SURGICAL EMERGENCIES OF THE URINARY TRACT

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Urinary Tract Trauma

Diagnosis

Urinary tract trauma should be considered when there are associated injuries to the caudal thoracic area, lumbar vertebrae or pelvis. Abdominal pain, shock, depression, hematuria, or anuria can result from the rupture of kidneys, ureters, bladder or urethra. Abdominal distension and uremia slowly develops as urine leaks into the peritoneal cavity or retroperitoneal space. With urinary tract trauma, plain abdominal films often reveal free abdominal fluid and large kidney shadows or homogenicity of the retroperitoneal space. An intravenous pyelogram (IVP) is necessary in most urinary trauma cases to properly evaluate the kidneys and ureters whereas a positive contrast urethra cystogram is preferred to diagnose ruptured urethras or bladders. Abdominocentesis or diagnostic peritoneal lavage is often beneficial in detecting free urine within the peritoneal cavity. Both serum and abdominal fluid urea and creatinine values should be run if a diagnosis of uroperitoneum is suspected. Creatinine is a much better indicator of uroperitoneum since the molecule is larger and does not equilibrate with the serum as rapidly as the urea molecule.

Initial Management

The presence of free urine in the abdomen does not necessarily mandate emergency laparotomy. In addition to having an elevated BUN and creatinine the patient also is usually hypovolemic, hypercalcemic, hyperphosphatemic, and suffers from severe metabolic acidosis. Most patients with uroperitoneum should be stabilized prior to surgery. Urine is very irritating to the peritoneal surface and the abdomen should be emptied to not only reduce uremic toxins but reduce the amount of protein loss from inflamed peritoneal membranes. This can be done by needle abdominocentesis or by placing a penrose tubes or dialysis catheter using a local anesthetic and stab incision. The abdomen then can be lavaged with either isotonic crystalloid solution or preferably peritoneal dialysis solution if available. At least 50 ml/kg of the solution should be used and allowed to remain in the abdomen for a period of 30 minutes before being removed by gravity flow. The process can be repeated several hours later. The purpose of drainage and lavage is to remove and dilute urea, creatinine, potassium and phosphorus and thereby help correct the serum levels of these respective indices. The patient is concurrently treated with intravenous crystalloids, preferably lactated Ringer’s solution with bicarbonate added as needed to help correct acid base irregularities. After several lavages and intravenous volume expansion the patient is often a much better surgical candidate five to six hours after original presentation to the clinic.
Kidney

The kidney is susceptible to contusion, hemorrhage or avulsion from its vasculature. When this occurs renal hemorrhage usually fills the retroperitoneal space with blood. Rupture of the renal pelvis may cause urine pooling within the retroperitoneal space. If retroperitoneal fluid is seen on plain abdominal radiographs an IVP should be performed to try to demonstrate urine leakage. With renal contusion and hemorrhage pressure within the retroperitoneal space may arrest hemorrhage and laparotomy is not always required. Therefore, if urine leakage is not seen on the IVP and the patient is stable, a conservative approach may be taken. However, if urine leakage is seen on the IVP, surgery is ultimately necessary. If bleeding continues from renal contusion and the circulatory status deteriorates even with shock treatment surgery is probably indicated. With severe parenchymal damage to the kidney a partial and/or total nephrectomy is often necessary.

Partial nephrectomies in severely contused and focally injured kidneys are done by reflection of the renal capsule excision of the damaged parenchymal and stick ligatures of the parenchymal vessels. The renal pelvis must be closed using 3- or 4-0 synthetic absorbable suture material and the renal capsule is closed with a continuous 3- or 4-0 monofilament synthetic suture. With capsular tears, exposed parenchyma may be covered with adjacent abdominal musculature, synthetic hemostatic compounds or by using serosal patch techniques. When the IVP indicates a nonfunctioning kidney due to vessel avulsion or severe parenchyma damage and the opposite kidney retains function then a complete nephrectomy is usually indicated. Total nephrectomy is performed by ligating the multiple renal arteries, the renal vein and ureter individually or by quickly applying the TA-30 autostapler using the 2.8 mm vascular cartridge. Renal function should be closely monitored postoperatively with diuretics such as mannitol, or furosemide required if urine production is not adequate.

Ureter

With ureteral damage leakage of urine occurs into the retroperitoneal space. Ureters are often avulsed from the renal pelvis or the neck of the bladder. Renal pelvis avulsions are often difficult to suture although sometimes injuries can be stented by introducing a catheter through the abdominal wall through the renal parenchyma and into the proximal ureter. The tear is then sutured as best possible and the in-dwelling catheter is kept in place for ten days postoperatively. With ureteral tears at the neck of the bladder reimplantation is sometimes possible. The traumatized section of ureter is excised and slightly tunneled through the bladder neck at the trigone. The ureteral orifice is incised longitudinally and sutured to adjacent bladder mucosa using 5- or 6-0 absorbable suture material. Midsection tears of the ureter are more difficult to repair and may require microsurgical expertise. The transected ends are freshened obliquely and anastomosed over a 3.5 French feeding tube using 60 absorbable suture material. The feeding tube is then passed out the urethra and pulled ten days postoperatively. Recently especially in cats ureteral calculi which can’t be easily removed can be managed using in interventional radiology and using ureteral stents deployed through the use of guide wires. These stents can be left in indefinitely if need but alos can be removed if they irritate the bladder or create persistent infection.

Bladder

Bladder tears are commonly seen and are often associated with pelvic fractures. Tears can occur in any area but are most commonly seen on the dorsal surface near the trigonal area. Wound edges should be debrided prior to closure. When repairing tears in the trigonal area it is best first catheterize the ureters to make sure they are not encircled with sutures. Although a double layer inverting pattern has been suggested for bladder closure we find that a single layer of 30-40 simple interrupted approximating sutures works well for repair of most bladder tears and does not reduce lumen capacity as much as the inverting pattern.
Urethra

Urethral lacerations are usually traumatic, being due to car accidents and pelvic fractures but are occasionally iatrogenic due to catheterization. Urethral tears are more common in males than females in both dogs and cats. Diagnosis of urethral tears is made by positive contrast study. Most small tears can be effectively repaired via the use of urethral catheters which serve as a stent. Longitudinal tears may often heal within a one week period. However, transverse tears with urethral defects treated by stenting may require three to four weeks to heal properly and secondary strictures are common. When treating a urethral tear by stenting it is often wise to insert an antipubic cystostomy catheter as well. This will allow the majority of the urine to be diverted directly from the lumen of the bladder and thereby minimize the amount of urine flowing past the urethral defect. Two commercial catheters can be used for prepubic cystostomy tubes, the Foley catheter and the Stamey catheter.

Complete transection of the intrapelvic or prosthetic urethra is often seen iatrogenically during cryptorchid castrations or may be secondary to pelvic trauma. With complete transection of the urethra it is usually best to explore the area and suture the defect primarily. The wound is debrided and reapposed with simple interrupted of 4-0 absorbable suture. Following the reanastomosis a urinary catheter is placed for five to seven days to serve as a stent. If prostatic or pelvic urethra damage are irreparable, antipubic urethrostomy may be performed as a salvage procedure. Strictures of stented or sutured urethral lacerations are common sequelae. Management of these strictures involves either balloon dilation using cystoscopic equipment or resection and reanastomosis of the involved area.

Urethral Obstruction

Incidence/Clinical Signs

Obstruction of the urethra by calculi is the most common surgical emergency involving the urinary tract in the dog and cat. Males become obstructed more than females because of the anatomic reduction in the penile urethral diameter. In the dog, male to female ratio is greatly dependent on the calculus type. Phosphate (struvite) calculi are usually seen in conjunction with a cystitis caused by urease-producing bacteria. Adult females are affected more than males, although in immature (less than 1 year old) animals there is a higher incidence of calculi in the male. Urate and oxalate calculi are predominantly seen in the male, with silicate and cystine calculi being reported almost exclusively in male dog.

In the cat, the feline urologic syndrome (FUS) may be caused by urethral plugs seen exclusively in males or uroliths seen in the males and females. Urethral plugs contain varying quantities of proteinaceous material, cellular debris, and magnesium ammonium phosphate (struvite) crystals and are usually not associated with bacterial cystitis. Conversely, uroliths are organized, crystalline aggregates that are usually composed of struvite and are radiodense. Urease-producing bacteria are present in some of these cases.

The dog with cystic calculi or the cat with unobstructed FUS usually demonstrates signs consistent with cystitis. Pollakiuria, stranguria, and hematuria are seen. In the male dog, the calculi often pass along the urethra and lodge at the caudal aspect of the os penis. Single or multiple calculi may lodge at this site, and signs will vary from those indicating partial obstruction (dysuria) to that of complete urethral obstruction. When complete urethral obstruction is present, rapid progression to postrenal azotemia, emesis, dehydration, metabolic acidosis, hyperkalemia, and hypothermia occurs.
Diagnosis

Diagnosis of complete urethral obstruction is based on clinical signs and palpation of a greatly distended, turgid bladder. Attempts at expressing urine are usually unrewarding, but occasionally a few drops of bloody urine will dribble from the penile urethra. Plain film radiography may indicate the presence of radiopaque cystic or urethral calculi. Contrast retrograde urethrography is often helpful in diagnosing radiolucent urethral calculi in the dog. The penile urethra is best viewed with the legs pulled caudally; the perineal urethra is seen best with legs pulled rostrally. In the cat, the obstruction is commonly located in the penile urethra near its tip. The tip of the penis is hyperemic, and often the calculi or urethral plug can be palpated by gently rolling the penis between the thumb and index finger.

Treatment

Initial management of the patient depends on the acid-base, electrolyte, and hydration status as well as the degree of uremia. Acidemia may be treated using alkalinizing electrolyte solutions such as Multisol (Abbott Laboratories, North Chicago, IL) which contains 53 mEq/L NaHCO₃. The volume of fluid administered is based on the severity of dehydration. Dehydration is corrected as rapidly as possible to reestablish renal blood flow. A five percent dehydration is mild, 8 percent is moderate, and 12 percent is severe. Fluid deficit replacement is administered over 1-2 hours and should not exceed 50-60 ml/kg/hr in the cat, or pulmonary edema may develop. Although hyperkalemia can be treated with intra-venous infusions of dextrose and/or insulin, increased survivability with this technique has not been documented. A more reliable and safer method of treating the hyperkalemia is to restore circulatory volume and increase renal perfusion, which, in turn, increases renal excretion of potassium. In addition, correction of acidemia causes increased cellular uptake of potassium which aids in the reduction of the serum hyperkalemia.

Relief of obstruction in the cat is usually accomplished by retrograde flushing of the penile urethra to remove the urethral plug or calculus. Open-ended polyethylene catheters (Open End Tom Cat Catheter, Sovereign Labs, St. Louis, MO) or blunt lacrimal cannulas may be used for this purpose. The obstruction can often be relieved without sedation, using lidocaine gel in the moribund animal, or with a low dose of ketamine (2-4 mg/kg IV) in other cases. If a good stream of urine is noted with adequate bladder detrusor function, the urethra is not left catheterized. Indwelling catheterization is performed if the urethral stream is poor, if urethral trauma is severe, if bladder atony is present, or if renal failure is suspected and urine output must be monitored. Indwelling catheters will increase gross hematuria, due to bladder wall trauma, urethritis, and an increased tendency for postoperative cystitis. If the urethral plug cannot be removed, cystocentesis is performed, followed by a repeated attempt at catheterization. If this is unsuccessful, an emergency perineal urethrostomy may be required. Another alternative may be the placement of a percutaneous, suprapubic, Stamey urinary drainage catheter (Stamey Suprapubic Catheter, 10 French, Cook Urological, Spencer, IN). The animal may then be stabilized and a perineal urethrostomy performed on an elective basis. The catheter is a 10 French, polyethylene catheter with 4 wings at the tip and an 18-gauge stylet. It is introduced into the bladder lumen percutaneously after aseptic preparation. When the stylet is removed, the wings of the catheter extend outward, forming a circular configuration at its tip and preventing migration out of the bladder lumen. The catheter is then secured to the skin with a piece of adhesive tape and 3-0 nylon. Removal involves reinsertion of the stylet, which straightens the wings and facilitates catheter removal.

Relief of urethral obstruction in the dog can usually be accomplished nonsurgically under deep sedation or general anesthesia. With 1-3 urethral calculi and no cystic calculi, normograde urohydropropulsion is initially attempted. An 8-12 French rubber or foley catheter is lubricated and inserted 2-3 cm into the urethra. The urethra is dilated by injecting saline under pressure while digitally occluding the external urethral orifice around the catheter and
having an assistant simultaneously compressing the pelvic urethra via rectal palpation. When the assistant feels that the urethra has dilated to twice normal size, the penile urethral catheter is quickly withdrawn while maintaining pelvic urethral pressure. Small calculi may then move past the os penis and out of the urethra, relieving the obstruction. If this method fails, or, if multiple urethral and cystic calculi are present, the calculi can sometimes be flushed back into the bladder with retrograde saline flushes. Occasionally, retrograde urohydropropulsion is needed to relieve the obstruction. With retrograde urohydropropulsion, the urethra is distended as previously described, but the assistant rapidly removes pressure from the pelvic urethra, allowing retrograde movement of saline and calculi into the bladder. The procedure is repeated until the urethra is clear of all calculi. An indwelling catheter may then be retained, allowing patient stabilization and cystotomy on an elective basis. If urohydropropulsion is not successful at dislodging urethral calculi, emergency cystocentesis may be performed, followed by a urethrotomy to remove the calculi or a permanent urethrostomy proximal to the obstruction.

Surgery

Indications for urethrostomies are: (1) calculi that cannot be removed nonsurgically, (2) strictures caused by previous surgery or chronic calculi lodgement, and (3) prevention of obstruction in dogs with rapidly recurring urolithiasis. In the dog, urethrostomies are performed in the perineal, prepubic, or scrotal locations. The perineal location is not recommended in the dog because of postoperative scrotal urine burns and propensity for hemorrhage and stricture formation. However, perineal urethrostomy may be necessary when obstruction or stricture is located at the ischial arch. The prepubic urethrostomy is made immediately caudal to the os penis. The advantage of the procedure is that the scrotum and testicles are salvaged. The disadvantages are: (1) the urethra is surrounded by cavernous tissue and bleeding is often considerable, and (2) the urethra is somewhat narrow, and stricture is more likely. Scrotal urethrostomy is the preferred technique by most surgeons because: (1) the urethra is more superficial at this location and contains less cavernous tissue; (2) the urethra is wide so that stones are passed with greater ease; and (3) ventral drainage of urine is good, and skin scalds are rare. The disadvantages of scrotal urethrostomy are that castration and scrotal ablation must be performed.

If cystic calculi are still present after the relief of obstruction, a cystotomy is performed. If the animal is not uremic, the urethrostomy and cystotomy are performed at the same time. If the animal is uremic, urethrostomy is performed to relieve obstruction, and cystotomy is performed at a later date. A specimen for culture and sensitivity is taken from a piece of the bladder mucosa or the interior of the calculus. Some stones should be submitted for crystallography. Multiple passages of the urethral catheter along with saline flushes are necessary to assure removal of all calculi. Closure is performed with a continuous Cushing pattern of 3-0 polyglactin 910.

Postoperative Care/Complications

Fluid therapy is continued postoperatively until azotemia, hyperkalemia, and postoperative diuresis have resolved. Hyperkalemia usually abates within 24 hours, but postoperative obstructive hypokalemia may result and may require supplementation of 20 mEq KCl to each liter of balanced electrolyte solution. Azotemia often falls to within normal limits within 72 hours.

Bladder atony may result from bladder detrusor muscle dysfunction. An indwelling urethral catheter may be required to keep the bladder emptied for several days and to allow tight junctions of the detrusor muscle to reform. Oral bethanechol (2.5 mg TID) can also be used to facilitate bladder emptying. Patency of the urethra must be insured when using this drug, because if residual obstruction is present, rupture of the bladder may occur. Treatment of a
concurrent bacterial cystitis is done with appropriate antibiotics as determined by culture and sensitivity. Postoperative dietary management, urine acidification or alkalization, antimetabolite therapy, and antimicrobial management are critical to reducing the recurrence of specific types of canine and feline uroliths. The recent development of prescription medical dietary regimens effecting dissolution of canine struvite uroliths has also been described. Dietary management of aseptic struvite uroliths has been successfully in many instances with dissolution of the stones occurring in 8 to 20 weeks.