Urinary Tract Emergencies

David Holt, BVSc, Diplomate ACVS
University of Pennsylvania School of Veterinary Medicine, Philadelphia, PA

Urinary tract emergencies requiring surgery include trauma induced urine leakage, urinary tract obstruction, severe infection or hemorrhage, and acute renal failure requiring peritoneal dialysis. Any of these conditions can cause life threatening renal dysfunction. Once the diagnosis of a condition requiring surgery is made, the clinician's first priority should be stabilizing the animal as much as possible before anesthesia.

**Stabilization**

Urinary obstruction or leakage often results in severe dehydration, azotemia, hyperkalemia, and acidosis. Intravenous access is mandatory. Rehydration should begin immediately, using warm intravenous fluids. The rate of fluid administration is based on the severity of dehydration. Severely dehydrated animals can be given 60ml/kg over the first hour; subsequent rates of between 5 and 15ml/kg/hr are used depending on hydration status. The type of fluid used for initial rehydration is controversial. Some clinicians use 0.9% NaCl to avoid administering potassium. Other believe that 0.9% NaCl might worsen the strong ion difference and feel that Normasol R gives better clinical results. 2.5% Dextrose in 0.45% NaCl has also been recommended.

Severe hyperkalemia is truly life threatening, and requires additional treatment. Animals are often recumbent and semicomatose. Hyperkalemia decreases resting membrane potential towards the threshold potential. Cardiac arrhythmias are first apparent at potassium levels of 8 mmol/L when the P-R interval becomes prolonged. As the hyperkalemia becomes more severe, P waves are absent (atrial standstill), QRS complexes become progressively wider, and T waves become peaked. Calcium gluconate (a functional antagonist of potassium) should be administered slowly intravenously (0.5 ml/kg). Although it does not lower serum potassium, changes the threshold potential and returns membrane excitability to normal for approximately 20 to 30 minutes. Regular insulin (1 unit/kg) and glucose (1-2 grams/unit of insulin) can also be administered. Animals are often also severely acidotic. Sodium bicarbonate can be administered (3-9 mEq/kg) to correct acidosis; however, this can paradoxically lower ionized calcium and so worsen the effects of hyperkalemia.

**Urinary Diversion and Drainage**

The urinary tract obstruction or leakage should be addressed simultaneously. In cases of urethral obstruction, a urinary catheter should be passed into the bladder if possible. Stones or "plugs" can often be retropulsed by flushing saline through the catheter. In some cases, a catheter cannot be passed. The bladder is decompressed by careful cystocentesis, and catheterization is attempted again. Occasionally, tube cystostomy is required to drain the bladder whilst the animal is stabilized. The ventral abdomen is clipped and prepared for aseptic surgery. Using local anesthesia with minimal sedation, a mini-laparotomy is performed on the caudal ventral midline (or in the perirepueptlal area in male dogs). A Foley catheter is inserted into the abdominal cavity via a second small stab incision in the body wall, and int the bladder through a purse string suture. The balloon
of the Foley is inflated, the purse string suture tightened and the incisions closed. The catheter is connected to a sterile, closed urine collection system.

Urine can be drained from the peritoneal cavity in an emergency using a large gauge, fenestrated intravenous catheter or a peritoneal dialysis catheter. The caudal abdomen is prepared for aseptic surgery and local anesthetic is infused. A small stab incision is made caudal to the umbilicus with a scalpel and the catheter is introduced in a caudal direction. The peritoneal cavity is entered cautiously, the minimize damage to abdominal viscera. The catheter is advanced off the stilette, sutured in place, and connected to a sterile, closed urine collection system.

**Anesthesia**

Anesthesia should be induced and maintained with caution. The animal should be well hydrated and cardiac and output and blood pressure maintained to ensure adequate renal perfusion. Urine output should be measured intraoperatively where possible to monitor renal function. Agents such as methoxyflurane, phenothiazine tranquilizers, droperidol, barbiturates, and tiletamine/zolazepam should be avoided. Agents providing cardiovascular stability, including narcotics such as oxymorphone or etomidate, and inhalants such as isoflurane are recommended.

**Urogenital Trauma**

Renal trauma is uncommon because of the retroperitoneal location of the kidneys. Blunt trauma can cause injuries varying from subcapsular hemorrhage to renal rupture. Penetrating trauma can occur secondary to bites, missiles or penetrating foreign bodies. Diagnosis of isolated renal trauma is difficult. Sublumbar pain and gross or microscopic hematuria can occur but do not specify a diagnosis. Renal injury may be confirmed by leakage of contrast during excretory urography. Rapid administration of an iodinated contrast agent (880mg/kg) should be done with caution as profound bradycardia or cardiac arrest can occur. At surgery, lacerations of the parenchyma should be sutured. If one pole of the kidney is severely affected, partial nephrectomy is indicated.

Ureters are not injured commonly. Ureteral tears secondary to external trauma can be difficult to diagnose, especially if unilateral, because urine may leak into the retroperitoneal space rather than the peritoneal cavity. The urine is hyperosmolar, and draws water from the extracellular space, resulting in dehydration. Clinical signs are vague and may include dehydration, localized pain, vomiting and pyrexia. If both ureters are disrupted, signs of acute azotemia will develop. If the peritoneum is disrupted, uroperitoneum will develop. An increase in size or a change in density of the retroperitoneal space on abdominal radiographs increases suspicion for ureters damage. Excretory urography usually documents the presence of ureteral disruption.

Ureteral anastomosis is attempted when the ends of the ureter can be located and apposed without excessive tension. Magnification and microsurgical instruments aid accurate suture placement. The ureter is re-implanted into the bladder if the tear is distal. Using stay sutures, the ureter is pulled thorough a tunnel in the bladder wall, spatulated, and the edges apposed to the bladder mucosa with 5 or 6 sutures of 5/0 or 6/0 absorbable material in dogs and 7/0 or 8/0 material in cats. In cases where neither of these options are feasible, ureteronephrectomy can be considered if the remaining kidney and ureter are intact and functioning normally.
Urinary bladder trauma is commonly associated with automobile accidents or falls, penetrating wounds and forceful catheterization. Such presenting complaints should increase the clinician's index of suspicion for bladder or urethral disruption. Urine leaking into the peritoneal cavity will initiate a chemical peritonitis. Hyperosmolar urine will draw water from the extracellular space into the peritoneal cavity, resulting in dehydration. Electrolytes rapidly equilibrate across the peritoneal membrane, resulting in hyperkalemia and acidosis. Urea, a small molecule, rapidly equilibrates across the peritoneal membrane. Creatinine, a much larger molecule, diffuses more slowly. Therefore to diagnose uroperitoneum, abdominal fluid and serum creatinine levels are compared. The creatinine level in fluid from a uroperitoneum is usually much higher than that of the serum. A positive contrast cystogram will locate the urine leak. At laparotomy, the urinary tract is carefully examined and the damaged area of the bladder debrided and sutured using 3/0 or 4/0 polydioxanone (PDS) sutures in a single interrupted appositional pattern. The peritoneal cavity is copiously lavaged with warm balanced electrolyte solution before abdominal closure.

Urethral damage is also commonly associated with trauma. Many animals with pubic fractures sustain concurrent urethral injury. Bite wounds to the perineum, penetrating wounds of the pelvic and perineal areas, fractures of the os penis, and difficult urethral catheterization should also increase the index of suspicion for urethral injury. Obtaining urine from a urethral catheter does not exclude the possibility of urethral trauma. The catheter could pass directly through the urethral rupture into the peritoneal cavity where urine is collecting. Similarly, the presence of a bladder on abdominal radiographs does not necessarily indicate an intact urinary tract. The author has seen cases in which the urethra is avulsed from the bladder neck or prostate, and contraction of muscles at the bladder neck maintained a relatively full bladder. The diagnosis of urethral disruption is confirmed by retrograde urethrography. To accurately locate the tear, an catheter is inserted one or two inches into the distal urethra. Positive contrast material is injected slowly into the urethra under fluoroscopy. Leakage of contrast pinpoints the urethral tear.

Exploration of the abdomen and pelvic canal identifies the urethral disruption. Devitalized tissue surrounding the urethral ends is debrided. Lacerations of the urethra are debrided and sutured using 4/0 PDS. Ureteral obstruction is rare in dogs but occurs secondary to calculi and improper placement of ligatures during ovariohysterectomy. Studies have shown that if obstruction is relieved within 10 weeks, the dilated ureteral segment returns to normal; however, complete ureteral obstruction for 4 weeks results in a permanent 75 to 100% loss of kidney function. Renal damage is totally reversible if the obstruction is relieved within one week. The diagnosis is made from the history, plain and contrast radiographs, and possibly ultrasound. The remainder of the urinary tract is evaluated carefully for the presence of other calculi. At surgery, the calculus is located and removed via a longitudinal incision through the ureter wall. The calculus is saved for culture and analysis. The ureter is flushed proximally and distally, and the incision is closed using single
interrupted sutures of 5/0 PDS. If the obstruction is secondary to a ligature from an ovariohysterectomy, it is removed.

In cats ureteral obstruction secondary to calcium oxalate stones is becoming more frequent. The cause of the increased incidence of calcium oxalate stones is unclear. Animals present with clinical signs of vomiting, anorexia, and dehydration. Rehydration and management of azotemia, including potentially dialysis, may be required. Imaging, including plain radiographs, abdominal ultrasound, and pyelography may be necessary to determine the nature and location of the ureteral obstruction. Surgery on these cases requires magnification, ideally an operating microscope. Options for treatment include stone removal via ureterotomy, placing of ureteral stents, or bypass of the affected ureter using a Subcutaneous Ureteral Bypass (SUB) device. Ureteral surgery in cats requires magnification, either loupes or an operating microscope.

Urethral obstruction in male dogs and is a common urologic emergency. Obstruction is most commonly associated with calculi and gelatinous plugs, but neoplasia (particularly transitional cell carcinomas in female dogs), prostatic disease, urethral strictures, and entrapment of the bladder in a perineal hernia can all cause urethral obstruction. Animals present for stranguria, dysuria, pain, and progressive depression. Stabilization of these animals (as described above) is imperative. In male dogs, calculi lodge at the base of the os penis where the urethra narrows. Catheterization necessitates retropulsion of the calculi into the bladder. This is best performed with the dog sedated. An 8 to 10 F catheter is introduced into the penile urethra and advanced 1 to 2 inches only. The penis is held firmly around the catheter, and pulses of 5-20ml (depending on the size of the dog) of sterile saline are forcefully injected. The aim is to dilate the urethra around the stone with the saline flush, allowing it to pass retrograde into the bladder. Once the dog is stable, a cystotomy is performed to remove the stones.

In 10 to 30% of canine cases, the stone will remain lodged in the urethra, and a catheter cannot be passed. In these cases, a prescrotal urethrostomy enables calculus removal. A skin incision is made caudal to the os penis over the stone. A large gauge urinary catheter is passed into the urethra abutting the stone. The retractor penis muscle is carefully dissected from the penis and retracted laterally. The penis is stabilized and the urethra is incised on the midline through the corpus spongiosum penis, avoiding the paired corpora cavernosa. The calculus is removed, the urethra flushed, and a catheter passed into the bladder. The urethra is closed using single interrupted sutures of 4/0 absorbable material. If the dog is not stable for this surgery, a tube cystostomy is performed to drain urine from the bladder.

Dogs occasionally present with urethral obstruction secondary to bladder entrapment in a perineal hernia. The perineum is swollen and discolored, and the condition is often mistaken for neoplasia. The diagnosis is confirmed by perineal cystocentesis. This is both diagnostic and therapeutic, as bladder decompression often allows passage of a urethral catheter. One the animal is stable, the hernia is explored, and the bladder replaced in the abdominal cavity. An exploratory laparotomy is performed to further inspect the bladder if it appears compromised.

Male cats frequently present with urethral obstruction. Catheterization with a 3F open ended tom cat catheter often requires sedation. Flushing with sterile saline as the catheter is gently advanced often loosens the material obstructing the urethra. In some cases, catheterization is
facilitated by emptying the bladder by careful cystocentesis. If the obstruction cannot be removed, alternatives for treatment include either immediate perineal urethrostomy or temporary tube cystostomy. Although obstructed male cats are frequently diagnosed with a single condition referred to as "Feline Urologic Syndrome", there are a range of diseases which result in urethral obstruction. The urinary tract should therefore be carefully examined for abnormalities such as cystic calculi before proceeding with a surgical plan.

**Severe Infection**

Occasionally, emergency surgery may be necessary in animals with septicemia secondary to confirmed pyelonephritis. The diagnosis of pyelonephritis is based on the results of urinalysis, culture, and ultrasonography. Nephrectomy should be considered in severe cases which are not responding to appropriate antibiotic therapy. The remaining kidney must have sufficient function to compensate for loss of the infected kidney.

**Hemorrhage**

Severe hemorrhage from the kidney has been reported secondary to trauma and neoplasia. In addition, several animals with idiopathic renal hemorrhage have been described. In cases of neoplasia, surgery involves nephrectomy. In cases of idiopathic renal hemorrhage, all other causes of hematuria, including coagulopathies, should be ruled out before proceeding with exploratory surgery. A ventral cystotomy is performed and the ureteral openings are examined for any gross hemorrhage. If none is observed, each ureter is catheterized and a sample of urine collected and examined for microscopic hemorrhage. If only one kidney is involved, it is removed.

**Postoperative Care**

Fluid and electrolyte balance, urine output and renal function should be carefully monitored after relief of urinary obstruction or repair of urinary tract rupture. Post-obstruction diuresis can result in loss of water, sodium and potassium. Intravenous fluid volume and composition are adjusted to compensate for these losses.