oxalate disease is also indicated.

- **Treats** – Avoid high-protein treats and treats associated with increased oxalate levels (e.g., carrots and green leafy vegetables)
- **Tips for Increasing Palatability** – Water can be added to food to increase palatability.
- **Diet Recommendations** – A high-fiber, low-fat diet is recommended for dogs with calcium oxalate urolithiasis. A lower protein, alkalizing diet is also appropriate.

Client Education Points

- Calcium oxalate uroliths occur when urine contains high levels of calcium and/or oxalate.
- Calcium oxalate uroliths are recurrent, with approximately 30% recurrence rate at 12 months and approximately 60% recurrence within 5 years.
- Dietary modification may decrease risk of recurrence of calcium oxalate uroliths

Common Comorbidities

Calcium oxalate urolithiasis occurs commonly in dogs with hyperadrenocorticism or hyperparathyroidism if hypercalcemic.

Interacting Medical Management Strategies

Potassium citrate:

- Urinary alkalizing agent
- Increases calcium oxalate solubility with alkaluria
- Citrate may inhibit calcium oxalate crystal formation and aggregation
- 50–100 mg/kg orally (PO) every 12 hours, adjust to urine pH of approximately 7.5

Thiazide diuretics:

- Increases distal renal tubular reabsorption of calcium resulting in lowered urinary calcium excretion
- Can result in hypercalcemia
- No long-term studies in dogs on safety or efficacy
- Hydrochlorothiazide: 2 mg/kg PO every 12 hours

Vitamin B6:

- Involved with oxalate metabolism
- Deficiency does not likely occur and no data that supplementation helps
- 20 mg/kg PO every 24 hours

Monitoring

Urinalysis should be done monthly for 3 to 6 months to monitor response to treatment (Table 1). pH should be neutral to alkaline; specific gravity: should be dilute; and crystalluria should be absent. Survey abdominal radiography or ultrasonography should be performed at 6 and 12 months and then every 6 to 12 months depending on response. Serum calcium should be monitored 1 month after starting hydrochlorothiazide and then every 3 to 6 months. If urolithiasis is secondary to endocrine disease, the management of that condition should be monitored appropriately.

Table 1. Expected changes with therapy of calcium oxalate uroliths.

Factor	Pre Therapy	Prevention
Polyuria	±	variable
Pollakiuria	0 to 4+	0
Hematuria	0 to 4+	0
USPG	variable	1.004–1.025
Urine pH	< 7.0	> 7.0
Urine inflammation	0 to 4+	0
Calcium oxalate crystals	0 to 4+	0
Bacteriuria	0 to 4+	0
Culture	positive/negative	negative
BUN (mg/dL)	> 15	10–30
Urolith size and number	small to large	0

Algorithm – Nutritional Management of Canine Calcium Oxalate Uroliths

