Q&A: EMERGING TOPICS

Noninvasive Methods for Removing Cystoliths

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Abstract

A cystotomy is an invasive procedure that involves a lengthy recovery period as well as risks for complications, such as abdominal urine leakage, postoperative infection, postoperative pain, and incomplete cystolith removal. Three noninvasive methods for cystolith removal have been developed to offer safer, less traumatic alternatives to surgery: voiding urohydropropulsion; catheter-assisted retrieval; and cystoscopy with the use of laser lithotripsy, stone retrieval baskets, and/or an Ellik bladder evacuator.

Take-Home Points

- Noninvasive methods of cystolith removal are associated with quicker recovery times and lower complication risks than surgical methods.
- Voiding urohydropropulsion and catheter-assisted retrieval require minimal equipment and expertise and are effective for removing small stones.
- To remove larger stones, cystoscopy can be coupled with other tools (e.g., laser lithotripsy, stone retrieval basket, Ellik bladder evacuator); cystoscopy also enables visualization to verify that all stones are removed.

Uroliths are solid masses or stones that form in the urinary tract, including the kidneys (nephroliths), bladder (cystoliths), ureters (ureteroliths), and urethra (urethroliths). Uroliths are composed of minerals that crystallize and aggregate over time. Uroliths can cause significant health problems, such as painful urination, blood in the urine, urinary tract infections, and urinary blockages that are life threatening when severe.

The formation of uroliths is not an illness or disease but rather a complication from an underlying disorder (e.g., infection that can lead to struvite uroliths, metabolic defects such as hyperuricosuria in Dalmatians that can lead to ammonium urate uroliths). In many cases, the underlying cause is not identified. However, the result is an oversaturation of urine with 1 or more crystal precursors that leads to stone formation.[1] This article will focus on cystoliths.

Q How are cystoliths usually removed?

Traditionally, cystotomy, a surgical incision into the bladder wall, has been the preferred method to remove cystoliths. However, cystotomy carries risks for complications, including urine leakage, wound dehiscence, and incomplete stone removal; complications have been reported for 20% of canine patients.[2] Furthermore, suture material in the bladder wall can serve as a nidus for future stone formation. One study found that 9.4% of stones removed by cystotomy were induced by suture.[3] In addition, clients frequently reported that postoperative pain caused a delayed return to normal function for their dog.

Noninvasive methods of removing cystoliths are becoming the gold standard in veterinary care and include voiding urohydropropulsion; catheter-assisted retrieval; and cystoscopy with use of laser lithotripsy, stone retrieval baskets, and/or an Ellik bladder evacuator (EE). Although all but the catheter-assisted retrieval method require general anesthesia, they often take less time than a cystotomy and do not require an incision. If a patient experiences postprocedural pain, it is typically brief and mild.

Q What is voiding urohydropropulsion?

Voiding urohydropropulsion involves infusing saline into the bladder via a urethral catheter, positioning the patient vertically, and applying pressure over the bladder to expel the infusion along with the stones. The necessary supplies are a bag of warm saline, a urethral catheter, and a collection container. Lifting the patient so that its spine is vertical to the floor encourages the stones to fall toward the neck of the bladder and pass through the urethra (**FIGURE 1**).

FIGURE 1. The author assisting in voiding urohydropropulsion

Intermittently agitating the bladder while applying pressure promotes suspension of the stones in the saline infusion for more effective evacuation. A 10-Fr catheter will typically permit voiding of stones up to 3 mm in diameter.[4] Because of the risk for urethral obstruction, voiding urohydropropulsion should not be attempted with male cats.[5]

Q What is catheter-assisted stone retrieval?

Catheter-assisted stone retrieval is a noninvasive method of removing small stones from the bladder of male dogs. The necessary supplies are a 35- or 60-mL syringe, a urinary catheter, and saline. The patient is placed in lateral recumbency, and a urinary catheter is aseptically inserted into the bladder. Saline is flushed through the catheter into the bladder. The bladder is intermittently agitated while a syringe is used to aspirate the saline and stones (**FIGURE 2A**). To prevent bladder overdistention, the volume of infused saline must be limited to 10 mL/kg. Catheter fenestrations can be made with iris scissors to help aspirate stones into the syringe (**FIGURE 2B**); however, to prevent the catheter tip from breaking off in the bladder, the edges of the fenestrations must be smooth and not too deep (**FIGURE 2C**).

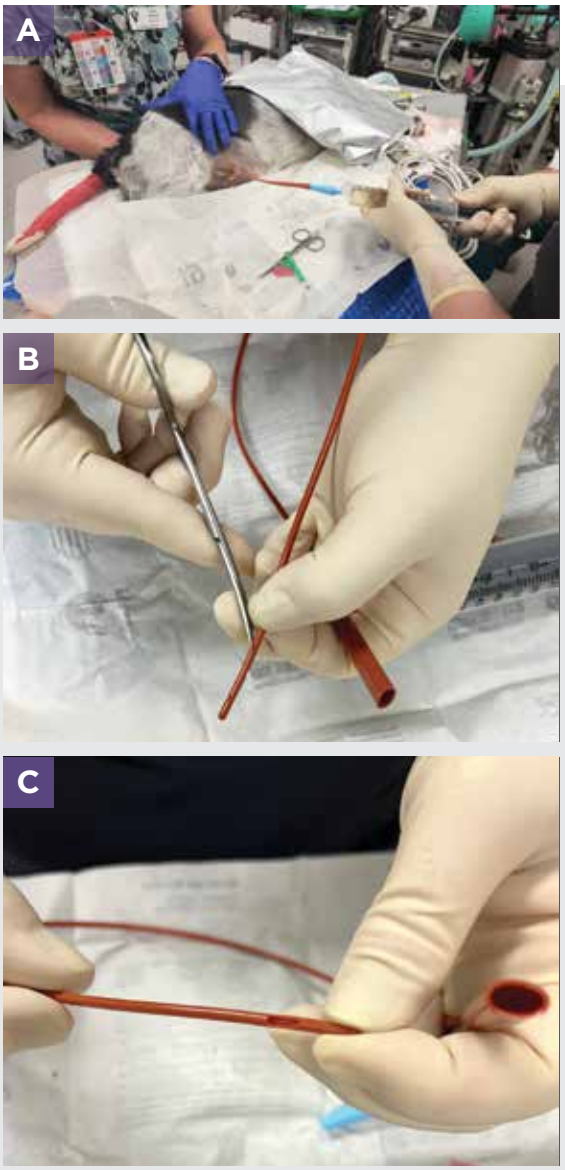

FIGURE 2. (A) Flushing the bladder for catheter-assisted stone retrieval. **(B)** Cutting the fenestration with iris scissors. **(C)** Fenestrating the catheter.

Q How is cystoscopy superior to cystotomy for confirming stone removal?

Through an endoscope, cystoscopy provides the ability to visualize the urethra and urinary bladder, which enables confirmation that all stones are removed. In male dogs, a flexible ureteroscope is passed into the penile urethra to visualize the urethra and urinary bladder. A stone retrieval basket can be passed through the endoscope channel to collect and remove stones by retracting the endoscope. In female patients, a rigid endoscope is passed into the urethra and bladder via the vulva. A stone basket is then passed through the biopsy channel of the endoscope sheath to collect and remove stones by retracting the endoscope (**FIGURE 3**).

FIGURE 3. Basketing the stone.

This method can be used for stones less than 5 mm in diameter in female dogs, less than 4 mm in diameter in female cats, and less than 4 mm in diameter in male dogs (limited by the size of the penile urethra).[6]

Q What is laser lithotripsy and how does it work?

The most common laser is holmium:yttrium-aluminum-garnet (**FIGURE 4**). Holmium is strongly absorbed by water, which produces a thermal effect that causes stones to vaporize or fracture. Thus, laser lithotripsy can be used in patients with stones too large to pass through the urethra, effectively fracturing them into smaller pieces that will comfortably pass. Newer lithotripsy machines with more power can turn stones to dust, rather than fragments, making stone removal more efficient.[7]

Q What is an Ellik bladder evacuator and how is it used?

An EE is a 3-ball device that attaches to the sheath of a rigid endoscope and provides a way to flush saline into the bladder and then apply suction to remove fluid and stones. Cystoliths collect in the gravity-dependent ball of the device and are easily retrieved for stone analysis (**FIGURE 5A AND 5B**). The device was originally designed to collect pieces of bladder tumors after transurethral resection, a procedure that uses cautery to remove or debulk bladder tumors, and is now most often used for patients with many cystoliths.

FIGURE 4. Lithotripsy laser on stone.

An EE works best with a 15-Fr resectoscope that uses a 2.9-mm 0° telescope and biopsy bridge. The fit between the EE and resectoscope sheath needs to be snug. The EE is filled with saline, and the clinician positions the rigid endoscope with the resectoscope at the neck of the bladder. Then, the telescope and bridge are removed. The EE is connected to the resectoscope sheath by using a custom 3D-printed adaptor (**FIGURE 6**). Using a figure-8 motion, the compressible bulb of the EE is alternately depressed and released. Bulb depression infuses saline through the sheath into the bladder. Releasing the bulb creates a vacuum to

FIGURE 5. (A) Ellik bladder evacuator (EE) usage. **(B)** EE with stones.

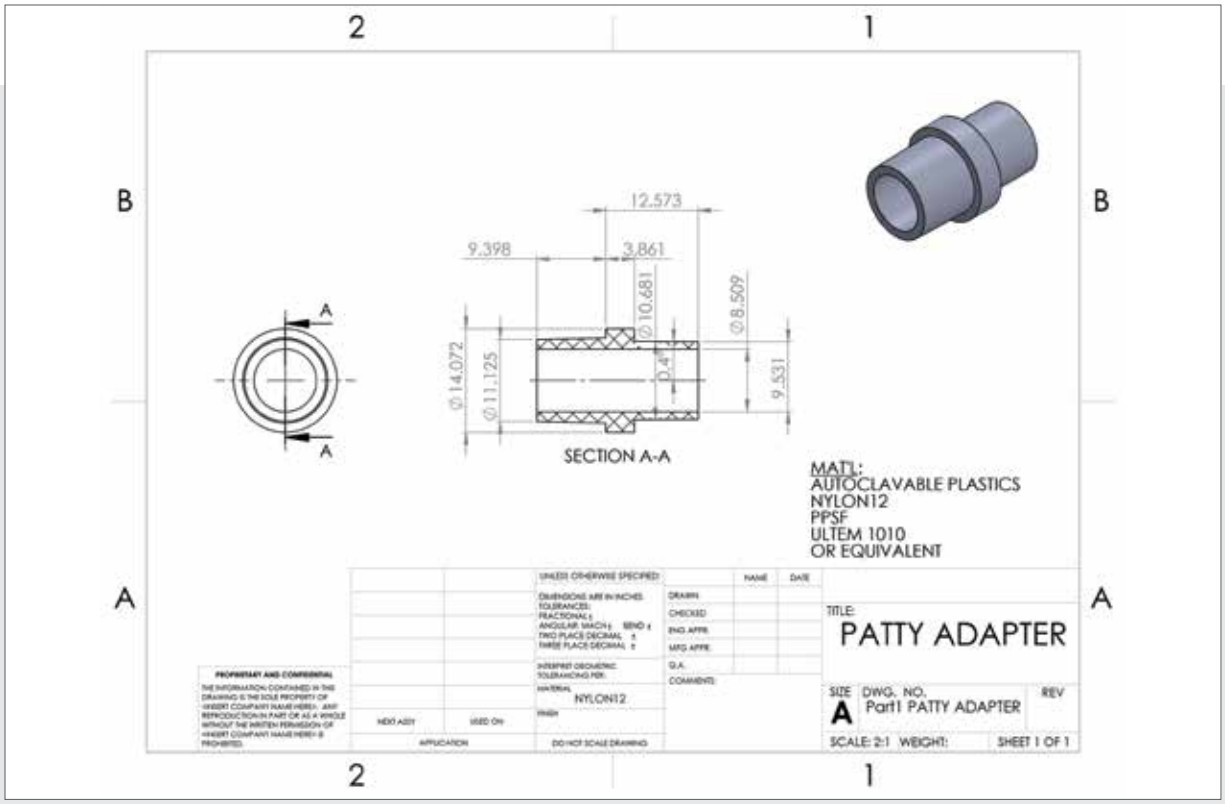

FIGURE 6. 3D-printed adaptor for resectoscope.

remove the mixture of saline, urine, cystoliths, and sediment. During the procedure, a veterinary nurse must keep a hand on the patient's abdomen over the bladder. The veterinary nurse should monitor bladder size and turgidity to minimize the risk for overfilling the bladder, which can cause bladder mucosal tearing.

In addition, a veterinary nurse can facilitate stone removal by agitating the bladder during suction (at the release of the bulb). Periodically, the EE is removed and replaced by the endoscope and bridge to see if all stones have been successfully removed (see **VIDEO 1**).[8]

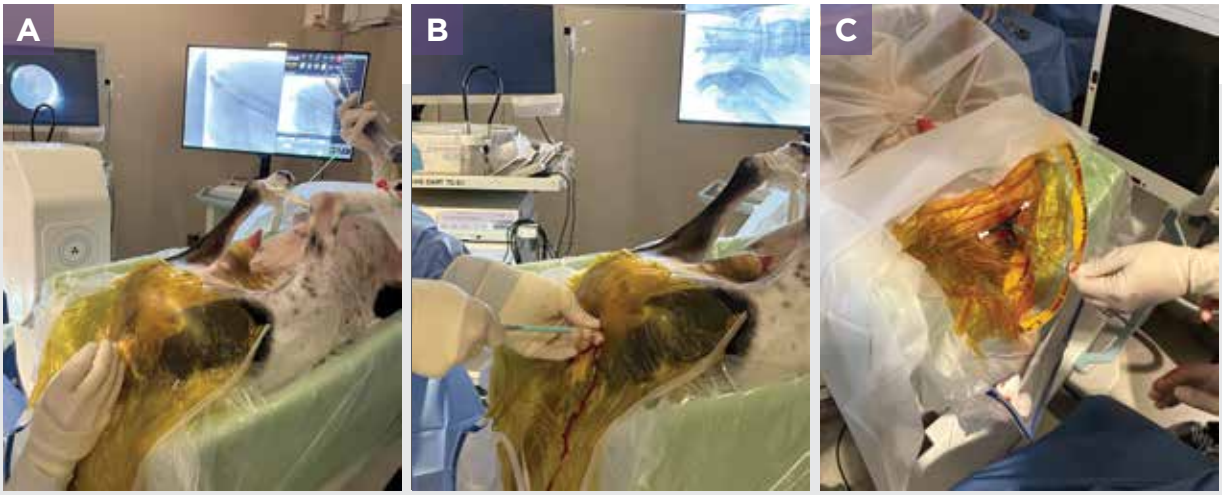

FIGURE 7. (A) Perineal approach. **(B)** Dilation for perineal approach. **(C)** Access sheath with perineal approach.

FIGURE 8. Use of an Ellik bladder evacuator with the perineal approach.

For male dogs, a perineal approach to the straight portion of the urethra is used to enable the use of the resectoscope and EE (**FIGURE 7A**). A small incision is made at the perineum, and a Foley catheter is placed in the urethra with the balloon at the flexure to dilate the part of the urethra that is closer to the perineum. Using fluoroscopy and a flexible endoscope, the urethra is accessed by inserting a 2-in, 18-g hypodermic needle through the perineum into the urethra. When the Foley balloon is punctured by the hypodermic needle, the catheter is removed. A 0.025-in hydrophilic guidewire is passed through the needle until it reaches the bladder. The area from the perineum to the urethra is dilated with a 12-Fr vascular dilator passed over the guidewire, then again with a 16-Fr dilator (**FIGURE 7B**). A 16-Fr peel-away introducer access sheath is passed over the guidewire and then removed (**FIGURE 7C**). The peel-away portion is adjusted to an appropriate length to enable visualization of the neck of the bladder through the endoscope and then stapled to the perineum. Through the access sheath, the resectoscope and EE can be used for stone removal (**FIGURE 8**). If needed, lithotripsy can be used on larger stones before stone removal with an EE.

VIDEO 1
Noninvasive removal of cystoliths using an Ellik bladder evacuator

SUMMARY

Noninvasive methods for removing cystoliths represent a significant advance in veterinary medicine, offering safer and less invasive alternatives to traditional surgical procedures. Through methods such as voiding urohydropulpulsion; catheter-assisted retrieval; and cystoscopy with the use of laser lithotripsy, stone retrieval baskets, and/or an EE, veterinary professionals can effectively manage cystoliths with improved clinical outcomes and reduced patient morbidity. **TVN**

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