SURGICAL MANAGEMENT OF FELINE CALCULI

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Key Points

- Patients with cystic and urethral calculi present with stranguria
- Retropulsion of urethral calculi into the urinary bladder simplifies management of urethral calculi
- Aggressive lavage of the urethra and bladder should be performed during cystotomy
- Permanent urethrostomy is an acceptable method of managing chronic stone formers

If you would like a video of this surgical procedure go to www.videovet.org or contact videovet@me.com.

Definition: Cystic and urethral calculi have various compositions (i.e., oxalate, struvite, urate) and may be present in the urinary bladder or lodged in the urethra, respectively. They may be multiple or single, may cause partial or complete obstruction (i.e., urethral), and may require surgical manipulation for removal.

DIAGNOSIS

Clinical presentation:

Signalment: There is no age, sex or breed predisposition.

History: Patients generally present with a history of urinary obstruction and/or signs of urinary tract infection. Common complaints include difficulty urinating, straining to urinate, hematuria, blood tinged urine in the litter pan, and/or a distended abdomen. Patients that present several days after complete obstruction may have a distended and painful abdomen and a history of anuria. These patients may be so compromised that they present in shock.

Clinical signs: The most frequently reported clinical signs in patients with cystic and urethral calculi include unproductive straining to urinate, blood tinged urine seen in the litter pan, hematuria, and/or polakiuria. Severity of clinical signs may vary with the degree of urethral obstruction and duration of obstruction prior to presentation. Patients with complete obstruction for several days may show signs of post-renal azotemia (i.e., severe depression, recumbant, shocky).

Physical examination: Abdominal palpation may reveal a full urinary bladder; occasionally, calculi within the bladder may be palpable. Patients with severe clinical signs (i.e., presented several days after complete obstruction) may show azotemia, shock, and/or severe depression. Abdominal palpation generally reveals a large, turgid urinary bladder and may result in discomfort to the patient.

Laboratory findings: Results of a complete blood count and serum chemistry profile are generally normal in patients presenting acutely; urinalysis may show evidence of urinary tract infection and and/or crystalluria. Patients presenting after several days of complete obstruction may have significant changes in their biochemical profile including increased BUN, increased creatinine, metabolic acidosis,

and severe electrolyte abnormalities. Urine is generally grossly hemorrhagic and urinalysis may show signs of urinary tract infection and crystaluria.

Radiography: Survey radiographs may show presence of radiodense calculi in the urethra and/or urinary bladder as well as a distended urinary bladder. Occasionally, radiolucent calculi occur and can only be visualized using retrograde contrast cystourethrography. Careful radiographic evaluation of the kidneys and ureters should be done to rule out renal and ureteral calculi.

Ultrasonographic examination of the bladder, ureters, and kidneys may be helpful in diagnosis of cystic, ureteral, or renal calculi.

Differential diagnosis: Any disorder causing urinary obstruction, including urethral neoplasia, granulomatous urethritis, urethral stricture, and urethral trauma. Definitive diagnosis is based on clinical signs, inability to pass a catheter, and evidence of calculi on survey or contrast radiographs.

MEDICAL MANAGEMENT:

Immediate care: In animals with complete obstruction long enough to cause azotemia, temporary urinary diversion is provided by performing a prepubic cystostomy (see technique described below) or frequent cystocentesis (i.e, tid to qid). Azotemia is treated with crystalloid IV therapy prior to calculus removal.

Urethral catheterization of a female cat:

See www.videovet.org for a detailed video description of this technique.

- Female urethral catheterization is easier than male
- Use a closed ended tom cat catheter
- Ventral recumbancy is recommended
- Pass the catheter with no evidence of resistance

Urethral Catheterization – Female

Indications: Urethral catheterization is indicated in patients with urethral calculi (aids in retropulsion), measuring urinary output, chronic decompression of the urinary bladder, performing contrast cystography and preoperative placement to prevent cystic calculi from lodging in the urethra during cystotomy.

Applied Anatomy: The urethra leaves the bladder at the neck and courses caudally. The female urethra is short, straight, and wide, passing directly to the vestibule. Urinary catheterization of female cats is relatively easy because of the anatomic characteristics mentioned above.

Anesthesia: Heavy sedation or preferably, general anesthesia, is recommended for predictably successful catheterization of the female urethra. Occasionally, unsedated, unanesthetized cats will tolerate the procedure if they are slightly depressed.

Technique:

Positioning: The cat is placed in either lateral recumbency or ventral recumbency with the hindquarters elevated on a rolled fleece. Regardless of position chosen, it is important to maintain positional symmetry during the procedure. This author prefers ventral recumbency. The patient is placed on the rolled fleece with the

hind legs hanging over the fleece, abducted slightly, and the tail held or tied directly over the back.

Patient preparation: The long hairs around the vulva can be clipped to enhance visualization of the vulvar lips. Alcohol preparation of the vulvar lips is performed prior to catheterization. The vaginal vault can be lavaged with a 1:50 dilution of 1% betadine solution and saline.

Catheters: A closed ended polyethylene tomcat catheter or a 3-1/2 French diameter feeding tube is recommended for urethral catheterization of female cats. Open-ended tomcat catheters may be used but may be more traumatic to the urethra during placement.

Catheter placement: The catheter is removed from the sterile packaging taking special care to maintain sterility during placement. Sterile K-Y jelly lubricant is generously placed on the tip and shaft of the catheter. Closed ended polyethylene tomcat catheters have a gentle curve when they are removed from their original sterile package. This curve is used to help 'aim' the catheter into the urethral papilla during placement.

With the catheter in the right hand, use the left index and middle finger to gently spread the vulvar lips. With the curve of the catheter pointing toward the floor, pass the tip of the catheter along the ventral midline of the vaginal vault and vestibule, taking care not to allow the catheter tip to enter the clitorin fossa. Gently pass the catheter in a cranial direction until the catheter can be felt to 'fall' into the urethral papilla. If any resistance is met during attempted placement, pull the catheter caudally into the vaginal vault, re-direct the catheter to the ventral midline of the vagina and re-insert the catheter. Once the catheter is felt to 'fall' into the urethra, pass the catheter into the urinary bladder until urine begins to drip from the catheter, ensuring proper placement.

Securing the catheter: If the catheter is to be maintained for an extended period of time select a soft 3.5 French diameter catheter and secure it to the vulva using a Chinese finger-trap friction suture technique. Attach the catheter to a closed collection device to maintain asepsis.

Catheter removal: Cut the Chinese finger-trap friction suture and gently pull the catheter. Hematuria may be seen for 12 – 24 hours after catheter removal.

RETROGRADE HYDROPULSION OF LODGED URETHRAL CALCULI

Calculus removal: Retrograde hydropulsion:
See www.videovet.org for a detailed video description of this technique.
This technique should result in an 80-85% success rate for retropulsing urethral calculi into the urinary bladder!

Thoroughly mix 20 cc of sterile saline and 5 cc of Surgilube or K-Y Jelly in a 35 cc syringe and attach the syringe to a 3.5 - 5.0 French soft rubber catheter/feeding tube.

Anesthetize the animal, extrude the penis and pass the lubricated urinary catheter in the urethra up to and against the calculus. Place a dry gauze sponge around the extruded tip of the penis and occlude the penis around the catheter by squeezing it with thumb and finger.

Using a back and forth action on the catheter, simultaneously inject the saline/lubricant mix under extreme pressure.

a) During injection, the calculi and urethra are lubricated by the saline/lubricant mix while the viscosity of the mixture (i.e., KY jelly and saline) encourages the calculus to dislodge and become retropulsed into the urinary bladder.

b) This technique is attempted, and generally successful, regardless of how many stones are in the urethra and no matter where they are lodged.

If the above technique fails, use a stiffer catheter (i.e., open or closed ended tomcat catheter) and repeat the above maneuvers. Use care when manipulating these stiffer catheters against the calculus.

SURGICAL TREATMENT:

The objective of surgical treatment is to remove all retropulsed calculi from the urinary bladder and any remaining urethral calculi that were unable to be retropulsed. Bladder calculi are removed via cystotomy, urethral calculi are removed via urethrotomy, and patients that are frequent stone formers may benefit form a permanent urethrostomy to allow continual passage of small urethral calculi.

Preoperative management: Patients that present acutely can be anesthetized immediately and retropulsion attempted (see above described technique). If urinary tract infection is suspected, preoperative treatment with antibiotics may be instituted.

Patients that present after several days of complete obstruction should be treated medically until the azotemia resolves, blood gas abnormalities resolve, and electrolytes return to normal. The patients' electrocardiogram should be monitored if hyperkalemia is present preoperatively. Medical treatment may consist of intravenous fluids, systemic antibiotics, continuous ECG monitoring, and bladder decompression. Bladder decompression may be accomplished via multiple cystocentesis (i.e., tid or qid), or placement of an antepubic cystostomy tube (described in detail below).

Anesthesia: Routine general anesthesia is performed in patients that present acutely without signs of azotemia. Azotemic, shocky patients with moderate to severe biochemical abnormalities should be treated as described above until these abnormalities return to normal.

Surgical anatomy: The male feline penile urethra consists of urethral mucosa (i.e., urothelium) surrounded by corpus cavernosum urethra, which is in turn surrounded by tunica albuginea. Because of the blood filled corpus cavernosum urethra and the tough fibrous connective tissue tunica albuginea, the urethra can withstand tremendous pressure (e.g., as with aggressive retropulsion) without the fear of urethral rupture.

The urinary bladder consists of the following layers; serosa, muscular, submucosa and mucosa. The bladder is lined with transitional epithelium.

Positioning: Patients are positioned in dorsal recumbancy for retropulsion, cystostomy tube placement and routine cystotomy.

Surgical technique: The surgical technique varies depending upon the procedure chosen and are described in detail below:

Retropulsion: The technique for retropulsion of urethral calculi is described above in medical management.

Percutaneous cystostomy tube placement: Occasionally, it may be necessary to perform a percutaneous antepubic cystostomy to decompress the urinary bladder whilst treating a severely azotemic and metabolically derranged patient until they become a better anesthetic and surgical risk.

Surgical technique: The patient is sedated and placed in dorsal recumbancy. A 3-4cm incision is centered between the umbilicus and pubis. Subcutaneous tissues are disected to expose the ventral midline (i.e., linea alba). A 2-3 cm incision is made in the linea alba and the bladder wall located. A 12–14 French Foley catheter is advanced through a skin incision 2-3 cm lateral to the abdominal incision, tunneled in the subcutaneous tissue and brought into the abdominal cavity at a location just lateral to the midline abdominal incision. A purse string suture is placed in the bladder wall at the proposed site of Foley catheter placement with 3-0 monofilament absorbable suture. A 1cm incision is made into the bladder lumen and the Foley catheter advanced. The purse string suture is carefully tightened to create a water tight seal but not to tight as to create bladder wall necrosis. The bladder wall is pexied to the abdominal wall at the point of entry of the Foley catheter with 3-0 monofilament absorbable suture in a simple interrupted pattern. The abdominal wall is closed in a routine fashion. The cystostomy catheter is held in place with a Chinese finger trap friction suture technique using #1 monofilament nonabsorbable suture and attached to a closed collection system to avoid urinary tract infection. The cystostomy tube remains in place until the patient is ready for definitive surgical treatment.

Urethrostomy: Urethrostomy is generally performed in patients that are recurrent stone formers. It provides a permanent opening that is large enough to accommodate passage of most urethral calculi, crystals and mucoid debris.

Perineal urethrostomy; perineal approach: is the location of choice for urethrostomy in cats. It is a convenient location for surgical manipulation, the urethral diameter will accommodate passage of most urethral calculi and there is less urine scald postoperatively.

See www.videovet.org for a detailed video description of this technique.

Prior to surgery a urethral catheter is passed, if possible. After a routine castration, an elliptical incision is made around the scrotum and penis. Then the subcutaneous tissues are dissected to expose penile urethra. The penile urethra is dissected free from surrounding connective tissue. The ventral attachment of the pelvic urethral to the pubis (i.e., ishiocavernosus m.) is identified and transected. The penile urethra is freed from its connective tissue attachments to the pelvic floor using blunt digital dissection. The retractor penis muscle is identified on the dorsal aspect of the penis and is dissected from its attachment on the penis. The dissected retractor penis muscle is then used to develop the dorsal plane of dissection to separate the pelvic urethra from its dorsal connective tissue attachments. Once the urethra is dissected enough to visualize the dorsolaterally located bulbourethral glands penile dissection can stop. The penis is catheterized and the urethral orifice identified. An incision is made from the penile urethra to the pelvic urethral to the level of the bulbourethral

glands using a Stevens tenotomy scissor or Iris scissor. The urethral orifice at the level of the bulbourethral glands is generally of large enough diameter to accept the flange of a tomcat catheter.

After incision of the urethra, the glistening urethral mucosa is identified. 5-0 nonabsorbable monofilament suture with a swaged on cutting or taper-cut needle is recommended by the author. The first urethrostomy suture is placed at the dorsal aspect of the urethrotomy incision on the right or left side at a 45o angle to include urethral mucosa and skin (suture split thickness of skin). The suture is tied and cut leaving the ends 3-4 cm long to act as a stay suture. A mosquito hemostate is placed on this suture to provide traction and countertraction to enhance visualization of the urethral mucosa. The second suture is placed opposite the first suture and tied as described for the first. A stay suture is also placed here. A third urethrostomy suture is placed directly on the dorsal midline to hold the dorsal margin of urethral mucosa to the dorsal margin of the skin incision. Alternating sutures from dorsal to ventral are placed until approximately one half of the penile urethra has been sutured to skin. The remainder of the penis is amputated and the subcutaneous tissue and skin are closed routinely. Fine ophthalmic instruments make tissue handling and suturing easier. Use of a 2X magnifying loupe and headlamp light source enhances visualization of the urethral mucosa and facilitates accurate suturing. It is critical for the surgeon to recognize the glistening urethral mucosa and carefully suture it to skin. This will decrease (or eliminate) the chance of urethral stricture.

Perineal urethrostomy; dorsal approach:

See www.videovet.org for a detailed video description of this technique.

Perineal urethrostomy can be performed with the patient placed in dorsal recumbancy. This positioning is more ergonomic for the surgeon and allows easy access of the urinary bladder for concurrent cystotomy. When positioning the cat on the operating table tie the hind limbs cranially until the pelvis is slightly elevated off the surgery table. Place a folded towel under the pelvis to support this slightly elevated position. The surgical technique is as described above for the perineal urethrostomy performed using a perineal approach.

Cystotomy:

See www.videovet.org for a detailed video description of this technique.

After successful retropulsion of urethral calculi into the bladder the catheter used to retropulse calculi is passed into the urethra and bladder and left in place. Leaving a catheter indwelled in the urethra ensures that remaining cystic calculi will not roll back into the urethra during patient transfer to the surgery suite and during patient prep. The patient is place in dorsal recumbancy with the hind legs tied gently cranially to slightly elevate the pelvis. A folded towel is placed under the pelvis to help support it in this position. This positioning will greatly facilitate exteriorizing the penis during surgery.

Just prior to aseptic preparation of the abdomen a soft, 5-8 French red rubber catheter or feeding tube is placed into the prepuce and a prepucal lavage is performed using 20 cc of a 1:50 dilution of 1% betadine solution and sterile saline.

This aseptically prepares the penis and prepuce so they can remain in the surgical field throughout the cystotomy procedure.

A caudal midline incision is made from umbilicus to pubis. The bladder is exteriorized and examined. Stay sutures of 3-0 suture are placed in the apex and neck of the bladder. A scalpel blade is used to penetrate the ventral aspect of the bladder and enter the lumen. The ventral cystotomy incision is extended with Metzenbaum scissors. The bladder should be opened from apex to neck to allow proper visualization of bladder mucosa and easy retrieval of all calculi. Stay sutures are placed on each side of the incision at its midpoint to facilitate visualization of the bladder interior. Large hemostats are placed on the stay sutures to help retract the bladder margins. A cystotomy spoon is used to scoop the bladder neck for calculi. This is performed several times. When no more calculi can be removed with the spoon, digital palpation of the bladder neck is performed to identify presence of further calculi. If calculi are palpated further attempts are made to retrieve them. Once no more calculi can be spooned or palpated the indwelling urethral catheter placed after retropulsion is removed.

Next, a 3.5 - 5 French urethral catheter is placed in the penile urethra (i.e., retrograde). A dry sponge is used to grasp the extruded penis to create a water tight seal around the catheter. A 35cc syringe filled with sterile saline is injected through the catheter under moderate pressure. The stay sutures on the bladder incision are retracted to enable visualization of the bladder lumen during lavage. Suction or intermittent spooning is performed during lavage in an attempt to identify and remove any remaining stones. After several high pressure lavages and negative results in obtaining stones, the catheter is placed from the bladder lumen into the bladder neck and pelvic urethra (i.e., normograde). Lavage is once again performed in an attempt to identify and remove any remaining stones. After several lavages and negative results, the catheter is advanced until it can be seen coming out of the penile urethra. The catheter is run back and forth in the urethra several times (‘urogenital floss’) to ensure there are no remaining calculi (i.e., gritty feeling while passing the catheter).

Finally, a piece of bladder mucosa is excised from the cystotomy incision for culture and susceptability testing. The interior of the bladder is examined for urachal diverticulum, masses, etc. and biopsied as necessary. The bladder wall is closed with 3-0 or 4-0 absorbable monofilament suture material using a swaged on taper or taper-cut needle in a simple continuous or simple interrupted appositional suture pattern. Only one layer closure is necessary. Abdominal closure is routine.

Suture material/special instruments: Urinary catheters of various sizes, Foley catheter, head lamp light source, 2X loupes, ophthalmic instruments, 4-0 or 5-0 monofilament nonabsorbable suture material.

POSTOPERATIVE CARE AND ASSESSMENT:

Postoperative care varies depending upon procedure performed:

Percutaneous cystostomy tube: It is important to keep the percutaneous cystostomy tube attached to a closed collection device. The tube can be connected to a sterile collection bag via a sterile intravenous catheter connection set. An elizabethan collar may be necessary in some patients to prevent iatrogenic removal of

the cystostomy catheter. Careful management is important to control catheter related urinary tract infection.

Cystotomy: An indwelling urethral catheter is not recommended after an uncomplicated cystotomy for removal of cystic calculi. An Elizabethan collar should be considered, especially in patients that may be prone to self-mutilation. Patients should be kept quiet and away from other animals.

Perineal Urethrostomy: An Elizabethan collar should be considered, especially in patients that may be prone to self-mutilation. Patients should be kept quiet and away from other animals. An indwelling urinary catheter placed routinely postoperatively is NOT necessary following an uncomplicated urethrostomy.

PROGNOSIS

The prognosis for surgical management of urethral and cystic calculi is dependant upon preoperative management of azotemic patients prior to anesthesia, success of retropulsion of urethral stones into the urinary bladder, care in removing all stones via cystotomy, and care of ensuring urethral mucosa to skin apposition during urethrostomy.

Patients that have successful retropulsion of urethral calculi and do not require urethrostomy have a excellent prognosis. If careful attention is paid during cystotomy to ensure that no calculi are left behind (see discussion on cystotomy technique), the prognosis for cure is excellent. Long term prognosis is dependant on evaluaiton of calculus composition, dietary management, management of urinary tract infection, and attention to urine pH.

Patients that have an elective perineal urethrostomy have a favorable prognosis if attention is paid to proper surgical technique (i.e., urethral mucosa is sutured to skin). Occasionally, chronic stone forming patients will form a calculus that is to large to pass through the urethrostomy stoma.