LAPAROSCOPIC UROGENITAL TRACT PROCEDURES

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Introduction

In small animals, surgical removal of uroliths by cystotomy or urethrotomy has been the traditional method of choice, and these procedures are still commonplace. However, several studies have elucidated insufficiencies in the open cystotomy technique. In a 1992 study, calculi remained in the bladder after cystotomy in 10% of dogs and 20% of cats. In a larger, more recent study, removal of uroliths was incomplete in 20% of dogs after cystotomy. Furthermore, a 2008 study reported that 9.4% of recurrent stones in dogs were suture induced, indicating that cystotomy could, in fact, increase the risk of stone formation. Recently, complications associated with traditional surgical cystotomy, regardless of closure method, were reported in 37-50% of cases, with a mean duration of hospitalization of 4 days. The above listed shortcomings of the open cystotomy procedure make less-invasive alternatives with fewer complications, fewer long-term stone recurrences, more efficient stone removal, and shorter hospitalization times desirable.

In small animals, minimally invasive treatment options for lower urinary tract stones include voiding urohydropulsion, intracorporeal lithotripsy, extracorporeal shock-wave lithotripsy, transurethral cystoscopic stone retrieval, laparoscopic-assisted cystotomy, and percutaneous cystolithotomy.

Indications and Case selection

Case selection is of critical importance when choosing between open surgery when uroliths are very large or with minimally invasive urolith retrieval techniques when the urolith size does not require the need for conversion to a open cystotomy. Surgical failure and complications can often be avoided when careful attention is paid to both patient factors (signalment and concurrent disease) and stone characteristics (location, size).

Nearly all calculi in female dogs and cats can be removed by transurethral cystoscopy, laparoscopic-assisted cystotomy, or percutaneous cystolithotomy. Most male dogs can be treated with laparoscopic-assisted cystotomy or percutaneous cystolithotomy. Transurethral cystoscopy is preferred for female cats and dogs because it is less invasive than laparoscopic-assisted techniques. However, the calculi must be small enough to be exteriorized by the transurethral route. Size criteria are continually being modified, but in general, in female cats and dogs calculi can be removed that are twice the diameter of the largest cystoscope appropriate for the patient. In male dogs, transurethral removal is limited to smaller calculi because the stones must pass the os penis region of the urethra. Calculi in male cats can be removed by laparoscopic-assisted cystoscopy and percutaneous cystolithotomy, but the urethra is likely too small for current transurethral cystoscopy techniques.

Instrumentation

1) Multi-Purpose rigid endoscope
   (HOPKINS® II Forward-Oblique Telescope 30° (Karl Storz, Goleta, CA)
   Length= 18cm
Diameter= 2.7mm  
Sheath= 14.5 Fr, working length 15cm and working channel 5 Fr  

2) Flexible Uretroscope  
   FLEX-X2 (Karl Storz, Goleta, CA)  
   Diameter= 7.5 Fr  
   Working length= 67cm  
   Working channel= 3.6 Fr  

3) 5mm Port with Luer lock attached to suction.  
4) 5mm Ternamian cannula; EndoTIP (Karl Storz, Goleta, CA)  
5) Stone basket (Re-sterilizable) (Karl Storz, Goleta, CA)  
6) Grasper  
7) Hom Yag Laser tip for laser lithotripsy  
8) Pressure bag for lavage  
9) Red rubber catheters or Foley catheter  
10) Hydrophilic guide (Weasel) wire (0.018, 0.035, and 0.045mm)  
11) 360-degree wound retractor  

**Technique description**  
Laparoscopic-assisted cystotomy has been described in detail by Rawlings et al. The procedure is performed via a minilaparotomy, the location of which is guided by visualization of the bladder through a laparoscopic cannula placed immediately caudal to the umbilicus. In this technique, the bladder is catheterized or aspirated to drain urine. After laparoscopic entry and pneumoperitoneum creation (described in detail elsewhere in this book), the bladder is visualized. Another cannula is placed at the level of the bladder apex, and the bladder is grasped using laparoscopic Babcock forceps. The port incision is enlarged to create a minilaparotomy, and the bladder partially exteriorized. A small cystotomy is performed, and the bladder wall is sutured to the skin of the abdominal incision using four isolated tension-relieving sutures (cruciate, or mattress patterns). A rigid cystoscope (2.7-mm except for cats and dogs < 5kg where a 1.9-mm scope is preferred) is then inserted into the bladder for calculus retrieval. The cystoscope is used in combination with a basket retrieval instrument, which is passed through the cystoscope’s operating channel.

After calculi are removed from the bladder, the urethra is examined with a rigid cystoscope (female dogs) or a flexible fiberoptic urethroscope (male dogs). Urethral calculi in male dogs can be removed by either retrograde flushing or a basket retrieval device. The cystotomy incision is closed routinely. Retracting a portion of the omentum to be sutured over the bladder incision has been recommended. Abdominal incisions are closed routinely.  

Modifications of the above laparoscopic-assisted cystotomy technique have been described by Pinel et al. Modifications include creation of a temporary complete cystopexy with the abdominal wall instead of placement of stay sutures to secure the bladder. The cystopexy is thought to limit bladder manipulation and contamination of the peritoneal cavity with urine during surgery. Additionally, a 5 mm laparoscope can be used instead of a 2.7/1.9-mm cystoscope to gain access to the bladder. When used with a cannula, this allows for the creation of a flow of saline to flush uroliths out of the bladder without the need for forceps. Larger
Uroliths can be grasped with forceps introduced next to the cannula, which is technically less challenging than grasping uroliths with a retrieval device through the working channel of a cystoscope. The 5-mm laparoscope also provides a larger viewing window and greater image resolution compared to the 2.7/1.9-mm cystoscope. Lastly, creation of retrograde saline flow using a urethral catheter as opposed to antegrade saline flow created with a cystoscope is described to help flush uroliths out of the bladder lumen.

Complications and follow-up

Percutaneous cystolithotomy has been described by one of the authors (JJR). A small ventral midline incision (approximately 1 to 1.5 cm) is made in the abdominal cavity just over the apex of the urinary bladder. A wound retraction device is used to expose the urinary bladder. The bladder is palpated digitally and grasped with a Babcock. Three stay sutures are placed near the apex of the bladder in a triangular arrangement. The sutures are used to hold the bladder in place and simultaneously place counter traction on the bladder while a laparoscopic threaded cannula is inserted into the bladder. The location of this threaded cannula placement is located caudal to the apex on the ventral aspect of the bladder centered within the triangulated stay sutures. The threaded cannula is inserted immediately after a small 2-3 mm incision is made using a #11 blade into the urinary bladder to enable insertion of the cannula. A rigid cystoscope or flexible ureteroscope is inserted through this port and into the bladder lumen or urethra, allowing for identification and removal of stones using a stone-retrieval basket through the working channel of the cystoscope. For very small stones, suction can be placed into the threaded port and the stones can be flushed and suctioned out of the port in retrograde fashion with saline being flushed through a urethral catheter. For stones that exceed the diameter of the port a number of options exist to enable removal. A 10mm threaded cannula can be used as an alternative lithotripsy can be used to fragment the stones to allow for removal, or the stones can be manipulated through the small incision with the stone basket. Following calculi removal from the bladder, the urethra is examined using a rigid cystoscope in female dogs or a flexible ureteroscope in male dogs. A basket retrieval device can be used locate and remove any remaining urethral calculi through the working channel of the scope. The bladder wall is closed routinely using an interrupted appositional suture pattern and absorbable suture material.

Laparoscopic ureteronephrectomy

Ureteronephrectomy is most commonly indicated in dogs and cats in cases of primary renal neoplasia, hydronephrosis, end-stage chronic renal failure with chronic infection, renal dysplasia, nephrolithiasis, trauma, or idiopathic renal hematuria. Prior to a ureteronephrectomy being performed kidney function in the contralateral kidney should ideally be documented by measurement of glomerular filtration rate. Case selection for laparoscopic ureteronephrectomy needs to be stringent especially in the early part of a surgeon’s learning curve to avoid a high conversion rate and significant morbidity. Appropriate cases include modestly sized primary renal neoplasms, chronic renal failure with infection, renal dysplasia and idiopathic renal hematuria. Contraindications should initially include large renal masses including neoplasia, hydronephrosis and pyelonephritis with abscession, and if there is any infection that extends beyond the renal capsule. In clinical cases pre-operative imaging with ultrasonography and preferably computed tomography (or MRI) would be very helpful in ruling out conditions that might make a laparoscopic approach undesirable. These imaging modalities will also allow assessment of the relationship of the kidney to its’ surrounding structures.
**Patient positioning and port placement** - A three port technique with patients in near lateral recumbency is used to perform ureteronephrectomy. A camera port is placed initially at the subumbilical location or in a paramedian location more dorsal to the umbilicus. Care should be taken not to place the camera portal too dorsal however. Once pneumoperitoneum has been established two further instrument ports are placed one at the mid-abdominal level just caudal to the last rib and one at the same level just cranial to the pelvic limb. In general two ports are established using cannulae capable of passing 5mm instrumentation and one is placed for use with 10mm instrumentation.

**Surgical technique** - Initially the surgeon should survey the kidney and the surrounding structures and optimize patient positioning to allow access to all important anatomical landmarks. The ureter should be identified as well as the adrenal gland cranially. To initiate dissection of the kidney a vessel-sealing device or bipolar electrosurgical device is used to dissect the kidney from its’ retroperitoneal attachments. Next, the ureter will be dissected out close to its’ insertion into the renal pelvis. The ureter will then be used as a handle to suspend the kidney during dissection of the renal artery and vein. The artery and vein will be triple clipped using a laparoscopic clip applier prior to being sectioned. In small dogs and cats the renal artery and vein could be sealed and cut using a vessel-sealing device alone. Remaining attachments of the kidney to the surrounding retroperitoneum will be sectioned using the vessel sealer. Once the kidney is completely dissected out tension is placed on the proximal ureter. This facilitates dissection of the remaining section of the ureter down to its’ insertion into the bladder. Once close to the bladder the ureter can be clipped with hemoclips or ligated and the ureter sectioned between clips. The resected specimen is removed from the abdomen using a specimen retrieval bag. The port sites are closed by placement of sutures in the muscular layers followed by placement of intradermal sutures.

**References:**