

SURGICAL MANAGEMENT OF CANINE CALCULI

*Howard B. Seim III, DVM, DACVS
Colorado State University*

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Key Points

- Patients with 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

Definition: Cystic and urethral calculi have various compositions (i.e., oxalate, struvite, urate, uric acid, cystine, silicate) 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.

Synonyms: Bladder stones, urethral stones

Diagnosis

Clinical presentation:

Signalment: There is no age predisposition. Dalmations are more likely to present with uric acid calculi and commonly present with calculi lodged in the urethra. Schnauzers are more likely to present with struvite calculi and Daschunds are more likely to present with cystine stones.

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, dripping blood tinged urine from the prepuce, 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 dripping from the prepuce, 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: Observation in the examination room may reveal multiple unsuccessful attempts to urinate. 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 creatine, 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. The most common location of urethral calculi in male dogs is immediately caudal to the os penis. Careful evaluation of the kidneys and ureters should be done to rule out renal and ureteral calculi.

Ultrasound: 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 of a duration long enough to cause azotemia, temporary urinary diversion is provided by either passing a small urinary catheter (e.g., 5 French) alongside the calculus, 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.

Retrograde hydropulsion: [See the DVD for a detailed video of this technique.](#) This technique should result in a 90-95% success rate of retropulsing urethral calculi into the urinary bladder!

Technique

1. Select the largest diameter sterile high density polypropylene urinary catheter that will fit past your patients os penis (generally 6, 8, or 10 French diameter)
2. If the selected catheter turns out to be a 6 French diameter then mix 30cc of Sterile KY Jelly with 70cc of sterile physiologic saline solution.
3. If the selected catheter turns out to be an 8 or 10 French diameter then mix 40cc of Sterile KY Jelly with 60cc of sterile physiologic saline solution.
4. Thoroughly mix the sterile saline and KY Jelly in a 35 or 60 cc syringe and attach the syringe to the urinary catheter.
5. 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.

6. Using a back and forth action on the catheter, simultaneously inject the saline/lubricant mix under extreme pressure. Be certain the catheter tip hits the calculus like a battering ram to help dislodge it and encourage the saline-lubricant mix to surround the calculus and coat the urethral wall. 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 repulsed into the urinary bladder.

This technique is successful regardless of how many stones are in the urethra and no matter where the calculi are lodged.

If the above technique fails, place a finger in the rectum, palpate the urethra and occlude its lumen (this dilates the urethra); repeat the above maneuvers and when maximum pressure is exerted on the urethra by the saline/lubricant mix (i.e., the urethra is maximally dilated), suddenly release digital urethral occlusion allowing lodged calculi to flush into the urinary bladder.

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

Preoperative management: Patients that present acutely can be anesthetized immediately and repulsion 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 patient's 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 passing a small gauge urinary catheter (e.g., 5 French) past the calculus, 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 canine 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 fluid filled corpus cavernosum urethra (blood) 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, urethrotomy, urethrostomy, cystostomy tube placement and cystotomy.

Surgical technique: The surgical techniques vary 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 patient until they become a better anesthetic and surgical risk.

The patient is sedated and placed in dorsal recumbancy. A 3-4cm incision is centered between the umbilicus and pubis. Subcutaneous tissues are dissected to expose the ventral midline (i.e., linea alba). A 2-3cm 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 pursestring 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 pursestring 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. and

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.

Urethrotomy: [See DVD for detailed video of this technique.](#)

The urethral calculus to be removed is located by evaluation of radiographs, palpation of the os penis and its relationship to the calculus, and/or passing a catheter in the urethra until it contacts the stone, removing the catheter and using it as a measure to locate the calculus.

A 2–3 cm skin incision is made directly over the calculus. Subcutaneous tissues are dissected until the retractor penis muscle is exposed. The cream colored retractor penis muscle (smooth muscle) is dissected off the corpus cavernosum penis (the corpus cavernosum penis has a bluish tint from venous blood) and retracted laterally. A sharpe #15 BP scalpel blade is used to incise the urethra directly over the calculus being careful to incise the urethra directly on its midline

to help decrease cavernous sinus bleeding. No attempt is made to control cavernous sinus hemorrhage with cautery or hemostats as this creates excessive urethral trauma and is generally unsuccessful at controlling hemorrhage. Rather, hemorrhage is controlled via digital pressure and suction until suturing can commence. The calculus is grasped with forceps and removed from the urethra.

The urethral incision can be left open to heal by second intention; if this method is chosen moderate to severe hemorrhage can be expected for several days postoperatively.

Alternately, the urethral incision can be closed using 5-0 multifilament or monofilament absorbable suture in a simple interrupted or continuous pattern. Subcutaneous tissues are closed with 3-0 monofilament absorbable suture in a simple continuous pattern and skin with 3-0 or 4-0 nonabsorbable monofilament suture. If this method is preferred by the author over healing by second intention as postoperative hemorrhage is significantly reduced.

Both urethrotomy techniques (i.e., sutureless or sutured) result in predictable urethral healing without evidence of urethral stenosis or stricture.

Urethrostomy: [See DVD for detailed video of this technique.](#)

Urethrostomy is generally performed in patients that are recurrent stone formers. It provides a permanent opening caudal to the os penis that is large enough to accommodate passage of most urethral calculi. This technique is often performed in Dalmations for treatment of recurrent uric acid calculi.

Scrotal urethrostomy is the location of choice for urethrostomy in dogs. It is a convenient location for surgical manipulation, this area of the urethra generally bleeds the least, the urethral diameter will accommodate passage of most urethral calculi, and there is less urine scald postoperatively. Other locations for urethrostomy include prescrotal and perineal.

Prior to surgery a urethral catheter (the largest size that will fit past the os penis) is passed, if possible. After a routine castration and scrotal ablation have been performed, the subcutaneous tissues are dissected to expose the retractor penis muscle. The retractor penis muscle is smooth muscle and appears light grey to cream colored. The retractor penis muscle is dissected from its attachment to the corpus cavernosum urethra. The blood filled cavernous tissue gives the urethra a bluish color. The urethral catheter is palpated and used as a firm surface to cut against when incising the urethra. Every attempt is made to incise the urethra exactly on the midline to help decrease hemorrhage. A 3–4 cm incision is made in the urethra. The caudal aspect of the urethral incision is positioned directly over the ischial arch. As this is the new point of urine flow it is most efficient to have urine exit before it makes a sharp turn ventrally. No attempt is made to control cavernous tissue hemorrhage with cautery or hemostatic forceps; only pressure, suction, and suture pressure should be used.

After incision of the urethra, the glistening urethral mucosa is identified, 4-0 or 5-0 nonabsorbable monofilament suture with a swaged on cutting or taper-cut needle is recommended by the author to suture urethral mucosa to skin. The first urethrostomy suture is placed at the midpoint of either side of the urethral incision

to include urethral mucosa, tunica albuginea, and skin (suture split thickness of skin). The suture is tied leaving the end without the needle 3-4 cm long to act as a stay suture. The second suture is placed directly across from the first suture and tied as described for the first. The urinary catheter can now be removed. After the first two sutures are placed, the needle end of one suture is used to begin suturing the cranial portion of the urethrostomy using a simple continuous suture pattern. When the opposite suture is encountered, the stay suture is used to tie off the first continuous suture line. The opposite suture is then used to suture the caudal portion of the urethrostomy in a similar fashion tying the final suture to the remaining stay suture. Fine ophthalmic instruments make tissue handling and suturing easier. Use of a magnifying loupe (about 2x) and head lamp light source enhances visualization of the urethral mucosa and facilitates accurate suturing. It is critical that the surgeon recognize glistening urethral mucosa and suture it to skin. This will decrease (or eliminate) the chance of urethral stricture. It has been shown that a continuous suture pattern incorporating the urethral mucosa and tunica albuginea (i.e., squeezes the cavernous tissue) results in less postoperative hemorrhage.

Cystotomy: [See DVD for detailed video 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. A portion of the catheter can be left exiting the penis. 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.

Just prior to aseptic preparation of the abdomen a soft, 10-12 French red rubber catheter or feeding tube is placed into the prepuce and a prepucal lavage is performed with 180cc of a 1:50 dilution of saline and 1% betadine solution. This aseptically prepares the penis and prepuce so they can remain in the surgical field throughout the cystotomy procedure. In female patients the vulva and vaginal vault are similarly aseptically prepared.

A paraperpucial incision is made from just caudal to the umbilicus to pubis. The prepuce is retracted and a midline celiotomy is performed. 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 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 to maintain visualization of the bladder interior. 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 further calculi are palpated further attempts are made to retrieve the calculi. Once no more calculi can be spooned or palpated the previously placed indwelling urethral catheter is removed.

Next, the largest urinary catheter or feeding tube that can be passed through the os penis is passed in the penile urethra to the level of the os penis (i.e., retrograde). A dry sponge is used to grasp the extruded penis to create a water

tight seal around the catheter. A 60cc 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 lavages and negative results in obtaining stones, the catheter is placed from the bladder to 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 to ensure that there are no remaining calculi (i.e., gritty feeling while passing the catheter).

Finally, a piece of bladder mucosa is excised from the cut edge of the cystostomy incision for culture and susceptibility testing. The interior of the bladder is examined for urachael 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 and 5-0 monofilament absorbable 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.

Sutureless Urethrotomy: If urethrotomy without suturing is performed, patients must be monitored for blood loss from the urethrostomy site. Blood loss can be severe enough to lower the PCV by 2 – 3%. An Elizabethan collar may be necessary in some patients to prevent self-mutilation. Patients should be kept quiet and away from other animals (especially bitches in heat!). Tranquilization is occasionally necessary to control hyperactive or overly excitable patients. Clients should be warned that drops of blood may be present from the urethrotomy site as long as 2 weeks postoperatively.

Sutured Urethrotomy: If a sutured urethrotomy is performed, patients will exhibit very little blood loss. However, 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 (especially bitches in heat!). Tranquilization is occasionally necessary to control hyperactive or overly excitable patients.

Scrotal Urethrostomy: The most common postoperative complication of scrotal urethrostomy is bleeding from the urethrostomy site. Utilization of a simple continuous suture pattern incorporating the urethral mucosa and tunica albuginea (i.e., squeezing the cavernous tissue and creating an air-tight/water-tight seal) has significantly decreased the incidence of postoperative hemorrhage in the author's opinion. 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 (especially bitches in heat!). Over excitement immediately postoperatively can result in frank hemorrhage or subcutaneous hemorrhage. Tranquilization is occasionally necessary to control hyperactive or overly excitable patients.

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.

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 urethrotomy or urethrostomy have an 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 evaluation of calculus composition, dietary management, management of urinary tract infection, and attention to urine pH.

Patients that require sutured or sutureless urethrotomy have a favorable prognosis if all of the remaining calculi are removed from the urinary bladder via cystotomy to ensure that no calculi are left behind (see discussion on cystotomy technique). Attention must be paid to careful lavage during cystotomy to ensure removal of all cystic calculi.

Patients that have an elective 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 too large to pass through the urethrostomy stoma.