URETERAL SURGERY – TO STENT OR TO CUT?
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Key points

- Ureteral obstruction secondary to urolithiasis is the most common indication for ureteral surgery in dogs and cats.
- The number of ureteroliths, the integrity of the ureteral wall, infection, and the presence or absence of concurrent nephrolithiasis, will often dictate the treatment that is performed.
- Prospective studies comparing traditional surgery to the novel technique of stenting with regards to complications and long term outcome are necessary in guiding treatment recommendations.

Ureteral surgery in both dogs and cats can be challenging, even for the most experienced surgeon. Meticulous surgical technique in conjunction with appropriate magnification is essential in preventing both short and long term complications. The most common indication for ureteral surgery in our veterinary patients is ureteral obstruction secondary to urolithiasis. Although the majority of these cases are treated with traditional surgical techniques, with the recent introduction of ureteral stents for veterinary patients, many surgeons question the best approach for patients with ureteral obstructions. Presentation of a patient can vary with regards to the number of ureteroliths, the presence or absence of concurrent nephrolithiasis, infection, whether the disease is unilateral or bilateral, the degree of obstruction present, and any underlying kidney dysfunction. Limited information currently exists in the veterinary literature regarding complications and long term outcome in patients following ureteral stenting and there are currently no evidence based studies in the veterinary literature that compare traditional surgery to this novel technique. Cases of trauma, fibrosis, congenital stenosis, stricture, neoplasia and dried solidified blood calculi have also been associated with ureteral obstruction in our veterinary patients and generate similar discussion with regards to the best approach for treatment.

Urolithiasis in dogs and cats

Calcium oxalate (CaOx) containing uroliths are the predominant stone type identified in the ureter of both dogs and cats. A dramatic increase in the prevalence of CaOx uroliths in cats from 1994 until 2004 was thought to be the result of dietary modification used to promote urine acidification and minimize magnesium ammonium phosphate urolith formation. Unfortunately, medical dissolution of CaOx uroliths is not possible. Therefore, surgical removal or bypass via placement of a ureteral stent is often recommended if the stones are causing clinical disease. If intervention is necessary, it is not always clear how long one should wait to address ureteral uroliths. Patients are often treated initially with a period of medical management, including the parenteral administration of fluids alone or in combination with diuretic therapy (mannitol) to determine if passage of ureteral calculi will occur. Additional therapies with anecdotal efficacy include the administration of various smooth muscle relaxants including prazosin, the tricyclic antidepressant amitryptilline and other alpha antagonists such as tamsulosin. Because of the high incidence of urinary tract infections in dogs presenting for ureteral obstructions (>75%), broad spectrum antimicrobial therapy is indicated. In the author’s experience, if medical management does not appear to be effective within 24-48 hours and a partial or complete ureteral obstruction
is present, or the ureterolith is associated with an infection that doesn’t respond to medical therapy, surgical intervention is recommended.

At the University of Pennsylvania, clinical presentation, as well as results of imaging studies, help guide the clinician on the best approach for a given patient. Cats with uroliths affecting the ureter can present asymptomatic or with non-specific clinical signs including lethargy, weight loss, anorexia, vomiting, fever, polydipsia, and polyuria. Other signs of uremia including oral ulcerations may be observed. Hematuria may or may not be present. Patients may also present with abdominal pain and splinting or renomegaly. Dogs more commonly present with signs of dysuria including stranguria, hematuria, polyuria, pollakiuria, incontinence, and signs of systemic illness often associated with a pyelonephritis. A complete physical examination, urinalysis/culture, complete blood count and biochemical profile are performed, as many affected patients are older and may have concurrent disease(s). Imaging including survey radiography and ultrasonography are performed on all patients at the time of presentation. Plain abdominal radiography can be helpful with surgical planning by providing information on the number and location of radiopaque renal and/or ureteral calculi. It is important to note that ureteroliths, radiolucent ureteroliths or those overlying colonic contents are occasionally missed. Ultrasonography is often performed in conjunction with plain radiography and provides information regarding the degree of hydronephrosis and or hydroureter secondary to urolithiasis, assessment of the renal parenchyma, and for any evidence of peri-renal inflammation or effusion. In one feline report, a combination of survey radiography and abdominal ultrasonography revealed ureteroliths in 90% of patients. Other techniques that may be employed to help identify small ureteroliths as well as delineate the level of the obstruction include intravenous urography, antegrade pyelography, computed tomography angiography, and magnetic resonance imaging. It is important to note that ureteral dilation identified using one of these modalities, does not always extend to the level of the obstruction. Additionally, in patients with subacute obstructions, pelvic and ureteral dilation may not have yet developed.

Urolithiasis in humans

In human medicine, although open surgery can be performed, it is usually reserved for the difficult and complicated cases. More commonly, a minimally invasive procedure is recommended that may include extracorporeal shock wave lithotripsy, ureteroscopy in conjunction with laser lithotripsy, percutaneous nephrolithotomy, or a combination of techniques. In human patients with stone disease, stents are placed in conjunction with ureteroscopy and laser lithotripsy to maintain drainage of the kidney until ureteral swelling resolves. These stents are typically removed within a few days following the procedure. If small stone fragments remain, the stent may be left in place to allow small fragments to clear by themselves over time. If the ureter is too small to accommodate a ureteroscope, a stent can be left in place to allow the ureter to “dilate” around the stent so that the stones can be removed 2-3 weeks following the initial procedure. If a stent needs to be left in place in a patient with stone disease, it should be exchanged every few months to prevent the development of long term complications.

Equipment

Regardless of technique chosen, an important consideration for the surgeon is the availability of equipment as well as long term equipment costs. Ureteral surgery in cats and small dogs generally requires substantial magnification. The author recommends 8 to 10 times
magnification provided by an operating microscope. In larger dogs, surgical loupes providing 2.5x-4.5x magnification may be adequate. In order to perform a ureteral stent procedure, additional equipment is necessary including an array of dimensions of hydrophilic guidewires, double pigtail multifenestrated stents, ureteral dilators, and a traditional or mobile fluoroscopic C-arm. If the stent can be placed minimally invasively, which is not possible in male cats at this time, a rigid endoscope (diameters range from 1.9 to 7.5mm) or flexible ureteroscope (7-8 mm) is also be necessary. Extracorporeal shock wave lithotripsy has been successfully used in dogs for the treatment of ureterolithiasis in conjunction with ureteral stenting. The cost of equipment to perform extracorporeal shock wave lithotripsy or to bring in an outside company to perform the technique should also be considered. Unfortunately, because of the high number of shock waves that may be necessary in cats in order to fragment a nephrolith or ureterolith, the possibility of significant renal injury precludes the use of this technique in cats.

Surgical and interventional management

At the University of Pennsylvania a decision to perform a traditional surgical procedure or stent is made based on clinical presentation, imaging studies as well as findings at the time of surgery. In some cases, a combination of both techniques may be warranted. Because an open procedure is currently performed on almost all cats and some dogs that receive a ureteral stent, the benefit in humans of being able to perform the technique minimally invasively, is no longer seen as an advantage to the use of this technique for many of our patients.

In some patients, a nephrostomy tube is recommended prior to performing a more definitive procedure in order to stabilize the patient as well as make a determination regarding renal function. Percutaneous placement is recommended in dogs, however because of the mobility of the feline kidney and subsequent risk of leakage, surgical placement is recommended for cats.

One or 2 stones present in the proximal ureter are often removed by a ureterotomy or a pyelotomy. Uroliths may be visible on inspection of the ureter or palpable along its length. Once the location of the stones are identified, the affected segment of ureter is isolated using silastic material proximally and distally. In addition to decreasing urine flow into the surgical field, this preparation prevents spontaneous retrograde movement of ureteroliths. Care is taken when manipulating the ureter so as not to disrupt the blood supply or inadvertently traumatize the ureter. A longitudinal incision is made in the dilated ureter just proximal to the obstruction. Occasionally, depending on the location of the stones, removal from the same ureterotomy incision may be possible. In some cases, because the stone is embedded within the ureteral wall, the incision is made directly over the stone. If ureteral integrity is questioned following removal, a ureteral stent can be placed temporarily to divert urine during the healing process. The author also recommends stent placement in patients following a ureterotomy when the obstructive stone has been associated with a nephropyosis. In addition to diverting urine, the stent allows for continued drainage of purulent material. If a stent is placed in conjunction with a ureterotomy, the ureterotomy incision is closed after the stent is in place.

Uroliths lodged in the mid to distal ureter may be removed by ureterotomy or the affected area of the ureter may be removed in toto and a ureteroneocystostomy performed. Both intravesicular and extravesicular techniques have been described and used successfully in these cases to appose ureteral mucosa to bladder mucosa. Although the literature recommends a ureterotomy for stones lodged in the proximal third of the ureter, it is important to note that a ureteroneocystostomy can be performed when only the proximal third of the ureter is available.
for anastomosis. If tension on the ureteroneocystostomy is expected, renal descensus as well as a
cystopectomy to the abdominal wall and/or cystonephropexy can be performed. With this technique,
the kidney is mobilized from its retroperitoneal attachments and moved caudally. The renal
capsule is then sutured to an incision made in the adjacent body wall using 4-6 interrupted
sutures of 4-0 polypropelene. The bladder can be fixed cranially to the body wall or to the tendon
of the psoas muscle. The nephrocystopexy is performed using 3-0 to 4-0 absorbable or
nonabsorbable sutures.

The author has used ureteral stenting for patients with multiple ureteroliths located
unilaterally or bilaterally with or without the presence of nephroliths. Nephroliths do have the
potential to pass into a ureter that was recently unobstructed, but the exact occurrence of this
complication is unknown. In a report evaluating the management and outcome of 153 cats with
ureteral calculi\(^1\), 14 of 35 cats (40\%) with preexisting nephrolithiasis, developed recurrence a
median of 12.5 mo following ureterolithotomy suggesting migration of calculi following the
relief of the obstruction. Because the majority of stent cases are performed with an open surgical
procedure, knowing the incidence of re-obstruction in cases with nephroliths and only a few
ureteroliths would be important when making a decision regarding the appropriate treatment
option. Patients that have had a ureterotomy performed should be evaluated periodically
following surgery for this complication. Because a ureteroneocystotomy can be performed with
only a very short proximal segment of ureter, this technique is an option for patients with
multiple ureteroliths.

Complications

The most common complications associated with ureterotomy are leakage and stricture
formation. In a large multicenter study evaluating 153 cases\(^1\), the prevalence of complications
in cats following surgical removal of ureteral calculi was 31\% with the most common
complication being urine leakage (16\%) followed by persistence of ureteral obstruction (6\%). In
a second study evaluating postoperative mortality in 47 cats after ureterolithotomy, 3 patients
(6\%) developed a uroabdomen following the procedure.\(^2\)

In an abstract presented in 2008 on ureteral stenting in cats\(^3\), few procedural and peri-
operative complications were identified. Short term complications (<1 mo) included dysuria
which was self-limiting and long term complications (>1 mo) included UTI (20\%), pollakiuria
(17\%), hematuria (10\%), tissue ingrowth (7\%), stent migration (5\%), ureteritis (3\%) and reflux
(1\%). In a review of cases performed at the University of Pennsylvania, procedural
complications included ureteral injury and perforation secondary to guidewire and stent
placement and the development of a uroabdomen. Short and long term complications, including
the development of UTI, dysuria and stent encrustation, have been associated with significant
morbidity and have occasionally resulted in the need for a second procedure.

Interestingly, between 20 and 90\% of human patient have been reported to develop some
type of side-effect associated with their ureteral stent and these complications can be associated
with considerable morbidity. For this reason, stents are not intended for long term use in human
patients. For some, signs are present for a few days, while others find their symptoms persist
throughout their entire stent duration. Bladder irritation from the stent resulting in a feeling of
urgency to urinate (80-90\%) is the most common complication in humans and can be so
intolerable as to require early stent removal. Stent pain occurs in ~50\% of patients and can result
from reflux of urine into the kidney causing symptoms ranging from a warm, tingling sensation
to intense pain in the flank region. Other complications include ureteral injury during stent
placement, hematuria, incontinence, infection, stent migration, fragmentation, and encrustation. Bacteruria is frequent and occurs because the bacteria can attach to the stent surface and become protected by a layer of biofilm. These infections may temporarily be cleared with a course of antibiotics, but usually recur 2-3 weeks following antibiotic therapy. Stent migration, fragmentation and encrustation are more serious complications and can result in renal impairment and repeated procedures for removal. In a study of 41 human patients, 75.5% had become encrusted within 6 months and 42.8% within 4 months of placement necessitating removal.

In dogs and cats with ureteral calculi, recommendations for treatment are dictated by the number and location of stones, intraoperative findings, and the stability of the patient. Both traditional surgery and ureteral stenting have been used alone and in combination to successfully treat these patients. Ureteral stenting is a novel technique commonly performed in human medicine to treat stone disease. Because a significant number of human patients develop some type of side-effect with long term use, critical long term assessment and client preparedness for a second intervention is necessary in these patients to decrease morbidity associated with the technique.