Oxalate and Struvite Urolithiasis

Classic case: Cat or dog with stranguria, hematuria, +/- polydipsia.

Presentation:
• Signalment
  ▪ Dogs: Oxalate
    o Middle-aged to older neutered males
    o Miniature schnauzer, Lhasa apso, Yorkshire terrier, bichon frise, Pomeranian, shih tzu, miniature poodle
  ▪ Dogs: Struvite
    o Any age, females 2X more commonly affected than males (because of urinary tract infections)
    o Miniature schnauzer, shih tzu, bichon frise, miniature poodle, cocker spaniel (may be sterile uroliths), Lhasa apso
  ▪ Cats: Oxalate
    o Between 7 and 10 years old. Males around 60% affected
    o Ragdoll, British shorthair, foreign shorthair, Himalayan, Havana brown, Scottish fold, Persian, exotic shorthair
  ▪ Cats: Struvite
    o Neutered male cats at increased risk, between 4 and 7 years of age
    o Domestic shorthair, foreign shorthair, ragdoll, Chartreux, Oriental shorthair, Himalayan

• Clinical signs
  ▪ Hematuria, pollakiuria, dysuria, stranguria
  ▪ Inappropriate elimination (perioria)
  ▪ +/- systemic illness, PU/PD
  ▪ Enlarged, turgid urinary bladder if obstructed
  ▪ Renomegaly if hydronephrosis

DDX: Urinary tract infection, other types of uroliths, urinary neoplasia, behavioral disorder, neurologic dysfunction, anatomic urinary tract defect

Test(s) of choice:
• Serum biochem: +/- hypercalcemia (oxalate). If obstructed: azotemia, hyperkalemia, metabolic acidosis

• Urinalysis and culture and sensitivity:
  If ANY urine sits for more than an hour, oxalate or struvite crystals may precipitate (artifact)
  ▪ Oxalate: acidic to neutral pH, hematuria, +/- crystalluria
  ▪ Struvite: neutral or alkaline pH, pyuria, bacteria, +/- hematuria, +/- crystalluria
  ▪ Struvite: usually associated with UTI in dogs, but not in cats

• Abdominal radiographs – radiopaque calculi in bladder, urethra, ureter or renal pelvis.
  ▪ Struvite are most radiopaque followed by oxalate uroliths.
  ▪ Oxalates may be smooth, round, spiculated, or jackstone (they look like toy jacks)
  ▪ Struvites are usually smooth and round.

• Abdominal ultrasound – will help confirm location, assess kidneys for pyelonephritis or hydronephrosis

• Urolith analysis and culture: analyzed by crystallography, x-ray diffraction, infrared spectroscopy
Rx of choice:
- ACUTE – Rx depends on location
  - Relieve urethral tract obstruction – life threatening!
    - Cats only: Gently massage distal urethra to break apart urethral plug and GENTLY compress urinary bladder (usually not effective, but easy, so worth a try)
    - Decompressive cystocentesis (use IV tubing and 3-way stopcock so no need to repuncture bladder) – leave about 5-15 ml of urine in bladder to avoid damaging bladder wall
    - Flush plug out external urethral orifice (cats only)
      - Use open-ended catheter, IV tubing and 35 ml fluid (sterile isotonic solution) filled syringe
      - Flush into urethral lumen and GENTLY apply pressure to urinary bladder
    - Retrograde urethral flushing
      - Use open-ended catheter (8 Fr feeding tube in dogs), IV tubing and 3-20 ml fluid-filled syringe (in dogs, may mix saline with sterile water-soluble lubricant 50:50)
      - Insert catheter into distal urethral opening
      - Use moistened gauze sponge to occlude the distal urethra around the catheter and pull penile urethra caudally to extend it parallel to spine
      - Flush vigorously. Repeat if needed (may also need to repeat decompressive cystocentesis)
      - Smaller syringe gives greatest hydropropulsion pressure
  - Radiograph to verify uroliths are in bladder
  - Indwelling transurethral catheters (3-5 Fr flexible feeding tube in cats; 8 Fr in dogs)
    - Not always indicated – use when poor urine stream after flushing, postrenal azotemia, allow recovery of detrusor contractility, urethral tear
    - Maintain a closed collection system and remove as soon as possible
    - No antibiotics if urine is sterile; antibiotics indicated for UTI or other infection
    - No corticosteroids
    - Pain control (eg, buprenorphine)
    - Maintain hydration
      - Urohydropropulsion (avoid in male cats)
      - Catheter-assisted retrieval, or cystoscopic-assisted retrieval
      - Surgical retrieval, or lithotripsy
      - Medical dissolution (struvite only) – may take around 3 months (Hill’s s/d)
      - Repeat radiographs to ensure complete removal
- CHRONIC Rx: Determine if underlying disorder (hyperadrenocorticism, urinary tract infection)

Oxalate uroliths from a male miniature schnauzer.
Image courtesy, April Williams
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Extended version

Prognosis:
- Recurrence is common
- Prognosis for dietary dissolution of struvite uroliths is good

Prevention:
- **Oxalate:** diet high in moisture w/ moderate Mg, phosphorus
  - AVOID diets with moderate fat and carbs (Hill’s u/d or w/d (dogs) Hill’s c/d (cats))
  - Treat hypercalcemia if present
  - Promote water consumption, feed canned food
  - Add potassium citrate if urinary pH remains acidic
  - For persistent calcium oxalate crystalluria add hydrochlorothiazide or vitamin B₆
  - Consider perineal urethrostomy in male cats
- **Struvite**
  - AVOID diets high in magnesium, phosphorus, calcium, chloride, fiber, with moderate protein
  - Promote water consumption

Pearls:
- Oxalate and struvite uroliths are most common form of uroliths in dogs and cats
- **Risk factors for oxalate stones:** hypercalcemia (35% of cats and 4% of dogs), acidic urine, concentrated urine, infrequent urination, chronic metabolic acidosis, obesity, diets designed to minimize struvite formation in cats
- **Risk factors for struvite stones:**
  - In dogs, struvite uroliths are almost always associated with urinary tract infection involving urease-producing bacteria.
  - In cats, struvite uroliths are typically found in sterile alkaline urine

Feline radiograph, radio-opaque urolith in bladder.
Image courtesy, Dr. A Stambaugh

Urethral obstruction in a male dog, caused by three urinary calculi (blue arrows).
Image courtesy, Dr. Kalumet
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My Notes: