CANINE STRUVITE UROLITHS
In almost all dogs, struvite forms as a consequence of 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, 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 not ideal for dogs with urinary obstruction, but possible with a few adjustments (gentle retropulsion of urethral stones, ureteral stent, etc.).

**DISSOLUTION**

<table>
<thead>
<tr>
<th>DIAGNOSTIC CONSIDERATIONS</th>
<th>MEDICAL CONSIDERATIONS</th>
<th>NUTRITIONAL CONSIDERATIONS</th>
<th>MONITORING CONSIDERATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical Imaging (e.g. X-ray)</td>
<td>Penicillin’s (e.g. amoxicillin) are usually effective. Administer antibiotics throughout the entire dissolution time (i.e. 2 to 3 months).</td>
<td>Feed struvite dissolution foods (e.g. Hills c/d multicare, others). Canned struvite dissolution foods may shorten dissolution time.</td>
<td>X-ray every 6 weeks. Reduced urolith size/density indicates effective therapy and accurate mineral prediction, and is an indication to continue therapy. Dissolution- see prevention recommendations. No change in urolith size - verify compliance (urine culture, urinalysis) or consider other urolith removal strategies.</td>
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<tr>
<td>Urine culture</td>
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<tr>
<td>MUC App*</td>
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<tr>
<td>Urinalysis</td>
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</tbody>
</table>

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

** We advise reviewing manufacturer’s information 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.
CANINE STRUVITE UROLITHS

In dogs, struvite (magnesium ammonium phosphate hexahydrate) stones are commonly a consequence of urinary tract infection (UTI) with bacteria that produce urease. This bacterial enzyme 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.1

Consider These Facts:

Some veterinarians prefer to remove struvite uroliths surgically instead of medical dissolution due to the perception that medical dissolution is less effective, more expensive, associated with prolonged discomfort, and will result in urethral obstruction as uroliths decrease in size. These are more often misperceptions. Medical dissolution with Prescription Diet® s/d® Canine was 100% effective after just 3 to 6 weeks for sterile struvite uroliths3 and 8 to 12 weeks with antimicrobics for infection-induced struvite uroliths.4 Noninvasive medical dissolution is an effective and compassionate choice for dogs without a urethral 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.5 When feeding Prescription Diet® s/d® Canine, owner/patient compliance is easily and rapidly determined with a urine specific gravity (USG) (mean = 1.008 ± 0.003) and pH (mean = 6.2 ± 0.7).5 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.

The struvitolytic diet is relatively high in fat 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. Likewise, female Miniature Schnauzers (and other breeds) and dogs with hyperadrenocorticism are also risk factors for pancreatitis and urinary tract infections that include urease-producing uropathogens. Be aware of these associations and how to respond (e.g. discontinue struvitolytic diet, maintain hydration) to adverse events (vomiting/pancreatitis) if they occur. In these patients, consider low-fat alternatives that also acidify urine (e.g. canned Prescription Diet® w/d® Canine) to assist correction of both diseases.

Twenty-six percent of canine nephroliths are composed of struvite.7 As with bladder stones, struvite nephroliths can be dissolved medically. Dissolution times are typically longer due to reduced kidney function, reduced urine production, and reduced nephrolith dwell time in therapeutically undersaturated urine.

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. However, risk factors (distal renal tubular acidosis, hypoxemia, chronic diuretic use, administration of antacids, and hyperaldosteronism) promoting persistent alkalinuria, hyperphosphaturia and hyperammoniuria are rarely detected.

Nutritional Considerations:

- Diets with reduced protein, phosphorus and magnesium that promote formation of acidic urine (i.e. pH≤ 6.5) reduce struvite precipitation and promote struvite dissolution.
- Extreme and prolonged reductions of some risk factors that minimize struvite urolith formation, (e.g. acidic urine), may increase risk for calcium oxalate (CaOx), calcium phosphate carbonate, and calcium phosphate apatite uroliths, especially in breeds at risk (e.g. Bichon Frise, Miniature Schnauzer, Shih Tzu, Lhasa Apso, Miniature Poodle and others).
- High moisture foods (i.e. canned formulations) are more effective because increased water ingestion is associated with decreased urine concentrations of calculogenic minerals and increased crystal evacuation.

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.2
**MEDICAL DISSOLUTION OF STRUVITE UROLITHS IN DOGS**

**Therapy:** Struvitolytic Diet
- Appropriate antimicrobics for infection-induced uroliths

**Monitor:** Urinalysis and medical imaging every 4 to 6 weeks.

<table>
<thead>
<tr>
<th>USG &lt; 1.020</th>
<th>USG &gt; 1.020</th>
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</thead>
<tbody>
<tr>
<td>Urine pH &lt; 6.5</td>
<td>Urine pH &gt; 6.5</td>
</tr>
<tr>
<td>20% Reduction in Stone Size</td>
<td></td>
</tr>
</tbody>
</table>

(These parameters are ideal for successful struvite dissolution.)

- **Bacteriuria**
  - Culture urine to verify infection and antimicrobial administration
  - If positive, administer appropriate antimicrobial by an accepted route

- **Urine pH > 6.5**
  - To verify, measure using pH meter
  - Minimize confounding post-prandial alkalinuria by sampling urine just prior to meals or >8 hrs after meals

- **Identical or Increased Urolith Size, or Stalled Urolith Dissolution**
  - Inadequate Control of UTI
    - Administer antimicrobics throughout the entire period of dissolution
  - Incomplete Dietary Compliance
  - Incorrect or Incomplete Prediction of Mineral Composition
    - Consider minimally invasive or surgical methods to remove uroliths

- **Incomplete Urolith Dissolution**
  - Consider a diet with proven success (e.g. Prescription Diet® s/d® Canine) to lower USG and pH, and dissolve struvite.
  - If currently consuming Prescription Diet® s/d® Canine, verify dietary compliance by measuring blood urea nitrogen concentration; if > 9 mg/dl (3.2 mmol/L), encourage better compliance with therapeutic food and emphasize avoiding other foods and treats

**Incomplete Dietary Compliance**

- **Bacteriuria**
  - Culture urine to verify infection and antimicrobial administration

**Incomplete Urolith Dissolution**

- **Incomplete Urolith Dissolution**
  - Consider a diet with proven success (e.g. Prescription Diet® s/d® Canine) to lower USG and pH, and dissolve struvite.
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**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.**

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