URETERAL SURGERY: TIPS FOR THE TOYLESS
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The most important tenet of ureteral surgery is “Do No Harm.” While debatable amongst clinicians, many veterinarians agree that some ureteral conditions (such as ureteral calculi) may not be improved by open surgical treatment unless the condition is causing morbidity (e.g., obstruction). Additionally, newer modalities (e.g., ureteral stents, laser ablation of ectopic ureters) provide great success with less morbidity and therefore shorter hospitalization times and, ultimately, lower costs. It often pays for the owner to travel to a facility that offers these modalities rather than risk a procedure with greater complication rates and the same or lower success rates. Nevertheless, surgeons must at times tackle these conditions. The following techniques can be performed without the assistance of expensive tools.

Pyelolithotomy for proximal ureteral calculi:

Because damage to renal function is less likely, pyelolithotomy is preferred over nephrotomy for removal of calculi of the renal pelvis and proximal ureter, particularly when the renal pelvis is dilated. With this technique, renal parenchyma is left intact, reducing the risk of intraparenchymal hematoma formation, and intraoperative occlusion of the renal arteries is not required. Pyelolithotomy is difficult to perform when the renal pelvis is normal in size. Leakage of urine from the incision site may occur if ureteral obstruction is present. Damage to renal vessels during dissection could further exacerbate renal dysfunction.

Ureterotomy:

Ureterotomy is a technically demanding procedure that usually requires advanced training, specialized instruments, and magnification. It is most frequently recommended for removal of calculi within the proximal third of the ureter, particularly when they are adhered to mucosa. Occasionally, the ureter proximal to the calculus is dilated to the extent that ureterotomy can be performed in a dilated portion of the ureter with the use of surgical loupes or magnifying glasses rather than an operating microscope. Potential complications include leakage, dehiscence, stricture, continued or progressive renal dysfunction, and recurrence of calculi. In cats with ureteral calculi treated via ureterotomy or ureteroneocystostomy (performed by an experienced clinician), surgical complications were reported in 31% and perioperative mortality rate was 18%. Uroperitoneum was reported in 16% of cats after ureterotomy; most of these cats required a second surgery to revise the ureterotomy closure. Persistent obstruction was noted in 3% of cats.

Ureteroneocystostomy:

Transection of the ureter with reimplantation into the bladder is called ureteroneocystostomy. Indications for ureteroneocystostomy include renal transplantation; reconstruction of ectopic, ruptured, avulsed, strictured, or inadvertently ligated ureters; removal of ureteral calculi; or resection of distal ureteral tumors. Because the kidneys can be easily mobilized in many animals, ureteral reimplantation can be successfully performed when 3 to 4 cm of the proximal ureter remain. Animals with extensive ureteral resection will require renal descensus and some sort of pexy (nephropsoas hitch, vesicopsoas hitch, nephrocystopexy) to reduce anastomotic tension.
Surgical prep and draping for ureteral transplantation in animals with ectopic ureters should extend caudal the pubis and include the perivulvar tissues in female dogs. During surgery, catheters passed antegrade through the ectopic distal ureteral segment may inadvertently exit from the vulva; therefore, there should be a sterile field for their exit.

Ureteroneocystostomy is most commonly performed using an intravesicular approach, except in cats undergoing renal transplantation. In normal cats, creatinine concentrations and renal pelvis diameter tended to return to normal more quickly after undergoing interrupted extravesicular anastomosis. In dogs with ectopic ureters, extravesicular reimplantation resulted in more complications than intravesicular anastomosis. Use of a simple continuous pattern for extravesicular anastomosis increases postoperative mortality. Ureters can be reimplanted at any location proximal to the trigone; short ureters are usually transplanted at the apex of the bladder to reduce anastomotic tension.

Some authors recommend formation of a short oblique submucosal tunnel (3:1 tunnel length to ureteral orifice diameter) during intravesicular ureteral implantation. In normal dogs, formation of a short oblique submucosal tunnel results in less fibrosis and ureteral dilation than a transverse pull through technique; however, vesicoureteral reflux is not seen in normal dogs with tunneled or transverse pull-through techniques.

If ectopic ureters or ureteroceles are present, the distal anomalous segment of the ureter must also be removed, opened, or ligated to reduce postoperative incontinence. Extramural ectopic ureters are ligated and transected as close to their termination as possible. The distal segment of an intramural ectopic ureter can be ligated from an extraluminal approach or dissected free via an intravesicular approach after retrograde catheterization. Exposure of the distal opening will likely require incision of the trigone and urethra; intraluminal tissues should be handled cautiously (no gauze or suction) to prevent local swelling and trauma, which can interfere with ostium identification and local dissection. Additionally, care must be taken to appose the urethral and trigonal incision without obstructing the lumen. Resection of the intramural ectopic ureteral segment does not significantly improve outcome as compared with ligation of the ectopic remnant.

Complications of ureteroneocystostomy include hydroureter or hydronephrosis from temporary or permanent obstruction and uroabdomen from dehiscence or necrosis. Renal pelvic dilation, based on ultrasonography, is expected after ureteroneocystostomy because of postoperative swelling. In experimental dogs diagnosed with iatrogenic partial obstruction after ureteroneocystostomy, renal function gradually recovered in 1-2 weeks. Hydroureter and hydronephrosis may occur with complete or partial obstruction of the ureter secondary to swelling, blood clots, or stricture formation. Hydroureter from edema or tissue trauma usually resolves in 4-6 weeks. If ureters are dilated before surgery, hydroureter will most likely be permanent. Of cats undergoing ureteroneocystostomy for ureteral calculi, 11% had persistent obstruction that required surgical revision and 15% developed uroabdomen because of distal ureteral necrosis or avulsion from the bladder. In dogs with extravesicular reimplantation and anastomosis of the ectopic ureter, 8% required nephroureterectomy because of persistent hydronephrosis. In dogs with ectopic ureters, urinary incontinence persists in 44% to 67%. In cats with ectopic ureters, 92% are continent after ureteral transplantation and ligation of the distal ureteral segment.
Neoureterostomy:

Intramural ectopic ureters, which are the most common type of ectopic ureter, insert externally on the bladder at the normal site but continue to travel as submucosal tunnels or mucosal troughs through the trigonal region and into the urethra. Submucosal ectopic segments may open at one or more sites along the urethra distal to the trigone or at the vestibuule or vagina. As noted above, the distal openings of intramural ectopic ureters that open into the trigone or urethra can be approached through a caudal cystotomy that is extended through the trigone or even into the urethra. In animals with intramural ectopic ureters, a new ureteral opening (“neoureterostomy” or “neoureterocystostomy”) can be made by incising through the bladder mucosa into the ureter and apposing the mucosa of the two structures. It is unknown whether mucosal closure is necessary with surgical incision into the ectopic segment, since none is needed with transurethral endoscopic laser ablation. Some authors recommend removal of any distal ectopic segments or troughs to improve urethral sphincter function; others prefer ligation of the distal ectopic segment, since there is no difference in outcome. With the advent of cystoscopic assisted laser ablation of distal intramural segments, surgical approach to this condition is becoming less common.

The most common complication of ectopic ureter repair is continued incontinence. In one study of dogs with ectopic ureters, 71% of dogs that underwent distal ureteral segment resection and bladder neck reconstruction and 50% that underwent distal segment ligation continued to have urinary incontinence. Recurrent urinary tract infections were reported in 15% and 29% of the resection and ligation groups, respectively. Causes of continued incontinence include sphincter mechanism incompetence, hypoplastic bladder, or recanalization of the ligated distal ureteral segment. Culposuspension performed at the time of ectopic ureter repair may improve continence. Hydronephrosis and hydrourereter may develop temporarily because of postoperative edema and inflammation. Stranguria is common after bladder neck reconstruction, and 14% of dogs will develop dysuria. Some animals may require temporary urethral catheterization until postoperative swelling resolves. Stricture formation is rare but may occur several weeks to months after surgery.

Baori bladder flap:

When ureteral length is extremely short because of trauma or extensive resection, the ureter can be reconstructed by formation of a full thickness tube using a pedicle flap from the bladder. The flap can be developed from a vascular portion of the dorsolateral or ventral bladder wall and will provide several centimeters of additional length. Renal descensus should be performed prior to flap development to determine the length of flap required to reach the proximal ureteral segment. Width of the flap should be based on bladder size but should be a minimum of 1.6 cm (and even wider for thick bladders) to provide a tube 5-6 mm in diameter. The ureter can be inserted through the wall of the flap and sutured in place before the flap is closed into a tubular shape. A red rubber tube of appropriate size can be placed along the flap to serve as a temporary stent while the flap is sutured over it into a tube shape with a continuous pattern. Nephrocystopexy or nephropexy and vesicopectos hitch are performed before or after ureteroneocystostomy to reduce anastomotic tension. Vesicoureteral reflux may predispose the animal to recurrent infection.