

Cystotomy: Keys for Success
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Introduction

- Urinary bladder surgery commonly performed in GP and referral practice.
- Generally good outcomes, but as with any surgical procedure there can be potential complications, some of which are life-threatening.
- Important to adhere to best practices to reduce the risk of complications.

Anatomy

- Bladder lies in caudoventral abdomen.
- Maintained in place by three ligaments: median, which attaches to the ventral midline abdominal wall, and the two lateral ligaments, which attach dorsolaterally and contain the ureters.
- Retroflexion of the bladder allows identification of the ureters entering the trigone. In males, the paired ductus deferens are also visible- must be distinguished from the ureters.
- Blood and nervous supply enters dorsally and at the neck of the bladder.

Indications for bladder surgery

- Urolithiasis by far the most common indication.
- Less commonly, bladder rupture, neoplasia, polypoid cystitis, and congenital bladder abnormalities.

Urolithiasis

- Very common in small animal patients. Present with hematuria, pollakiuria, stranguria, and pain associated with urination. Occasionally may be an incidental finding. Most critical patients present with urinary obstruction.
- Stuvite stones: form in alkaline urine, and are frequently associated with urinary tract infections. Females overrepresented.
- Calcium oxalate stones: form in acidic urine. Risk factors include systemic hypercalcemia and calciuresis; however, in the majority of cases these factors are not present, and the underlying cause is not apparent. Genetic predisposition suspected, as small and toy breeds are over represented.
- Cystine stones: most commonly seen in the bully breeds, Newfoundlands, and Labradors. Cystinurea occurs due to a genetic disorder causing failure of cystine resorption; may be androgen dependent in some cases.
- Urate stones: develop in Dalmatians, and less commonly Labradors and bulldogs due to a genetic disorder of the hepatocyte urate transporter gene leading to uric acid secretion in the urine. Urate stones also identified in animals with portosystemic shunts who excrete uric acid due to impaired hepatic function.
- Complex stones also occasionally identified: composed of multiple types of mineral
- Treatment recommendations vary based on the type of stone present, and any stones retrieved from the urinary tract should be submitted for analysis.

- Until analysis returns, presumptive treatment may be started based on expected stone type. Imaging (struvite and calcium oxalate stones are radiopaque; cystine and urate are radiolucent), urine pH, breed, presence of crystals, concurrent UTI all useful in making a judgement call.
- Struvite, cystine, and urate stone all are potentially dissolvable by diet. Struvite benefit from an acidifying diet, as well as treatment of any concurrent UTI. Cystine and urate are treated with an alkalinizing, protein restricted diet. Additionally, the addition of allopurinol at 15 mg/kg PO q12 for urate stones or Thiola at 15–20 mg/kg PO q12 for cystine stones may reduce continued excretion of these substances into the urine.
- Calcium oxalate stones, silica stones, as well as urate stones in animals with portosystemic shunts, are not dissolvable with diet.

Urinary obstruction

- Medical emergency. Leads to acidosis, severe azotemia and hyperkalemia; death within 1-2 days.
- More common in males due to narrowing of distal urethra trapping dislodged uroliths.
- Hyperkalemia most immediately life threatening issue. Causes characteristic EKG changes (tall tented T waves, wide QRS, P wave suppression, eventual sin wave appearance, bradycardia). Must be addressed promptly. 10% calcium gluconate given at 0.5-1.5mL/kg IV over 10min for cardioprotective effects, then potassium lowered by administration of a combination of 0.5-1g/kg dextrose IV diluted 1:4 and given over 5 min or 0.25-0.5U/kg insulin + 2g/U dextrose diluted 1:4 and given over 5 min.
- IV fluids started; buffered ionic solution preferred as it will more rapidly improve the acidosis and help shift potassium intracellular as well. Even potassium containing fluids will have a net dilutional effect for hyperkalemic patients. Fluids are used for rapid resuscitation initially, then the pet should be started on a rehydration plan
- Bladder must be decompressed. Ideally a urinary catheter can be quickly and easily placed; however if necessary a decompressive cystocentesis can be performed to buy time, and a catheter attempted again once the animal is more stable.
- Tips for difficult urinary catheters: sedation, attempting with different sizes/types of catheters, flushing saline +/- lube, retropulse stones with the help of a nonsterile assistant compressing the proximal urethra via the rectum.

Surgery preparation

- Once animal is deobstructed, complete remaining diagnostic work up.
- Allow time for sequelae of obstruction to completely resolve. In cases of severe obstruction/AKI animal may require several days of stabilization before surgery should be considered. Fluid therapy is continued during this time, ensuring that ongoing losses from post-obstructive diuresis are accounted for.
- When bloodwork changes have resolved/stabilized, the animal may be fasted in preparation for surgery.

Cystotomy surgical technique

- Cystotomy is categorized as a clean contaminated procedure. Perioperative antibiotics are recommended, most commonly a penicillin.

- Bladder typically approached via a caudal midline laparotomy.
- In male dogs, parapreputial skin incision made, then SQ dissected under the prepuce to reflect it laterally. Body wall incision made along the line, not through the muscle.
- Bladder elevated from the abdomen and moistened laparotomy sponges used to isolate it/prevent spillage.
- Stay sutures placed to maintain gentle handling.
- Cystotomy planned in the least vascular region of the ventral, apical bladder. Avoid dorsal cystotomy incision due to risk of ureteral entrapment.
- Stab incision made to enter the bladder, then extended as needed with Metzenbaum scissors.
- Bladder spoon or finger used to retrieve and collect stones.
- Once all stones have been retrieved from the bladder, the urethra must be flushed to remove any more distal stones. This is a critical step, particularly in males.
- Stone and bladder mucosa submitted for aerobic culture; other stones submitted for mineral analysis.
- Cystotomy incision closed with a monofilament absorbable suture material, in an appositional pattern. All bites must engage the submucosa, but ideally not penetrate through the mucosa into the lumen, as suture can provide a nidus for new stone formation.
- Following closure of the bladder gloves and instruments are changed, the abdomen is lavaged, and the abdomen is closed routinely.
- Post operative radiographs are obtained to ensure all stones have been removed and for future documentation purposes.

Post-operative care

- Provide analgesia, typically an opioid immediately post operatively, followed by gradual transition to oral pain medications as tolerated. Avoid NSAIDs in animals who presented with an obstruction, or who have evidence of preexisting renal disease.
- IV fluids recommended for the first night post-operatively to encourage frequent urination and reduce the risk of obstruction due to a blood clot.
- Animal should be monitored for its ability to produce a strong stream of urine.

Potential complications

- Uroabdomen: results from leakage of the cystotomy incision. Similar presentation and treatment recommendations as for urinary obstruction, as animals are often severely azotemic and hyperkalemic. Presence of a uroabdomen can be confirmed with paired serum and abdominal creatinine and potassium ratio, or with a contrast study. Addressed with IVF, insulin/dextrose/calcium gluconate as for urinary obstruction, and place a urinary catheter. Perform an abdominocentesis to remove as much urine as possible from the peritoneum. If continued peritoneal effusion, place an abdominal drain, but for small tears this is often not necessary. Surgery once stable. Exception is in the case of a septic uroabdomen, when emergent surgery is required to decontaminate the abdomen.
- Ureteral injury: most commonly seen after a dorsal cystotomy has been performed, and a ureter entrapped during closure. Unilateral entrapment may not be immediately apparent, as clinical signs are non-specific and other kidney is often able to compensate. Avoid this complication by carefully noting the location of the ureters at surgery.

- Infection: most common in the subcutaneous space; rarely can see septic abdomen post operatively. Avoid with judicious aseptic technique (packing off the bladder, using suction to limit spillage, lavage, changing gloves and instruments).
- Residual stones: found in 20% of cases, highlighting the importance of post operative imaging and diligent flushing of the urethra.
- Stone recurrence: it is common for animals to develop more stones in the future, as in many cases there are underlying genetic factors contributing that cannot be fully eliminated. Limit this risk as much as possible by recommending specific diet changes +/- additional medications based on the stone analysis, as well as general recommendations such as keeping the urine dilute and encouraging frequent voiding.
- If an animal develops more stones in the future, and they are too large to be addressed by non-surgical means or dissolved by diet, it is appropriate to perform a repeat cystotomy. The bladder heals very well, returning to 100% of its intact wall strength within 2 months of surgery, and repeat cystotomies are not significantly more likely to result in complications.