CANINE STRUVITE UROLITH MEDICAL DISSOLUTION

In almost all dogs, struvite forms as a consequence of a urinary tract infection with bacteria that produce urease (e.g. Staphylococcus sp.). Benefits of dissolution over cystotomy include simultaneous resolution of unrecognized struvite nephroliths, avoidance of abdominal contamination with infected urine during cystotomy, and prevention of suture nidus, which is a risk for recurrent stones and recurrent infection. Urethral obstruction during dissolution is rare when infection and pain are effectively controlled. Dissolution is contraindicated for dogs with urinary obstruction (e.g. urethroliths, ureteroliths), but may be possible after obstruction is corrected (gentle retropulsion of urethral stones, ureteral stent, etc.).

DISSOLUTION

<table>
<thead>
<tr>
<th>DIAGNOSTIC CONSIDERATIONS</th>
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<tbody>
<tr>
<td>Medical Imaging (e.g. X-ray)</td>
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<tr>
<td>Urine culture</td>
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<td>MUC App*</td>
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<td>Urinalysis</td>
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<tr>
<th>MEDICAL CONSIDERATIONS</th>
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<tr>
<td>Penicillin’s (e.g. amoxicillin) are usually effective.</td>
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<tr>
<td>Administer antibiotics throughout most, if not the entire dissolution time (i.e. 2 to 3 months).</td>
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<thead>
<tr>
<th>NUTRITIONAL CONSIDERATIONS</th>
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<tr>
<td>Feed struvite dissolution foods (e.g. Hills s/d, c/d multicare, others).</td>
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<td>Canned struvite dissolution foods may shorten dissolution time compared to dry foods.</td>
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<th>MONITORING CONSIDERATIONS</th>
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<td>X-ray every 4 - 6 weeks.</td>
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<td>Reduced urolith size/density indicates effective therapy and accurate mineral prediction, and is an indication to continue therapy.</td>
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<tr>
<td>No change in urolith size - verify compliance (urine culture, urinalysis) or consider other urolith removal strategies.</td>
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</table>

*MN Urolith for Apple devices and Minnesota Urolith Center on Androids

** 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.
CANINE STRUVITE UROLITHS: MEDICAL DISSOLUTION

In almost all dogs, struvite forms as a consequence of urinary tract infection with bacteria that produce urease (e.g. Staphylococcus sp.). Urease is responsible for over-production of urine ammonia and subsequent urine alkalinization. Female dogs (85%) are over represented presumably because they are at greater risk for urinary tract infection. 

Sterile struvite stones are rare, and have been diagnosed more often in males. Benefits of dissolution over cystotomy include simultaneous resolution of unrecognized struvite nephroliths, avoidance of abdominal contamination with infected urine during cystotomy, and prevention of suture nidus (a risk for recurrent stones and recurrent infection). Urethral obstruction during dissolution is rare when infection and pain are effectively controlled. Dissolution is contraindicated in dogs with urinary obstruction (e.g. urethroliths or ureteroliths), but maybe possible after the obstruction is corrected (gentle retropulsion of urethral stones back into the urinary bladder, ureteral stents, etc.).

Medical Considerations:
- Urinary tract infection by urease-producing bacteria is the underlying cause of most canine struvite stones. Therefore, culture urine prior to antimicrobial administration to accurately classify and effectively manage uroliths.
- In some dogs, struvite formation occurs in the absence of urinary tract infections (i.e. sterile struvite stones). However, risk factors (distal renal tubular acidoisis, hypoxemia, chronic diuretic use, administration of antacids, and hyperaldosteronism) promoting persistent alkalinuria, hyperphosphaturia and hyperammoniauria are rarely detected. Sterile struvite stones can be dissolved with dietary therapy without the addition of antibiotics.

Nutritional Considerations:
- Diets with moderate reduction in protein, phosphorus and magnesium that promote formation of acidic urine (i.e. pH≤ 6.5) reduce struvite precipitation and promote struvite dissolution (Hills Prescription Diets c/d and s/d fit these criteria).
- Extreme and prolonged reductions of some risk factors that minimize struvite urolith formation, (e.g. acidic urine), may increase risk for calcium oxalate uroliths in some breeds (e.g. Bichon, Miniature schnauzer, Shih Tzu, Lhasa Apso, miniature poodle and others at risk for CaOx).
- Both dry and canned struvitolytic foods have been associated with successful infection-induced struvite dissolution.

Pharmacological Considerations:
- While waiting for urine culture results, consider antimicrobics (e.g. beta-lactam) with high efficacy for eradicating common, urease-producing uropathogens (e.g. staphylococcal sp.).
- Consider dl-methionine (100mg/kg q12 hr) or ammonium chloride to acidify urine and assist urolith dissolution in patients unable to consume therapeutic diets and in dogs whose urine remains alkaline following appropriate therapy.

Consider These Facts:
Some veterinarians prefer to remove uroliths surgically due to the perception that surgical management is more effective, less expensive, alleviates clinical signs quicker, and will not be associated with urethral obstruction that could occur as uroliths decrease in size with medical dissolution. These are more often misperceptions. Surgery is a feasible option; however, medical dissolution with Hills Prescription diet s/d ® was 100% effective after just 3 to 6 weeks.
for sterile struvite uroliths and 8 to 12 weeks with antimicrobics for infection-induced struvite uroliths. Noninvasive medical dissolution is an effective and compassionate choice for the majority without urinary obstruction.

Although low-protein, dissolution diets are not recommended for immature growing dogs, their short-term use in conjunction with antimicrobics has rapidly dissolved infection-induced struvite uroliths in 9 to 12 days without adverse events.

When feeding Hills Prescription Diet s/d, owner/patient compliance is easily and rapidly determined with a urine specific gravity (mean = 1.008 ± 0.003) and pH (mean = 6.2 ± 0.7). If urine is inaccessible, the serum concentration of urea nitrogen is also a reliable marker (mean = 3.5 ± 2.4 mg/dl) of dietary compliance.

Some struvitolytic diets are relatively high in fat (e.g. s/d) in order to maintain calorie intake while providing lower quantities of protein to reduce urolith precursors (e.g. phosphorus and urea) important for dissolution. High dietary fat is a risk factor for pancreatitis in susceptible dogs (e.g. miniature Schnauzers and some other breeds) and dogs with hyperadrenocorticism). Be aware of these associations and know how to respond (e.g. discontinue high fat struvitolytic diet, maintain hydration) to adverse events (vomiting/pancreatitis) if they occur. Then consider low-fat alternatives that also acidify urine to assist correction of both diseases (e.g. i/d low fat).

Twenty-six percent of canine nephroliths are composed of struvite. As with bladder stones, struvite kidney stones can be dissolved medically. Dissolution times are typically longer due to possible reduced kidney function, reduced urine production, and reduced nephrolith dwell time in therapeutically undersaturated urine. In some cases, stenting the ureter may assist clearing an infection from the kidney.

The duration of antibiotic administration to dissolve infection-induced struvite is unknown. Discontinuing antibiotics before complete dissolution may promote recrudescence of infection and stones.

Several case reports have demonstrated struvite dissolution using antibiotics without a struvitolytic diet. The addition of a struvitolytic diet will likely accelerate dissolution, reduce disease period and shorten duration of antibiotic administration.

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**Improving Your Success of Struvite Dissolution**

1. Strengthen your accuracy of stone prediction by using multiple sources of information (i.e. Radiography, CALCuRad, CALCulate, Urine culture, urinalysis)
2. Culture urine to select effective antibiotics when treating infection-induced struvite.
3. Administer antibiotics for the entire dissolution period
4. Recheck dissolution efficacy in 4 - 6 weeks for dogs and in 2 weeks for cats utilizing radiography, urine culture, and urinalysis.
5. Check in with clients often to enhance compliance
6. Dissolution is not ideal for animals with urethral obstruction, but can be cautiously considered if patients are carefully monitored for control of infection, pain and reobstruction.

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Medical Dissolution of Canine Struvite Uroliths

Minimum Diagnostics: Abdominal Radiography
Urinalysis
Urine Culture

Initial Therapy: Struvitolytic Diet
Antimicrobics*

Monitoring Diagnostics (Every 6 weeks)
Abdominal Radiography
Urine Culture
Urinalysis

Complete Dissolution
Reduced Stone Size or density
Same or Increased Stone Size and density
Urinary Obstruction

Urine Culture Positive
• Inadequate control of UTI
  • Administer susceptible antimicrobics thought-out the entire dissolution period.
  • Monitor in 4 to 6 weeks

Urine Culture Negative
• Incorrect or Incomplete Prediction of Mineral Composition
  • Consider minimally invasive or surgical urolith removal

• Follow canine struvite prevention guidelines (e.g. diet and UTI control)
• Continue therapy
• Monitor in 4 to 6 weeks

*Administer antimicrobics for most, if not the entire dissolution time. Antimicrobics are not needed for sterile struvite uroliths, only diet.