Urolithiasis

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KEYWORDS

- Lower urinary tract • Urolithiasis • Urinary calculi • Struvite • Calcium oxalate • Purine • Cystine

KEY POINTS

- Urolithiasis occurs commonly in dogs and cats, and most uroliths occur in the lower urinary tract.
- More than 80% to 90% of lower urinary tract uroliths are struvite or calcium oxalate.
- Some uroliths, such as struvite, cysteine, and urate, are amenable to medical dissolution, whereas others, such as calcium oxalate, are not.

INTRODUCTION

Formation of uroliths is not a disease but rather a complication of several disorders. Some disorders can be identified and corrected (such as infection-induced struvite urolith formation), some can be identified but not corrected (such as hyperuricosuria, which occurs in Dalmatians that excrete high levels of uric acid, which forms ammonium urate uroliths), whereas for others the underlying etiopathogenesis is not known (such as calcium oxalate urolith formation in miniature schnauzers). A common denominator of these disorders is that they can from time to time create oversaturation of urine with 1 or more crystal precursors, resulting in formation of crystals. To develop rational and effective approaches to treatment, abnormalities that promote urolith formation must be identified, with the goal of eliminating or modifying them. It is important, therefore, to understand several basic concepts associated with urolithiasis and the factors that promote urolith formation that may be modified with medical treatment, including the state of urinary saturation, modifiers of crystal formation, presence of multiple crystal types, and presence of bacterial infection, urinary obstruction, or foreign compounds.[1] Urolith formation, dissolution, and prevention involve complex physical processes. Major factors include (1) supersaturation resulting in crystal formation, (2) effects of inhibitors of crystallization and inhibitors of crystal aggregation and growth, (3) crystalloid complexors, (4) effects of promoters of crystal aggregation and growth, and (5) effects of noncrystalline matrix.[1]

The authors have nothing to disclose.
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DIAGNOSIS OF UROLITHS

Imaging is the most definitive diagnostic tool for detection of uroliths. Abdominal radiography is generally the first diagnostic imaging modality used to detect radiopaque uroliths (Fig. 1). Ultrasonography (Fig. 2) or double contrast cystography (Fig. 3) can be used to detect uroliths, including those that are radiolucent.[2] These abdominal imaging techniques are used to verify the presence of uroliths and location, number, size, shape, and density.

In patients with suspected urinary tract disorders, urinalysis is an important part of diagnostic evaluation. Crystalluria can be an important finding (Fig. 4). Crystals do not confirm the presence of uroliths, but they do suggest crystalline oversaturation, and some patients may have active urocystoliths present but not have crystalluria.[3] Temperature change caused by elapsed time between urine collection and urinalysis can cause crystals to form in urine, resulting in a false-positive crystalluria.[4] Therefore, in patients with suspected urolithiasis, freshly collected urine should be evaluated.[5]

Urine specific gravity and urine pH can help assess the chemical environment of urine. The chemical environment of the urine determines urolith formation and can suggest which type of urolith is present. A high urine specific gravity suggests an increase in concentration of urolithic precursors.[6] Calcium oxalate, purines, and cystine uroliths form typically in urine with a pH less than 7.0, whereas struvite calculi form typically in urine with a pH greater than 7.0.[5]

Urine culture and sensitivity testing are indicated because urinary tract infections may occur secondarily in patients with urolithiasis or may induce urolith formation in

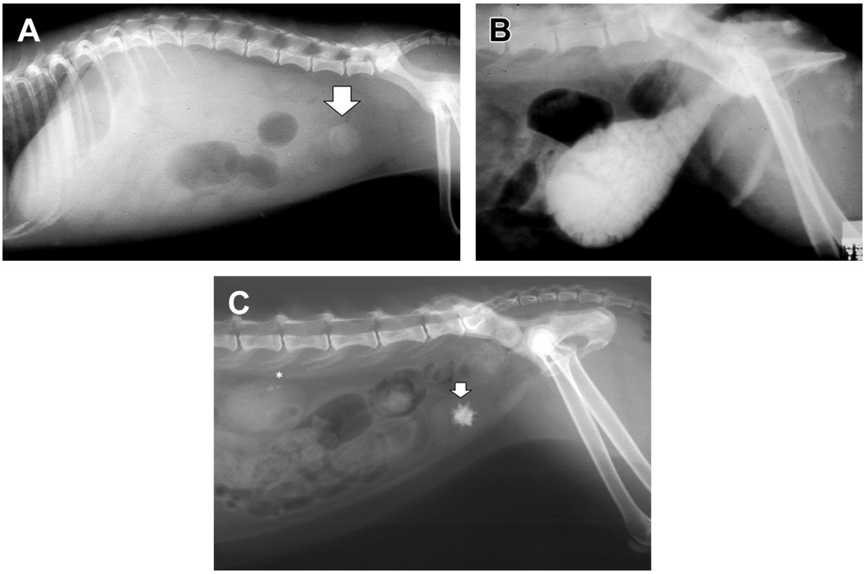

Fig. 1. Radiographic appearance of struvite and calcium oxalate uroliths by abdominal radiography. (*A*) Lateral abdominal radiograph of a 4-year-old castrated male domestic shorthaired cat showing a single round radiopaque sterile struvite urocystolith (*arrow*). (*B*) Lateral abdominal radiograph of a 3-year-old spayed female Irish setter with numerous variably sized and shaped infection-induced struvite urocystoliths. (*C*) Lateral abdominal radiograph of an 8-year-old castrated male domestic shorthaired cat showing 1 calcium oxalate dehydrate urocystolith (*arrow*). Renal mineralization is also present (*asterisk*).