Case Report

jfms OPEN REPORTS

*Journal of Feline Medicine and Surgery Open Reports*
1–5

DOI: 10.1177/20551169231220248
journals.sagepub.com/home/jfmsopenreports

This paper was handled and processed by the American Editorial Office (AAFP) for publication in *JFMS Open Reports*

Sage

# Cystoscopic-guided laser ablation of intramural ectopic ureters in a female cat

**Nicole H Gibbs, Larry G Adams, Masahiro Murakami, Julie Commons and Sarah ML Steinbach**

## Abstract

*Case summary* An 8-month-old female spayed domestic shorthair cat was presented for chronic urinary incontinence (UI). Since being adopted 6 months earlier, the cat had a history of urine leakage during both activity and rest. Baseline blood work and urine culture showed no significant abnormalities and no evidence of a urinary tract infection. An abdominal CT with excretory urography followed by a focal urinary tract ultrasound revealed a suspected right intramural ectopic ureter (EU) and potential left EU. Cystoscopy confirmed bilateral intramural EUs. Cystoscopic-guided laser ablation (CLA) of both EUs was performed. The cat developed temporary urinary obstruction (UO) 36 h after the procedure, which was medically managed with prazosin and buprenorphine. Ultimately, the cat's urinary signs completely resolved with no UI recognized after the procedure and the cat has remained continent during 18 months of follow-up.

*Relevance and novel information* CLA of intramural EUs is routinely performed in dogs, but this technique has not been previously reported in cats with this condition. Although post-procedural urinary tract signs were initially present, the cat ultimately had an excellent outcome with resolution of UI after this procedure.

**Keywords:** Ectopic ureters; laser ablation; minimally invasive; incontinence

**Accepted:** 22 November 2023

## Introduction

Urinary incontinence (UI) is an uncommon clinical presentation in cats, accounting for less than 0.25% of hospital admissions and only 4% of cats that present to referral hospitals with a complaint of lower urinary tract signs.[1–3] The most common disease process leading to UI in cats is neurologic disease followed by urethral disease.[2,3] Congenital causes, including spinal cord malformations, congenital urethral sphincter mechanism incompetence and ectopic ureters (EUs), are uncommon.[2–6] EUs account for 12.5–52.6% of cats with congenital etiologies of UI.[2,4]

EUs are classified as being intramural or extramural. Intramural EUs enter the bladder wall in a normal anatomic position but fail to penetrate through the bladder wall, and instead tunnel within the submucosa opening further distally in the urethra or lower genital tract.[7] Extramural EUs completely bypass the urinary bladder and terminate in the urethra or lower genital tract.[7] There is limited information on treatment options for feline EUs, with most studies discussing ureteral surgery in the light of other diseases.[6,8–10]

Several studies evaluate treatment options for canine EUs.[11–14] These include cystoscopic-guided laser ablation (CLA) or surgical correction using a variety of techniques.[7] Complications associated with surgery include the development of uroabdomen, hematuria, stranguria and progressive hydroureter and/or hydronephrosis due to stricture at the ureterovesical implantation site.[15]

Department of Veterinary Clinical Sciences, College of Veterinary Medicine, Purdue University, West Lafayette, IN, USA

**Corresponding author:**
Nicole H Gibbs DVM, Department of Veterinary Clinical Sciences, College of Veterinary Medicine, Purdue University, 625 Harrison Street, West Lafayette, IN 47907, USA
Email: nicolehgibbs@gmail.com

CLA is a minimally invasive technique for intramural EUs, whereas surgical reimplantation can be utilized in EUs of either type.[7] With CLA, the tissue of the free wall of the EU adjacent to the urethral lumen is transected using a cystoscopic-guided laser until the opening is within the urinary bladder.[7]

The major advantages of CLA compared with surgery include lower cost, decreased hospitalization time, lower minor complication rate, correction of distal intramural tunnel of the EU and the ability to evaluate the distal urogenital structures for other abnormalities.[12,13] Complications of canine CLA include hematuria, stranguria and perforation leading to urine leakage.[12,13] Regardless of therapeutic strategy, continued UI is a risk due to concurrent developmental abnormalities.[7,12–14]

To date, there are only reports of surgical correction of feline EUs[6,8] and the use of CLA for intramural EUs in cats has not been previously reported.

## Case description

An 8-month-old female spayed domestic shorthair cat was presented to the Purdue University Veterinary Hospital Nephrology/Urology Service for chronic UI. The cat had reported UI occurring since adoption 6 months earlier. Normal voiding with appropriate utilization of the litter box was observed otherwise. The urine leakage occurred both while sleeping and during activity. Before presentation, the cat had several urinalyses performed that showed well-concentrated urine. Hematuria was noted without pyuria or bacteriuria and suspected to be secondary to cystocentesis. The cat was previously treated with cefovecin (Convenia; Zoetis) and orbifloxacin 7 mg/kg PO q24h (Orbax; Merck) with no change in clinical signs. The cefovecin dosage could not be discerned from prior medical records. Cefovecin had last been given 2.5 weeks before presentation and orbifloxacin had been started 6 days before presentation. The cat was otherwise healthy. The cat had been spayed before adoption, with no information available regarding details of that procedure. At the time of presentation, her treatment included orbifloxacin and silver sulfadiazine cream, USP 1% (Ascend Laboratories) applied topically to the perivulvar area twice daily.

On presentation, a physical examination revealed a body condition score of 7/9 and perivulvar dermatitis with urine scalding. A complete blood count and serum biochemistry showed no significant abnormalities. As only a small amount of urine could be obtained by cystocentesis and prior urinalyses were unremarkable, a urine culture was prioritized and showed no growth within 24 h.

To further investigate the cause of UI, an abdominal CT (64-slice multidetector CT machine, Light Speed VCT; GE Medical Systems) with excretory urography (iohexol 1.8 ml/kg IV) and a focal urinary tract ultrasound (Aplio i800; Canon Medical Systems USA) were performed under general anesthesia. On abdominal CT, the right ureter coursed by the urinary bladder neck, mildly dilated with contrast, and the majority of contrast coursed caudally along the ventral aspect of the urethra in a tubular fashion. This finding suggested a likely right EU (Figure 1). The left ureter joined the urinary bladder at a similar level with less contrast filling and no distension. It was concluded that there was a possible left EU, given the caudal location and urethral contrast filling, but this could not be confirmed on imaging. A focal urinary tract ultrasound suggested the right EU was intramural (Figure 2).


**Figure 1** Multiplanar reconstruction with maximum intensity projection CT image of the lower urinary tract of the cat, 4 mins after intravenous contrast administration. Insertion of the right ureter (arrows) was seen at the urinary bladder neck region with contrast extending distally along the urethra (arrowheads) before filling the bladder, indicating right intramural ectopic ureter. UB = urinary bladder

Rigid cystoscopy was performed using a 9.5 Fr cystoscope (Karl Storz) with an operating telescope 30° lens and a working length of 14 cm. The cystoscope was advanced retrograde transurethrally using irrigation with 0.9% saline. Bilateral EUs and a vaginal septum were identified. The remaining structures were unremarkable. The right ureteral opening was identified in the mid to distal urethra (Figure 3), whereas the left ureteral opening was identified in the proximal urethra (Figure 4). Under fluoroscopic guidance, a 0.018 inch × 150 cm angled/regular taper hydrophilic coated guidewire (Weasel Wire; Infiniti Medical) was introduced into the left ureteral opening. A 3 Fr × 70 cm open-end ureteral catheter (Cook Medical) was advanced over the guidewire to catheterize the left ureter. The cystoscope was removed over the ureteral catheter and a pulsed CTH:YAG 400-micron (holmium:yttrium aluminum garnet) laser fiber (Odyssey Holmium Laser

**Figure 2** Ultrasound image of intramural right ectopic ureter. Indicated by the arrows, an echoic tubular structure with a thin hyperechoic wall-like structure is seen cranially from the urinary bladder neck and extends caudally along the proximal urethra. This tubular structure can be followed cranially to converge with the right ureter entering the region of the urinary bladder neck. EU = ectopic ureter

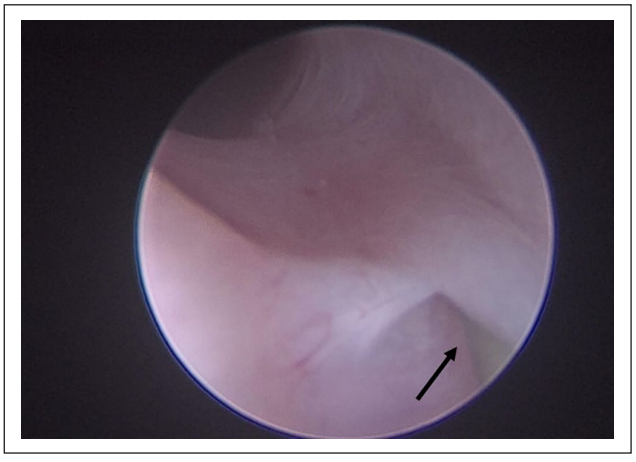

**Figure 3** Right ureteral opening identified during cystoscopy. The right ureter was identified in the mid to distal urethra. A hydrophilic coated guidewire was inserted into the ureteral opening as depicted in this picture

Fiber; Convergent Laser Technologies) connected to the Odyssey 30 Holmium Laser System (Convergent Laser Technologies) was inserted into the working channel of the cystoscope. The cystoscope was then reintroduced, and the medial aspect of the ureteral wall was transected from the distal ureteral opening proximally to the level of the bladder urethral junction via laser ablation (2100 nm 700 ms, 12 Hz × 0.6 J). These steps were repeated to correct the right EU (Figure 5). The vaginal septum was corrected

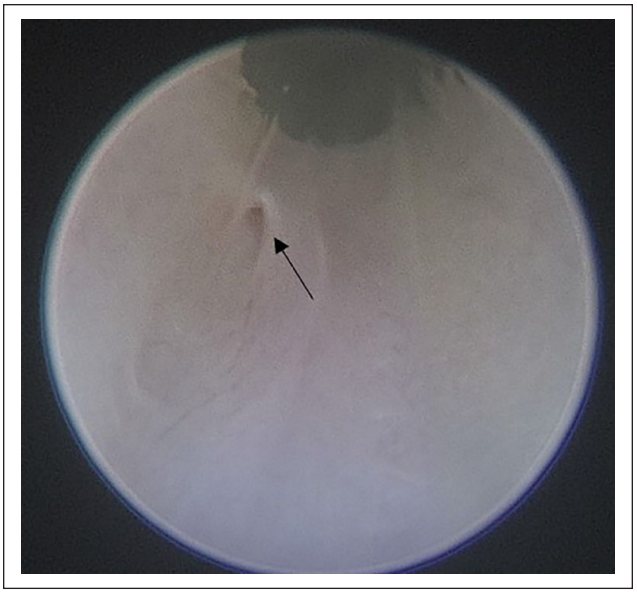

**Figure 4** Left ureteral opening identified with cystoscopy. The arrow is pointing to the left ureteral opening located in the proximal urethra

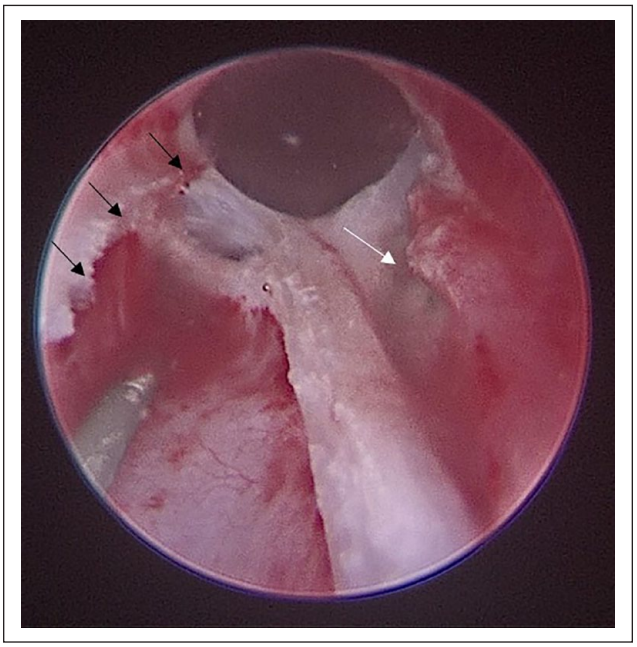

**Figure 5** Urethra after laser ablation. The black arrows are pointing to the cut edge after laser ablation of the right ureter. The white arrow is pointing to the tract left behind after laser ablation of the left ureter

using laser ablation as well. The cat recovered well from anesthesia with no immediate post-procedural complications. Methadone (Mylan) 0.2 mg/kg IV and robenacoxib 2 mg/kg SC (Onsior; Elanco) were given on recovery from the procedure for analgesia. An additional oral dose of

robenacoxib (1.8 mg/kg) was given the next day. Due to a mucosal surface injury from laser ablation, amoxicillin clavulanate (Clavamox; Zoetis) 15.2 mg/kg PO q12h was given for 5 days to prevent urinary tract infections, as the previously prescribed orbifloxacin was not available and the need for continued fluorquinolone therapy was questionable with previous negative urine culture.

Although the cat initially had normal urination postoperatively, approximately 36 h after the procedure, the cat had a large urinary bladder and was straining without urine production. Hematuria was noted on the bedding. Prazosin (Mylan) 0.3 mg/kg PO q12h and buprenorphine (Par) 0.03 mg/kg transmucosal q12h were started for urethral relaxation and pain management, respectively. Robenacoxib was discontinued in preparation for starting prednisolone (0.9 mg/kg q24h PO) to allow for a longer course of anti-inflammatory medication. Within the next 12 h, the cat was able to produce urine; however, pollakiuria, stranguria and gross hematuria were noted. Due to severe pollakiuria, a cystocentesis was not possible, and urinalysis with urine culture from free-catch urine was performed, which revealed severe hematuria. Urine culture grew $<10^3$ colony-forming units/ml of *Enterococcus faecium*, which was considered a contaminate, and postoperative inflammation was suspected to be the source of the hematuria, pollakiuria and stranguria.

The patient was discharged 2 days after the procedure with a 20-day tapering course of prednisolone. The initial prednisolone dosage was 0.9 mg/kg PO q24h for 5 days followed by 0.6 mg/kg PO q24h for 5 days, then 0.3 mg/kg PO q24h for 5 days, and finally 0.3 mg/kg q48h for 5 days before being discontinued. In addition, a 7-day course of prazosin and transmucosal buprenorphine to be used as needed were prescribed at the same dosage as utilized in hospital. After discharge, hematuria and stranguria dissipated after 5 days. No UI was observed at home after the procedure.

## Discussion

This is the first report of CLA being performed for intramural EUs in a cat. Postoperative lower urinary tract signs and transient urinary obstruction (UO) occurred. In dogs undergoing CLA, hematuria and stranguria are documented complications.[12] Similar to these complications in dogs, the signs were able to be medically managed and fully resolved within 7 days after the procedure. The successful treatment of UI was accomplished by correcting this cat's intramural EUs with CLA.

Ureteral surgeries in cats can be challenging, especially when ureteral dilation is not present.[9,10] With reinsertion of the ureter, renal pelvic dilation commonly occurs and is suspected to occur due to partial obstruction at the implantation site.[9] There are few reports of EU correction being performed in cats. In one case report describing the surgical repair of EUs in a male cat, postoperative azotemia and uroabdomen developed, requiring a second surgery.[8] Although this cat recovered, the complications from the procedure led to increased morbidity. In dogs, CLA of intramural EUs is associated with a lower complication rate, decreased hospitalization time and lower cost when compared with surgical management.[12,13] In the present case report, CLA led to the successful treatment of UI in a cat with minor complications that could be medically managed. Given the challenge of ureteral surgery in cats, CLA may be a safe and effective alternative to surgery for correction of intramural EUs.

UO occurred approximately 2 days after the procedure in the cat. Post-procedural inflammation with potential urethral spasms was suspected to be the cause of the UO. Given the small size of the feline urethra and inflammation induced by cystoscopy in cats, there may be an increased risk of UO after CLA compared with dogs. The authors have previously observed transient UO in a female cat after cystoscopy for basket extraction of urocystoliths. Medical management using prazosin, an α-1 adrenergic antagonist, as well as buprenorphine appeared to resolve the UO in this case after CLA. This may indicate that urethral spasms played a significant role in this cat's UO. Prazosin acts on the proximal urethra to prevent urethral spasm, which is where the most irritation and inflammation would be occurring after CLA.[16] Further investigation may be warranted to evaluate if the post-procedural α-1 adrenergic antagonist treatment may be helpful for the prevention of urethral spasms that could contribute to UO in cats undergoing CLA. Alternatively, the routine use of an indwelling urinary catheter for 24–48 h postoperatively could be considered to mitigate post-procedural UO.

## Conclusions

Although CLA is a commonly described procedure in dogs with intramural EUs, this is the first report of this technique being utilized in a cat. Lower urinary tract signs and UO are potential complications of this procedure in cats. CLA of intramural EUs is a safe and effective procedure that can be considered in female cats with this condition.

**Acknowledgements** The authors would like to acknowledge Maxime Derré and Madalyn Trowbridge for their care of the cat during hospitalization.

**Conflict of interest** The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Funding** The authors received no financial support for the research, authorship, and/or publication of this article.

**Ethical approval** The work described in this manuscript involved the use of non-experimental (owned or unowned)

animals. Established internationally recognized high standards ('best practice') of veterinary clinical care for the individual patient were always followed and/or this work involved the use of cadavers. Ethical approval from a committee was therefore not specifically required for publication in *JFMS Open Reports*. Although not required, where ethical approval was still obtained, it is stated in the manuscipt.

**Informed consent** Informed consent (verbal or written) was obtained from the owner or legal custodian of all animal(s) described in this work (experimental or non-experimental animals, including cadavers) for all procedure(s) undertaken (prospective or retrospective studies). No animals or people are identifiable within this publication, and therefore additional informed consent for publication was not required.

**ORCID iD** Nicole H Gibbs https://orcid.org/0000-0002-2780-9366
Masahiro Murakami https://orcid.org/0000-0001-7816-8311

## References

1 Lekcharoensuk C, Osborne CA and Lulich JP. **Epidemiologic study of risk factors for lower urinary tract diseases in cats.** *J Am Vet Med Assoc* 2001; 218: 1429–1435.
2 Lonc KM, Kaneene JB, Carneiro PAM, et al. **Retrospective analysis of diagnoses and outcomes of 45 cats with micturition disorders presenting as urinary incontinence.** *J Vet Intern Med* 2020; 34: 216–226.
3 Mérindol I, Dunn M and Vachon C. **Feline urinary incontinence: a retrospective case series (2009-2019).** *J Feline Med Surg* 2022; 24: 506–516.
4 Holt PE and Gibbs C. **Congenital urinary incontinence in cats: a review of 19 cases.** *Vet Rec* 1992; 130: 437–442.
5 Banes SJ, Speakman AJ, Williams JM, et al. **Genitourinary dysplasia in a cat.** *J Small Anim Pract* 1999; 40: 286–290.
6 Eisele JG, Jackson J and Hager D. **Ectopic ureterocele in a cat.** *J Small Anim Pract* 2005; 41: 332–335.
7 Kruger JM, Bartges JW and Ballegeer EA. **Congenital diseases of the lower urinary tract.** In: Ettinger SJ, Feldman EC and Côté E (eds). Textbook of veterinary internal medicine. 8th ed. St Louis, MO: Elsevier, 2017, pp 2027–2031.
8 Di Mauro FM, Singh A, Reynolds D, et al. **Combined use of intravesicular ureteroneocystostomy techniques to correct ureteral ectopia in a male cat.** *J Am Anim Hosp* 2014; 50: 71–76.
9 Mehl ML, Kyles AE, Pollard R, et al. **Comparison of 3 techniques for ureteroneocystostomy in cats.** *Vet Surg* 2005; 34: 114–119.
10 Gregory CR, Lirtzman RA, Koshin EJ, et al. **A mucosal apposition technique for ureteroneocystostomy after renal transplantation in cats.** *Vet Surg* 1996; 25: 13–17.
11 Berent AC, Mayhew PD and Porat-Mosenco Y. **Use of cystoscopic-guided laser ablation for treatment of intramural ureteral ectopia in male dogs: four cases (2006–2007).** *J Am Vet Med Assoc* 2008; 232: 1026–1034.
12 Dekerle B, Maurice E, Decambron A, et al. **Outcomes of 25 female dogs treated for ectopic ureters by open surgery or cystoscopic-guided laser ablation.** *Vet Surg* 2022; 51: 568–575.
13 Hoey CSFK, Friend E, Meakin LB, et al. **Long-term outcome of female dogs treated for intramural ectopic ureters with cystoscopic-guided laser ablation.** *Vet Surg* 2021; 50: 1449–1462.
14 Ho LK, Troy GC and Waldron DR. **Clinical outcomes of surgically managed ectopic ureters in 33 dogs.** *J Am Anim Hosp* 2011; 47: 196–202.
15 Mathews K. **Ureters.** In: Johnston SA and Tobias KM (eds). Veterinary surgery: small animal. 2nd ed. St Louis, MO: Elsevier, 2017, pp 2202–2218.
16 Frenier SL, Knowlen GG, Speth RC, et al. **Urethral pressure response to alpha-adrenergic agonist and antagonist drugs in anesthetized healthy male cats.** *Am J Vet Res* 1992; 53: 1161–1165.