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URINARY TRACT OBSTRUCTION: Bad to the Stone
Elke Rudloff, DVM, DACVECC
Glendale, WI
www.lakeshorevetspecialists.com

Urethral obstruction is a common problem requiring emergency treatment. Post-renal obstruction becomes life-threatening because rapid development of hyperkalemia, azotemia, and acid-base disturbances promotes cardiac and neurological dysfunction. It usually occurs in male dogs, cats, and ferrets, but can occur in female animals. Historically, pet owners will complain of bloody urine, and/or frequent attempts to urinate, with little or no urine being expelled. Cats may seek places outside the litter box to urinate, lick excessively at their genitalia, and howl quite distinctively. Cats and dogs may act restless, and vomit. Some owners may complain that their pet is constipated.

FELINE LOWER URINARY TRACT OBSTRUCTION
The most common causes of urethral obstruction in cats include crystalline-matrix origin or matrix origin (accumulations of sloughed tissue, inflammatory cells, or erythrocytes). The most common crystalline matrix found is struvite, however other crystals (such as calcium oxalate, calcium phosphate, ammonium acid urate, cysteine, etc.) can also be the origin. The crystals can form a urolith, and multiple crystal forms can cause lower urinary tract problems. Other causes include inflammatory swelling of the urethra, urethral muscle spasms, and reflex dysynergia. Uroliths can form when there is supersaturation of the urine with calculogenic minerals. The type of calculus that is formed will depend on renal excretion of minerals, pH of urine, presence of promoters, absence of inhibitors, concomitant bacterial infection, and underlying inflammation. Therefore quantitative stone analysis is required to determine initiating cause.

Cats with post-renal obstruction can present with normal or comatose mentation, depending on the severity of serum chemical alterations. Perfusion can be normal or decreased. Heart rate can be rapid, normal or slow regardless of the potassium level. Dysrhythmias may or may not be ausculted with pulse deficits, depending on the electrolyte and acid-base disturbance and require ECG evaluation to diagnose. Palpation of the abdomen may be very painful, and a large hard bladder is indicative of urethral outflow obstruction. Palpation must be gentle, and bladder expression not attempted, in order to avoid rupture of the compromised bladder wall. The penis may be extruded, there may be a discharge at the tip, or even crystals present. The penile tip may be discolored purple because of vascular compromise to the distal tissue.

STABILIZATION
The following protocol can be used for therapeutic management of urethral obstruction in the cat. Place a peripheral IV catheter and initiate fluid therapy using a balanced isotonic replacement crystalloid, such as Plasmalyte-pH 7.4® or Ringer's lactate at an initial rate of 10 ml/kg/hr. Fluids may be withheld if unblocking cannot be immediately performed. Obtain an emergency laboratory database to include: PCV/TS, Azostick/Dextrostick, Na⁺, K⁺, Ca²⁺, venous blood gas. Submit CBC/Chemistry profile. An ECG should be evaluated to diagnose dysrhythmias associated with hyperkalemia requiring immediate treatment. There is no set potassium level that predicts a dysrhythmia. ECG changes associated with hyperkalemia include tall T-waves (1/4-1/3 the height of the R wave), prolonged P-R interval, bradycardia, sinoventricular rhythm, sine wave (near arrest) and asystole. If hyperkalemia is present without a significant dysrhythmia and perfusion is adequate, forced diuresis is generally effective at correcting the potassium excess. If hyperkalemia is sufficient enough to cause dysrhythmias (see below) associated with poor perfusion or altered mentation, 0.2 units/kg regular insulin IV is administered, followed by 2g dextrose/unit insulin (6cc of 25% dextrose). This will drive potassium intracellularly, making it less available to the myocardial cells. Fluids should be supplemented with 1.25-2.5% dextrose solution until the insulin has metabolized. In addition, 10% calcium gluconate by slow IV infusion at 50-100 mg will antagonize the membrane effects of hyperkalemia and is cardioprotective, decreasing the threshold potential and reestablishing the difference between the resting membrane potential and the threshold potential. The effects are immediate and last approximately 20-30 minutes. Rarely is 0.1-0.2 mEq/kg sodium bicarbonate IV necessary to reduce intravascular potassium.

UNBLOCKING PROCEDURE
Sedation for urinary catheter placement may require a narcotic/tranquilizer combination: 0.4-0.8 mg/kg butorphanol + 0.2 mg/kg midazolam IV, or 1-3 mg/kg ketamine + 0.1 mg/kg midazolam, or 4 mg/kg propofol + 0.2
mg/kg midazolam. Ketamine should not be used in the cat with a heart murmur, dysrhythmia, or history of heart disease. In cardiovascularly unstable patients, 0.2 mg/kg midazolam and 1-2 mg/kg etomidate may be the safest combination. To facilitate post-urethral sphincter dilation 0.01 mg/kg acepromazine can be administered in the cat with normal blood pressure. Inhalation anesthesia using isoflurane or sevoflurane can also be used, but they are profound vasodilators, and endotracheal intubation and assisted ventilation are necessary.

The urethra can be unblocked by first massaging the penis to loosen any crystals that may be lodged in the tip. A 3.5 French open-ended polypropylene catheter (tom-cat catheter) is lubricated with sterile KY or lidocaine gel and inserted into the penis. Once the obstruction is encountered, sterile saline and KY-gel infusion will usually retropulse the obstruction into the bladder. With the difficult obstruction, the following tips may facilitate catheter placement. 1. Try to straighten the penis once the catheter is fit into the distal urethra by pulling the prepuce caudally and 2. use a tuberculin (1 cc) syringe to retropulse saline in a pulsating manner to infuse warm saline mixed with KY-gel.

If unsuccessful at relieving the obstruction with flushing, careful cystocentesis removing as much urine as possible may be performed as a last resort to reduce the pressure on the blockage, but this may result in urine leakage into the abdomen. Emergency placement of a cystostomy tube or emergency perineal urethrostomy may be required for the most difficult cases.

Once the urinary catheter passes into the bladder, the urine is removed using gentle aspiration, and the bladder copiously lavaged with sterile saline to dilute the crystals and remove as much sediment as possible. The urethra is flushed as the polypropylene catheter is removed. A soft, 3.5 French red rubber tube is placed into the trigone of the bladder and secured in place. Larger catheters may be associated with catheter kinking and knotting.

**MONITORING**

A closed collection system is attached to the urinary catheter using a sterile empty IV fluid bag and fluid administration set. An Elizabethan collar is needed to prevent premature removal. Urine is submitted for analysis and culture. Any crystals or uroliths collected are submitted for analysis and culture of the nidus. Anticipated complications include hyperkalemia, dehydration, azotemia, post-obstructive diuresis and hypokalemia, urethral damage, hypocalcemia, hemorrhage, and hypothermia. Urine output is measured every 1-2 hours once the animal is rehydrated. Output must be at least 1-2 ml/kg/hr, otherwise fluid input is adjusted with outflow during the diuresis phase. Once diuresis begins, polyuria associated with post-obstructive diuresis or fluid overload may occur. A good rule of thumb is to adjust the hourly fluid rate to equal 2-6 ml/kg/hr + hourly urine output.

Should the urine output decline in the face of adequate fluid input and serum potassium increase, the urine collection system should be examined for an obstruction/kinking, laboratory values should be assessed for indications of acute renal failure, the urinary bladder is evaluated for atony or rupture.

Continuous analgesia can be provided with an opioid +/- local anesthetic epidural injection, fentanyl continuous infusion, or with standing orders for intermittent methadone or buprenorphine injection. Non-steroidal injections should be used with extreme caution, since urinary patency may not be guaranteed, and renal damage may be exacerbated. Antiinflamatory doses of corticosteroids may be used when significant swelling and inflammation of the urethra is affecting urethral patency.

**ADDITIONAL DIAGNOSTICS**

Following stabilization and reestablishing urethral patency, diagnostic imaging is recommended to assess the kidneys, urinary bladder, and proximal urethra. Infusion of sterile saline will inflate the bladder, making identification of bladder calculi, mass lesions and the urethral catheter more easily using ultrasound. If radiographs are obtained, the bladder should be partially inflated with sterile saline. Using a wooden spoon to gently compress the urinary bladder in the lateral position will enhance urinary bladder resolution, making calculi more easily identified. Survey radiographs may not identify radiolucent calculi, or calculi <3 mm. Abdominal ultrasonography and contrast cystography are more helpful identifying radiolucent and small calculi.

Urinalysis should be performed and evaluated for the presence of crystals, although crystals may not be evident in cases of crystalluria, and the presence of crystalluria does not correlate with type of uroliths. If surgical intervention is required to remove stones or a bladder mass, the bladder wall should be cultured and histopathology performed in addition to stone analysis and culture of the nidus.
The packed cell volume and total solids can be monitored in addition to physical exam findings to distinguish fluid overload from post-obstructive diuresis. Renal parameters are monitored when azotemia exists and the electrolyte panel evaluated when hyperkalemia is a complication.

Urethritis and urethral spasms are common following removal of the urinary catheter. Immediate therapy may include acepromazine (0.02-0.05 mg/kg IV q 4-6h) to relax the post-urethral sphincter, and anti-inflammatory doses of corticosteroids. Therapy with alpha-1-antagonists, such as prazocin (0.5 mg po q 8h) or phenoxybenzamine (2.5-7.7mg po q 12-24h) may decrease urethral tone, but the effects may not be immediately realized, and vomiting is not an unusual complication. Reoccurrence rates for obstructive uropathy in male cats are reported to be as high as 45% within the first 6 months. Strategies that can decrease the rate of reoccurrence include decreasing crystal supersaturation by reducing urine specific gravity. Feeding moist foods exclusively and increasing the number and type (fountains, wide bowls) of water sources may also improve elimination of crystals.

**CANINE URETHRAL OBSTRUCTION- Calculi**

Most commonly, urethral obstruction in the dog is a result of urinary calculi obstruction at the base of the os penis in the male, or at the distal urethral opening in the female, although the calculi can be found anywhere. The female dog can often be unobstructed by massaging the urethra via rectal palpation using analgesia and a benzodiazepine. The basic protocol for, and the anticipated complications are the same in the dog as outlined for the cat with a few variations.

Unblocking a male dog requires 2 people: one to apply downward pressure on the pelvic urethra via a rectal approach obstructing the flow of retrograde fluid, and the other to place the urinary catheter to the level of the obstruction and flush with sterile saline mixed with sterile lubricating gel. A stiff polypropylene catheter lubricated with lidocaine gel works best. As the pressure builds, the digital pressure on the urethra is released then replaced. The goal is to provide enough hydrostatic pressure to dilate the urethra and retropulse the stone back into the bladder without tearing the urethra. Often, the urolith is adhered to the urethral mucosa, and it may be bypassed with a smaller catheter.

Once the obstruction has been relieved, a soft red rubber, flexible argyle, or Foley tube is placed and connected to a closed collection system. Diagnostic imaging, complications and monitoring are as described above. The use of laser lithotripsy is becoming more prevalent for fragmentation of uroliths in dogs and is performed at a few specialty institutions. Repeat imaging of the urethra and urinary bladder are always recommended prior to surgical intervention since passage of the stone may have occurred. If surgical intervention is required, a scrotal or prescrotal urethrostomy is performed. Stone analysis as described above and a urine culture and sensitivity analysis are essential to determine preventative strategies. Unlike cats, canine struvite stones are commonly associated with infections.

**URETHRAL OBSTRUCTION- Prostatomegaly, Mass**

Occasionally, urethral obstruction will occur because of a neoplastic trigonal, prostatic or urethral mass, hematoma in the bladder, or benign prostatic hyperplasia. In most cases, urinary catheter placement is less difficult than with calculi. Diagnostic imaging including abdominal sonography and contrast radiography will localize the region to sample. The sublumbar lymphnodes should be evaluated for enlargement sonographically.

Tissue samples should be obtained via cystoscopy, catheterization or fine-needle aspiration and submitted for histopathological and cytological evaluation and culture. When the possibility of a transitional cell neoplasia exists, sample collection via cystoscopy or urethral catheterization is the preferred method, since seeding of the tumor can occur with transcutaneous fine-needle aspiration. A fine needle aspirate of a prostatic mass using ultrasound-guidance provides the most diagnostic information for cytological and microbiological evaluation.

Anti-inflammatory agents such as meloxicam or piroxicam are started if renal function is normal, and if necessary, a urinary catheter is left in place to maintain patency until inflammation is reduced enough to allow voluntary urination. When a hematoma is present, urinary catheterization and drainage may be necessary for 5-14 days until the clot dissolves, or surgical intervention can be performed to remove the clot. With urethral masses in dogs and cats, transurethral stent placement can provide palliative treatment.
**SUGGESTED READING**


