Urethral obstruction is a potentially life-threatening emergency. Male cats are more prone to obstruction than female cats.1 When the urethra becomes partially or completely blocked, urine is unable to drain from the bladder, resulting in fluid, electrolyte, and acid–base abnormalities.2 Feline urethral obstruction is a relatively common condition, accounting for up to 10% of feline cases presented to small animal referral and emergency clinics.3,4

ETIOLOGY

The urethra—the tubular passage through which urine is discharged from the bladder to outside the body—can become obstructed for several reasons. The urethra is longer and narrower in male cats than in female cats; therefore, male cats are more likely to develop an obstruction. The most common cause of obstruction is a urethral plug, which consists of mineral crystals (e.g., struvite, calcium oxalate), white blood cells, red blood cells, protein (mucus), and epithelial cells.5 The underlying cause of urethral plugs is unknown; however, plugs have been linked to struvite crystalluria — suggesting that diet may play a role — and idiopathic cystitis.6 Other causes of urethral obstruction include urethral edema and spasm associated with lower urinary tract inflammation and pain.7 Uroliths, neoplasms, and urethral strictures can also lead to urethral obstruction; however, they are reported less frequently than other causes.5

HISTORY AND CLINICAL SIGNS

Cats with a history of lower urinary tract disease—particularly interstitial cystitis—are at an increased risk for developing urethral obstruction.8 Some patients may have a history of obstruction.9 Clinical signs of urethral obstruction can vary depending on the severity and duration of the obstruction. Initially, the most common clinical sign is stranguria, which is sometimes mistaken by the owner as constipation.8 Affected cats may urinate frequently, strain to urinate, urinate inappropriately, and pass small volumes of blood-stained urine (hematuria).10 Lethargy, anorexia, vomiting, and other signs of systemic illness are also common.1 Signs of discomfort or pain caused by an inflamed urethra and increased bladder size include vocalization, inappetence, and hiding. Affected cats can be observed frequently licking their genital region.10 Vomiting and lethargy may also be noted.1 In addition, the patient’s mucous membranes will be pale, and capillary refill time is prolonged.4
On abdominal palpation, the urinary bladder is often large and firm and cannot be expressed easily. Caution should be used when attempting to express a possibly obstructed bladder. If too much pressure is applied to the distended bladder, it can rupture. If bladder rupture is suspected, the goal is to immediately stabilize the patient so that the clinician can perform emergency surgery. If the urethral obstruction goes untreated for more than 24 to 48 hours, the resulting uremia can lead to hypothermia, bradycardia, tachypnea, altered levels of consciousness (including coma), and death.

**DIAGNOSIS**
A common finding associated with urethral obstruction is a large, firm bladder on abdominal palpation. Urine should be collected for urinalysis, culture, and sensitivity testing. Blood work (i.e., complete blood count and serum chemistry profile, including serum potassium levels) should also be obtained. Serum potassium levels can be used to assess cardiotoxicity associated with hyperkalemia. An electrocardiogram (ECG) should be obtained to evaluate cardiac function and identify abnormalities consistent with hyperkalemia. Signs of hyperkalemia include diminished to absent P waves, widened QRS complexes, prolonged PR intervals, and tall, “tented” T waves. These abnormalities, which most often appear on lead II tracings when serum potassium concentration is >7 mEq/L, are the result of a raised (more positive) resting membrane potential that slows depolarization and exaggerates repolarization.

Abdominal radiographs can help determine the presence of cystic or urethral calculi. Identification of calculi (stones) affects how an obstruction is treated. The presence of calculi can make it much more difficult to use a urinary catheter to remove the obstruction and can result in additional urethral trauma. If bladder stones are present, a cystotomy should be performed after the urethral obstruction has been removed and the patient is stable enough to undergo anesthesia. Voiding urohydropropulsion is another method that can be used to remove bladder stones.

**TREATMENT**

**Address Metabolic Abnormalities**
When treating a cat with a urethral obstruction, it is important to quickly stabilize the patient’s vital signs and address metabolic abnormalities so that urethral catheterization can be performed to remove the obstruction. Administering IV fluids is the initial step in therapeutic management. Traditionally, 0.9% NaCl has been the fluid of choice because it does not contain potassium and has the greatest dilutional effect on hyperkalemia; however, a balanced electrolyte solution, such as Normosol-R, Plasmalyte 148, or lactated Ringer’s solution, can be administered as an alternative. Although these solutions contain some potassium, the concentrations are 5 mEq/L or less, which may also make the solutions effective in treating concurrent metabolic acidosis. Fluid rate and quantity should be determined based on the patient’s clinical signs and physical examination findings. Aggressive fluid therapy is indicated in patients that are markedly depressed or unresponsive. A shock dose of 60 mL/kg should be administered to these patients and titrated to effect. Hydration and cardiovascular status must be reevaluated after each bolus is administered. In patients with stable vital signs, the percentage of dehydration should be used to calculate the fluid rate and quantity required to correct hydration status (BOX 1).

**BOX 1**
How to Calculate Replacement Fluids

Dehydration + Maintenance + Ongoing losses = Amount of replacement fluids needed

Example: For a 5 kg cat that is 5% dehydrated:

- **Dehydration fluid rate:**
  - \(0.05 \times 1000 = 50 \text{ mL} \) (to replace over 12 hours)
  - \(50 \text{ mL} + 12 \text{ hr} = 4 \text{ mL/hr}\)

- **Maintenance fluid rate:** 12 mL/hr (60 mL/kg/day)

- **Ongoing losses:** Urine output is 40 mL/4 hr (10 mL/hr)
  \(4 \text{ mL/hr} + 12 \text{ mL/hr} + 10 \text{ mL/hr} = 26 \text{ mL/hr total fluid rate}\)
If results of the serum biochemistry profile indicate a potassium concentration that is life threatening (>6 mEq/L), and/or if ECG findings suggest hyperkalemia, 10% calcium chloride at 0.1 mg/kg IV should be administered immediately to protect the heart from the effects of hyperkalemia. This dose should be given slowly over 5 to 10 minutes while monitoring the patient’s cardiac status on an ECG for conversion to a normal sinus rhythm.

To decrease serum potassium concentration, a combination of regular insulin and dextrose can be administered. Insulin drives potassium into the intracellular space, and dextrose helps prevent hypoglycemia that may result from insulin administration. Regular insulin should be given at a dose of 1 U/cat. Blood glucose concentration should be monitored every 4 hours after administration of insulin and dextrose. If the glucose concentration decreases to 60 to 70 mg/dL or less, a dextrose constant-rate infusion should be initiated at the fluid rate already being administered. Dextrose 50% can also be administered without insulin to stimulate the release of endogenous insulin. The dose is 0.5 g/kg diluted 1:1 with NaCl or sterile water. The dextrose should be diluted 1:1 to decrease the osmolarity and should be administered with caution to avoid extravasation, since it can cause skin sloughing.

Alternatively, sodium bicarbonate (1 mEq/kg given slowly over 10 minutes) can be used to drive potassium into the intracellular space. Administration of sodium bicarbonate may result in ionized hypocalcemia, hypernatremia, alkalois, and seizures; therefore, its use should be restricted only to patients with severe hyperkalemia (potassium concentration >10 mEq/L) or acidemia (pH <7.1).

**Remove the Obstruction**

Urethral catheterization is the method most commonly used to remove a urethral obstruction. If urethral catheterization cannot be performed immediately, or if the patient is too unstable or in too much pain, the urinary bladder can be emptied through cystocentesis to help stabilize vital signs and to relieve discomfort (BOX 2). Cystocentesis should be performed with caution because the bladder wall is friable and prone to tearing.

A caudal epidural (BOX 3) can facilitate the deobstruction, help decrease the amount of inhalation anesthesia required, and provide analgesia during the recovery period. Various medications can be used for the epidural injection. Lidocaine 2% without epinephrine at a dose of 0.1 to 0.2 mL/kg can be used (approximately 0.5 mL/cat). Bupivicaine 0.75% can also be used at the same dose; its duration of action is approximately 2 hours. Astramorph (Fresenius Kabi, USA; preservative-free morphine) can also be used at a dose of 0.1 mg/kg, with a duration of action of 10 to 24 hours.

Administration of a sedative before the collection procedure may be required in fractious patients or patients with severe pain. Detailed information on the catheterization procedure as well as sedation is provided in BOX 4.

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*Cooper E, VMD, MS, DACVECC. Personal communication. The Ohio State University Teaching Hospital, 2008.
POSTOBSTRUCTION CARE

Medical Care
Acepromazine (0.03 to 0.1 mg/kg IV q6-8h)\(^1\) can be administered following urethral catheterization to provide sedation and decrease urethral spasms. It can be administered with buprenorphine (0.006 to 0.01 mg/kg IV q6-8h).\(^2\) (In the author’s clinic, doses of 0.01 to 0.03 mg/kg IV have been used q6-8h.) Buprenorphine should be administered to provide analgesia. Buprenorphine solution can be administered orally and should be placed on the oral mucosa, where it has been shown to have excellent bioavailability. Following urethral catheterization, urine output should be measured every 4 hours to ensure that output equals 1 to 2 mL/kg/hr. IV fluids should be recalculated every 4 hours to match urine output plus the maintenance fluid rate for that individual patient. Packed cell volume and serum concentrations of total protein, electrolytes, blood urea nitrogen, and creatinine should be measured once or twice a day to assess hydration status and resolution of metabolic abnormalities.

In some patients with significant azotemia, postobstructive diuresis occurs as a result of medullary washout, osmotic diuresis, pressure necrosis, or antidiuretic hormone resistance. Diuresis should be suspected if urine output exceeds 2 mL/kg/hr. Diuresis can cause rapid dehydration and electrolyte depletion. Urine output of these patients should be monitored closely. Serum potassium concentration should also be measured regularly and potassium supplementation provided as needed.

The urinary catheter should be left in place for 24 to 48 hours after urethral catheterization. Once urine output and results of blood and serum studies are normal, the catheter can be removed. A sterile urine sample for

### BOX 3 Caudal Epidural Technique

1. **Place the cat in sternal recumbency** and palpate the space between the sacrum and first coccygeal vertebra or the first and second coccygeal vertebrae. The first coccygeal vertebra will be mobile when the tail is moved.

2. **Clip a small square over the area** and aseptically prepare the skin. Sterile gloves should be worn after the area is prepped.

3. **Wearing sterile gloves**, again palpate the location of the most mobile joint caudal to the sacrum. If the patient is awake, have an assistant keep the tail from moving to preserve sterility. Use the nondominant index finger to identify this space, while the dominant hand is kept sterile for handling the needle.

4. **Once the space has been identified**, use a 25-gauge × 1-inch needle to penetrate the skin at midline. The index finger may remain near the injection site as a guide for needle placement. The needle is directed at a 30° to 45° angle and advanced through the interarcuate ligament/ligamentum flavum. A palpable “pop” may occur when the ligament is penetrated. As the needle is advanced, there should be a little resistance upon entering the epidural space. If bone is encountered, establish if the needle is superficial to the spinal canal or if it has been advanced through the epidural space to the floor of the vertebral canal. If the needle is superficial it should be kept underneath the skin, repositioned slightly either cranially or caudally, and walked off the bone until the space is entered. The needle should then feel more firmly seated. If the bone encountered is thought to be deep, back the needle out slightly and continue with the injection.

5. **Once the needle is properly placed**, attach and aspirate a syringe to confirm the absence of blood. If blood is encountered, the needle should be removed and another attempt made. If no blood is aspirated, infuse the medication being used for injection into the epidural space. There should be minimal resistance to injection. Air is not injected into this space because the potential space is small and air bubbles may result in an incomplete block. If resistance is encountered toward the end of the injection, the injection may be subcutaneous and the block may not be efficacious.

6. **Once the injection is completed**, withdraw the needle and observe the rectum and tail for relaxation. Relaxation does not need to be complete, but some relaxation should be observed before attempting catheterization. Pinching the tail or perianal region can be used to further confirm proper placement of the injection.

7. **If relaxation is not observed within 5 minutes**, the block may have been injected outside the epidural space. A second dose may be attempted using the same technique. It is not recommended to attempt more than 2 injections because of the risk for excessive cranial spread of the local anesthetic, which may result in paralysis of necessary spinal structures. In cases in which a higher dose or repeat injections are administered, some hindlimb weakness may be appreciated.
Anesthesia
When vital signs are stable, urethral catheterization should be performed with the patient under sedation or general anesthesia. Sedation is indicated in patients that are not stable enough for anesthesia. Moribund patients can be catheterized without any sedation. The anesthetic protocol should include a premedication, induction agent, and gas inhalant.

The premedication provides sedation and reduces the amount of induction agent required. Acepromazine, a phenothiazine, can be administered at 0.03 to 0.1 mg/kg IV, IM, or SC for premedication. Although doses at the low end of this range produce minimal cardiovascular effects, high doses can cause marked hypotension and reflex tachycardia; therefore, high doses should be used with caution in debilitated or hypotensive patients. Acepromazine may protect the heart against catecholamine-induced arrhythmias. Acepromazine can be combined with buprenorphine at 0.006 to 0.01 mg/kg.

Hydromorphone and fentanyl can also be combined with acepromazine. When given as a premedication, hydromorphone and acepromazine provide sedation and analgesia. Fentanyl, given as a constant-rate infusion, provides additional analgesia during catheter placement and allows for a decreased amount of inhalant to be used. Hydromorphone is administered at 0.025 to 0.1 mg/kg IV, IM, or SC. Fentanyl is given initially as a bolus dose of 2 to 5 mg/kg IV; a constant rate infusion of 1 to 5 mg/kg/hr is then initiated to maintain a level plane of sedation. Hydromorphone and fentanyl can cause respiratory depression at higher doses; therefore, debilitated patients should be given doses only at the low end of the range.

The induction agent enables intubation of the patient for administration of inhalant anesthetic gas. Ketamine and diazepam, or propofol alone, can be used for induction. Ketamine increases heart rate and contractility while maintaining blood pressure. Diazepam produces minimal effects on the cardiovascular system and provides skeletal muscle relaxation.

The inhalant gas provides maintenance of anesthesia. Following induction, the patient is intubated and isoflurane or sevoflurane is administered. Blood pressure and heart and respiratory rates should be monitored closely during the administration of anesthesia. If propofol is used for induction, the dose is 2 to 8 mg/kg IV administered to effect; 4 mg/kg is usually sufficient for induction of a premedicated patient.

Catheterization
The area around the penis and prepuce is clipped and prepared using standard aseptic technique following induction and maintenance of anesthesia. A solution of sterile water and sterile lubricant is mixed at a 1:1 ratio, and two 20-mL syringes are filled with the solution (FIGURES A and B). A sterile 3.5-Fr open-ended tomcat

FIGURES A and B. Two 20-mL syringes attached to a 3-way stopcock. One syringe contains 0.9% NaCl; the other contains sterile lubricant. While attached to the stopcock, the syringes are flushed back and forth to mix the NaCl and lubricant. A syringe filled with the resulting solution is attached to an extension set and then to the urinary catheter that is being passed. The syringe contents are “pulsed” into the catheter while it is advanced into the urethra to help with flushing.
The catheter is then attached to extension tubing and a 3-way stopcock, and one syringe of the sterile solution is attached to the stopcock. Before insertion in the urethra, the catheter should be filled with the sterile solution.

Before the catheter is inserted in the urethra, the penis is extruded and extended dorsally until the long axis of the urethra is parallel to the vertebral column. The catheter tip is then seeded in the distal urethra, and the prepuce is pulled caudally to straighten the urethral flexure and facilitate passage of the catheter (FIGURES C and D). The catheter is advanced slowly while the plunger of the syringe containing the sterile solution is pulsed at regular intervals. This process flushes the obstruction into the bladder. Once the catheter can be advanced easily through the urethra and all the sterile solution has been pulsed into and then aspirated from the bladder, the catheter is removed. A sterile indwelling 3.5- or 5.0-Fr urinary catheter should be inserted in the urethra and sutured in place (FIGURE E).

Some sterile indwelling catheters (e.g., MILA, Erlanger, KY) can be used for deobstruction and left in place and sutured. This can help decrease urethral trauma from multiple catheterizations. A closed urinary collection system is attached to the indwelling urinary catheter for monitoring of urine output (FIGURE F).

For difficult obstructions, ensure that the patient is positioned in dorsal recumbency with its legs pointing cranially. One the penis is extruded, a 22-gauge IV catheter can be used. This catheter takes the place of the tomcat catheter. Using the same technique mentioned above, seed the catheter in the distal urethra and flush the catheter with sterile lubricant and 0.9% NaCl while trying to advance it further into the urethra. Red rubber catheters (3.5 and 5 Fr) can also be used if other urinary catheters are unavailable. They are pliable enough that they can be used for the deobstruction as well as left in place and sutured. If they are not rigid enough for the initial placement, they can be stored in the freezer.
culture should be obtained from the urinary catheter just before removal. After the urinary catheter has been removed, the patient should be monitored closely during the next 24 hours to ensure that urination is normal.

**Home Care**

Following discharge to the owner, a patient treated for urethral obstruction should continue to receive treatment with acepromazine at 0.5 mg/kg PO and buprenorphine at 0.01 mg/kg PO for 5 to 7 days to provide continued sedation and analgesia as well as to decrease urethral spasms. Antibiotics should be administered based on the results of culture and susceptibility testing of the urine sample obtained immediately before urinary catheter removal.

Other medications can be used in the hospital or at home after discharge to help to decrease urethral spasms. Phenoxybenzamine, for example, is used mainly to decrease internal urethral sphincter tone, at a dose of 0.5 mg/kg PO q24h. The dose can be increased by 2.5 mg/kg to a maximum of 10 mg. The initial dose should be used for 5 days before reevaluation and then increased, if needed. Prazosin can also be used at a dose of 0.5 mg/cat PO q12h.

Recently, Cosequin for Cats (Nutramax Laboratories, Lancaster, SC) has been used as a symptomatic treatment in cats with FLUTD (feline lower urinary tract disease). This medication, which contains glucosamine and chondroitin sulfate, is a nutritional supplement indicated for cats with arthritis. In cats with FLUTD, it helps to create a water barrier that protects the cells of the urinary tract, which in turn helps prevent bacteria and crystals from adhering to their surface. Some studies show no significant effect compared with placebo; however, some cats in the treatment group showed dramatic improvement when given the medication. The capsule can be opened and the contents sprinkled over the cat’s food.

**LONG-TERM DIETARY AND ENVIRONMENTAL MANAGEMENT**

Long-term management should be geared toward decreasing the recurrence of interstitial cystitis, which may lead to another obstruction. Patients with a history of bladder or urethral stones should be placed on a urinary care prescription diet that keeps pH neutral to help prevent the crystals from returning. These patients can also benefit from increased water intake, with access to fresh running water. Although not ideal, water can be added to their canned food.

Cats that are prone to cystitis need environmental enrichment. Scratching posts and toys can help increase their activity. They also need to be in an environment that has reduced levels of stress, and they need a quiet place for their food and litterbox.

**CONCLUSION**

The short-term prognosis for cats treated for urethral obstruction is good when appropriate treatment and supportive care are provided as soon as an obstruction is suspected. Cats that have had one urethral obstruction are at increased risk for reobstruction. In addition, cats that develop urethral obstructions multiple times may require perineal urethrostomy to widen and shorten the urethra. This procedure should drastically reduce the chances of another obstruction from occurring; however, stones or calculi could possibly cause another obstruction.

**Acknowledgment**

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CE Test Article 1 Urethral Obstruction in Male Cats

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1. What is thought to be the most common cause of urethral obstruction in male cats?
   a. Uroliths
   b. Neoplasia
   c. Urethral plugs
   d. Urethral strictures

2. The initial treatment for urethral obstruction is
   a. cystocentesis.
   b. deobstruction.
   c. calcium chloride.
   d. intravenous fluids.

3. On an electrocardiogram, what are the signs of hyperkalemia?
   a. Diminished to absent P waves
   b. Diminished to absent T waves
   c. Narrow QRS complexes
   d. Shortened PR intervals

4. What immediate treatment should be administered if the potassium value is thought to be life threatening (>6.0 mEq/L)?
   a. Calcium chloride 10%: 0.1 mg/kg IV
   b. Calcium gluconate 10%: 100 mg/kg IV
   c. Regular insulin 1 U/cat IV
   d. Dextrose 2.5% CRI

5. When should a cystocentesis be performed?
   a. Immediately upon presentation
   b. Only if urethral catheterization and decompression cannot be performed soon after presentation
   c. Only before induction of anesthesia
   d. It is never appropriate to perform a cystocentesis on a cat with a urethral obstruction

6. A premedication is necessary to
   a. help to sedate the patient.
   b. reduce the amount of induction drug needed.
   c. aid in performing a cystocentesis.
   d. All of the above

7. Urethral obstruction lasting ___________ hours can result in severe metabolic derangement.
   a. 12–24
   b. 24–48
   c. 24–36
   d. 48–72

8. Traditionally, ___________ has been considered the fluid of choice in treating hyperkalemia associated with urethral obstruction.
   a. Lactated Ringer's solution
   b. Plasmalyte-148
   c. 0.9% NaCl
   d. 0.45% NaCl + 2.5% dextrose

9. After deobstruction, the patient’s urine output should be ___________ mL/kg/hr, assuming there is no postobstructive diuresis.
   a. 0.5–1
   b. 1–2
   c. 2–3
   d. 3–4

10. Postobstructive diuresis can result in
    a. rapid dehydration.
    b. worsening azotemia.
    c. hyperkalemia.
    d. antidiuretic hormone resistance.