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Case Report

J Vet Intern Med 2015;29:727–731**Treatment of a Urethral Duplication in a Dog Using Cyanoacrylate and Coil Embolization**

C.A. Palm, C.B. Glaiberman, and W.T.N. Culp

Key words: Anomaly; Embolic; Glue; Interventional Radiology; Urethra.

A 3-year-old male castrated golden retriever was presented to the University of California-Davis Veterinary Medical Teaching Hospital (UCD VMTH) for evaluation of urinary incontinence. The dog had a history of urinary incontinence since 6 weeks of age; however, the incontinence had worsened during the 3 months before initial presentation to the UCD VMTH. The owners reported that the dog was able to urinate normally, with no urine stream alteration, straining or hematuria. The dog was treated with phenylpropanolamine (dose unknown) 1 year before presentation to the UCD VMTH, but this had been discontinued 3 months before his evaluation. His owners reported no other abnormal medical history, trauma or surgeries, other than a routine castration that was performed when the dog was approximately 24 months of age.

On initial evaluation at the UCD VMTH, the dog was bright, alert, and responsive with normal vital parameters (temperature 101.8°F [reference range: 100.5–102.5°F]). His heart rate was 140 beats/min, and he was panting. Body weight was 40.4 kg, and he was noted to have a body condition score of 6 (on a scale of 9). On initial physical examination, his abdomen was soft and nonpainful, and his external genitalia appeared within normal limits. Rectal examination demonstrated that the palpable urethra was smooth and symmetrical and no stones or masses were palpate. The prostate was not palpable and no abnormalities were noted in other body systems.

CBC and biochemistry were within normal limits. Urine had a specific gravity of 1.037, a pH of 7, 8–12 white blood cells/hpf (reference range: 0–2 white blood

Abbreviation:

UCD-VMTH University of California-Davis Veterinary Medical Teaching Hospital

cells/hpf) and clusters of cocci. The urine culture yielded *Staphylococcus pseudintermedius* (beta-lactamase negative) and *Staphylococcus intermedius*. Both bacteria were sensitive to all antibiotics evaluated except that the *Staphylococcus intermedius* was resistant to penicillin. An abdominal ultrasound was performed and was within normal limits. Abdominal ultrasound revealed a normal urinary tract, however, only the right ureterovesicular junction was identified.

While abdominal ultrasound did not reveal any abnormalities, the lifelong presence of urinary incontinence was still suggestive of a possible congenital urinary tract abnormality, and cystourethroscopy and contrast cystourethrogram were recommended. The dog was premedicated with atropine (0.03 mg/kg SC) and morphine (0.7 mg/kg SC). Anesthetic induction was performed with ketamine (3.2 mg/kg IV) and midazolam (0.25 mg/kg IV) through a cephalic vein catheter. Anesthesia was maintained with isoflurane in oxygen. The dog was placed in right lateral recumbency on a table in the fluoroscopic suite. The prepuce was clipped, prepared with sterile technique and draped. A 7.5-Fr, 67.5-cm working length, 270° deflection flexible urethroscope^a was introduced into the urethra. The urethroscope was passed into the urinary bladder and a complete evaluation of the urinary bladder, ureteral openings, and urethra was performed; no abnormalities were seen, and the ureteral openings were noted to be in the correct location. An 8-Fr red rubber catheter^b was then introduced into the urethra. The urinary bladder was filled with a 50%/50% combination of iodinated contrast^c and saline to ensure that the bladder was full, but not overly turgid. When the bladder was full, a retrograde contrast cystourethrogram was performed by slowly removing the urinary catheter while a continuous injection of the contrast : saline mixture was performed. The cystourethrogram revealed a tubular structure extending from the prostatic urethra and ending into a blind pouch at the level of the distal prepuce (Fig 1); a congenital urethral duplication was diagnosed as an accessory urethra was found to originate dorsally and to the left of the normal urethra. The prepuce was palpated at this point, and a soft swelling was noted that had not been previously appreciated during physical examination.

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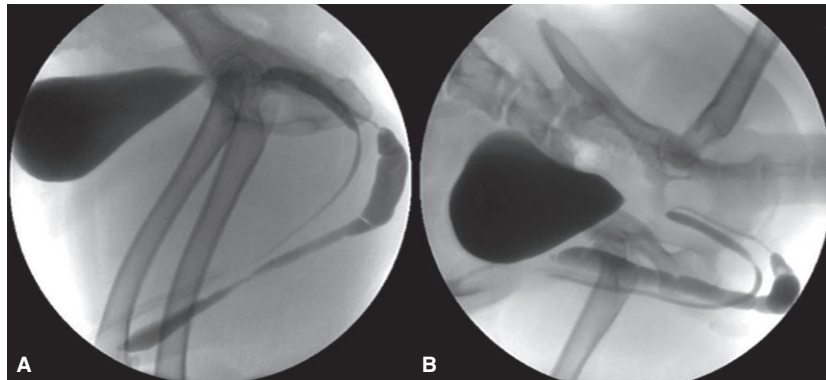


Fig 1. Lateral (A) and oblique (B) fluoroscopic images obtained during retrograde contrast cystourethrography. (A) In the lateral fluoroscopic projection, both the normal and accessory urethra with a blind-ending pouch can be noted. (B) Note the orifice of the accessory urethra at the level of the pelvic urethra.

The urethroscope was again introduced in an attempt to visualize the opening into the accessory urethra. A possible pinpoint opening was noted in the region of the prostatic urethra, but was not definitive and it was not possible to cannulate with a 0.035-inch hydrophilic guide wire.^d Ultrasonography of the preputial swelling was also performed and demonstrated a fluid-filled sac located ventral and lateral to the penis at the distal aspect of the prepuce. After completion of the above imaging diagnostics, the dog was recovered from anesthesia and no complications were encountered during recovery. Total anesthesia time was 4 hours; time for cystourethroscopy was 55 minutes, time for contrast cystourethrography was 10 minutes, and time for ultrasound was 20 minutes.

The dog was discharged the same day with the plan of treating the urinary tract infection and considering treatment options for the urethral duplication. Amoxicillin/clavulanic acid (15 mg/kg PO q12 hours) was prescribed for 2 weeks. Several treatment options were discussed with the owners including abdominal exploration with attempted surgical ligation of the opening of the accessory urethra or resection of the entire accessory urethra, as well as minimally invasive occlusion of the accessory urethra via an interventional radiology technique such as glue embolization.

The dog was re-presented to the UCD VMTH 2 months later; urinary incontinence had continued during the recheck interim. A urine culture obtained 5 days before this evaluation demonstrated no bacterial growth. Physical examination was unchanged and clinical laboratory parameters were within normal limits. His weight at this visit was 39 kg. Abdominal radiographs performed at this time revealed no abnormalities. After discussion, owners elected to proceed with minimally invasive treatment of the accessory urethra with combination of sterile glue (cyanoacrylate) and coils.

The dog was premedicated with glycopyrrolate (0.005 mg/kg, IM) and morphine (0.7 mg/kg IM), and anesthetic induction was performed with ketamine (2 mg/kg, IV) and propofol (3 mg/kg, IV). Anesthesia

was maintained with isoflurane in oxygen. The dog was placed in right lateral recumbency on a table in the fluoroscopic suite, and the prepuce was clipped, prepared with sterile technique and draped.

An 8-Fr red rubber catheter was introduced into the urethra and a contrast cystourethrography utilizing a 50%/50% mixture of contrast and saline was performed; the accessory urethra was again noted and was similar in appearance to the study performed previously. An 0.035-inch, 180-cm long hydrophilic guide wire^d was introduced into the urethra and passed into the bladder. A 7-Fr introducer sheath/dilator^e combination was passed into the urethra over the guide wire and the dilator was removed. A 7-Fr balloon dilatation catheter^f was placed over the guide wire to the level of the opening into the accessory urethra but was not inflated. A 22-gauge over-the-needle catheter^g was then introduced into the blind pouch percutaneously (distal aspect of the prepuce), and the needle was removed. The hydrophilic guide wire was introduced into the accessory urethra (retrograde) and passed through the opening of the accessory urethra into the normal urethra, and then into the urinary bladder. The over-the-needle catheter was removed over the guide wire, and a stab incision (using a #11 scalpel blade) was made in the prepuce in the region of the guide wire to allow for the passage of a 4-Fr introducer sheath/dilator^h combination into the accessory urethra. The dilator was removed from the introducer sheath, and a 4-Fr angled catheterⁱ was passed over the guide wire and through the introducer sheath to the proximal aspect into the accessory urethra. A 3-Fr microcatheter^j and 0.018-inch, 180-cm, hydrophilic guide wire^k combination were then coaxially introduced into the angled catheter and passed to the level of the proximal aspect of the accessory urethra; the angled catheter was retracted slightly to allow the microcatheter to be exposed, and the 0.018-inch guide wire was removed. An 0.018-inch embolization coil^l was then introduced into the microcatheter and deployed at the proximal aspect of the accessory urethra to act as a scaffold for the cyanoacrylate. A second coil was placed in a similar fashion (Fig 2).

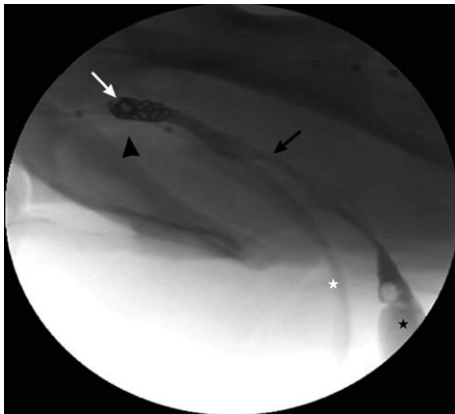


Fig 2. Fluoroscopic image after coil placement. Black arrow—The tip of the angled catheter can be visualized in the accessory urethra. White arrow—2 coils can be seen in the proximal aspect of the accessory urethra (black star). Triangle—The balloon can be visualized (note the black markers delineating the extent of the balloon) in the normal urethra (white star) in a position directly over the orifice of the accessory urethra.

The balloon of the dilatation catheter, which was positioned in the normal urethra, was then inflated to cover the opening of the accessory urethra, to prevent movement of cyanoacrylate into the normal urethra (Fig 2). The microcatheter was retracted 1 cm distally to the proximal aspect of the accessory urethra and flushed with a solution of 5% dextrose in water. Two milliliter of cyanoacrylate^m and 1 mL of ethiodized oilⁿ were introduced into a sterile glass container and were mixed with a sterile glass syringe. Two milliliter of the cyanoacrylate : ethiodized oil mixture was suctioned into a glass syringe and the syringe was attached to the microcatheter. The cyanoacrylate:ethiodized oil mixture was slowly injected through the microcatheter in the region of the coils with gentle retraction of the microcatheter immediately after injection, to prevent gluing of the catheter inside the accessory urethra. The balloon dilatation catheter, that was positioned in the normal urethra, was left inflated and in position over the opening into the accessory urethra for 10 minutes before deflation of the balloon to prevent gluing of the normal urethra. Upon deflation of the balloon, the balloon dilatation catheter was removed, and a contrast cystourethrogram was performed by injecting a newly placed Foley catheter with a 50%/50% mixture of contrast and saline. No filling of the accessory urethra was noted and the normal urethra remained patent with no evidence of glue present. A new 8-Fr Foley urinary catheter was introduced into the urethra and left in place at the completion of the procedure. The dog recovered uneventfully from anesthesia and spent the night in the hospital wards. Total anesthesia time was 4 hours and 15 minutes; the procedure time for cyanoacrylate and coil embolization was 1 hour and 15 minutes. A post-procedural radiograph demonstrated appropriate placement of the coils (Fig 3).

The urinary catheter was removed the next morning, and the dog was urinating normally at that time. The

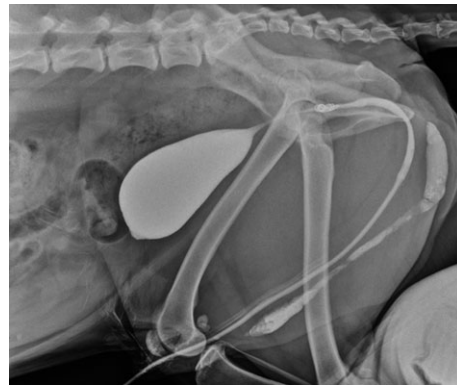


Fig 3. Lateral radiograph obtained during a contrast cystourethrogram immediately after coil and cyanoacrylate embolization. A urinary catheter can be visualized in the perineal urethra and contrast is being injected. The coils can be visualized at the origin of the accessory urethra and no contrast is filling the accessory urethra during the contrast cystourethrogram. In this image, the contrast present in the accessory urethra was introduced during the original contrast cystourethrogram before embolization and has been incorporated into the cyanoacrylate within the accessory urethra.

dog was discharged 1 day after the procedure. The owners noted hematuria for 3 days after the procedure and occasional urine dribbling; this resolved without treatment. The dog was reevaluated 1 month after the procedure and was noted to be clinically normal with no urinary incontinence. Radiographs performed at that time demonstrated static positioning of the coils and near complete resorption of the previously noted contrast in the accessory urethra (Fig 4). In addition, a urine culture performed at that time was negative for bacterial growth. The dog is now 29 months postembolization and is clinically normal.

The embryologic cause of urethral duplication is unknown in dogs, and even in human patients, where urethral duplication has been extensively studied, the embryologic cause of urethral duplication is not completely understood.¹ In humans, urethral duplication is a rare diagnosis, but presents a clearly identified clinical syndrome with several established classification systems defined.¹ One classification definitively diagnoses urethral duplication only when a second urethra originates from the bladder, bladder neck, or prostatic urethra (as was the case in the dog of this report).² Another system classifies cases of urethral duplication by the position of the duplicate urethra as compared to the normal urethra.³ In this system, sagittal duplications are classified when the duplication occurs above or below the normal urethra and collateral duplications are those in which the 2 urethras are positioned side by side.³ While the duplicated urethra of the dog of this report would likely be considered as a *sagittal* duplication because of the dorsal position in comparison to the normal urethra, it was located slightly to the left of the normal urethra as well.

During preputial examination performed after knowledge of the presence of an accessory urethra, the dog of

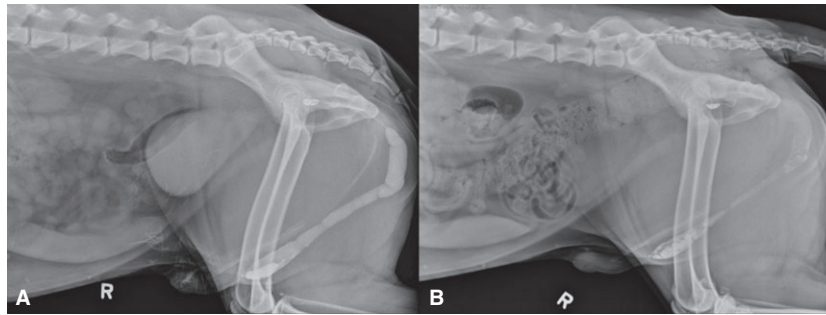


Fig 4. Right lateral radiographs obtained 1 day (A) and 1 month (B) after coil and cyanoacrylate embolization. The coil position was maintained over the month and the contrast in the accessory urethra has been nearly resorbed.

this report was found to have a distended prepuce during the first anesthetic event. The duplicate urethra was fluid-filled and distinct from the penis, only noticeable when the dog was in dorsal recumbency, and after performing a contrast cystourethrogram. It is likely that the duplicate urethra filled during normal voiding of the urinary bladder, and then drained over time, resulting in the intermittent urinary incontinence. Preprocedural plain radiographs of the bladder and urethra did not reveal any abnormalities, including no widening of the pubic symphysis, as has been reported in human patients with urethral duplication.¹

The clinical findings of urinary incontinence and urinary tract infection in this dog, are similar to the findings most commonly seen in humans diagnosed with urethral duplication.⁴ A urinary tract infection was treated and eventually eliminated in this dog, as it has not recurred since coiling and gluing of the duplicate urethra.

A diagnosis was not obtained in this dog after the evaluation of clinical laboratory testing, abdominal radiographs, and abdominal ultrasound. Cystourethroscopy demonstrated that the ureteral orifices were in a normal location, and there was evidence for a possible, but nondistinct lesion in the prostatic urethra. The cystourethrogram was critical for diagnosis of the urethral duplication. In the authors' opinion, performance of contrast radiography in dogs with a history of lifelong incontinence is mandatory. For the dog of this report, there was a possible abnormality noted on urethroscopy, however, appropriate diagnosis would have been missed without contrast radiography.

There have been 2 previous case reports describing urethral duplication in dogs. In 1 case,⁵ several fluctuant swellings were noted around the prepuce and the dog was noted to be incontinent. Evaluation of the fluid in the swellings revealed a creatinine that was consistent with urine as well as a positive bacterial culture (*Escherichia coli*). Contrast cystourethrography failed to identify a communication between the normal urethra and accessory urethra in that dog, although a direct puncture of the swelling clearly delineated several sacculations that appeared to have a connection through a small tube to the prostatic urethra. This dog underwent open surgical removal of the sacculations and appeared to be doing well 1 year after surgery.⁵

In the second documented case,⁶ a male Poodle with signs of abnormal urination was noted to have urethrorectal fistula, urethroperineal fistula, and urethral duplication. This dog was taken to surgery, and an ischial-pubic flap osteotomy was performed to gain access to the pelvic urethra. The urethrorectal fistula and urethroperineal fistulae were resected; the urethral duplication was not treated as clinical signs resolved after the fistulae were removed.⁶

Sterile glue can be injected into luminal structures to cause an obstruction. As the glue comes in contact with air, tissue, or blood, a polymerization occurs and a solid forms; the glue will contour to the structure within which it is injected.^{7,8} Cyanoacrylate is the most commonly used form of glue in medical procedures. Several types of cyanoacrylate are available, and the chosen form is procedure- and clinician-dependent.^{7,8} Cyanoacrylate has many positive characteristics that make it an effective substrate, including the ability to function effectively in a wet environment (such as the urinary tract), high adhesive property, rapid polymerization, and high antibacterial properties.⁹

To the authors' knowledge, the use of glue embolization in the treatment of a urinary tract anomaly has not been described in dogs. Several studies have evaluated the ability of cyanoacrylate to form a seal in the presence of urine or to assist in closure of fistulae related to the urinary tract in humans.⁹⁻¹⁶ Results of clinical studies have been very promising with most cases of urinary tract fistulae being repaired successfully with the infusion of cyanoacrylate.^{9,11-13,15,16} In 1 study, glue was shown to be a safe and effective (85% success) first-line option in the treatment of urinary fistulas and was particularly useful for narrow and long tract fistulas;⁹ the dog of this report demonstrated a similar lesion.

Coils were also placed in the proximal aspect of the accessory urethra of this case to fortify the obstruction caused by the glue and to prevent movement of glue into the normal urethra. The goal of the coils was not to primarily embolize, but instead to act as a scaffold for the cyanoacrylate. This technique is often employed during glue embolization of vascular anomalies.^{17,18} The use of coil placement to support glue embolization has also been investigated for ureteral occlusion in cases of human urogenital neoplasia.¹⁹

Footnotes

- ^a Storz Flex-X, Karl Storz Endoscopy, Goleta, CA
^b Red rubber catheter, Bard Medical, Murray Hill, NJ
^c Isovue[®] 370, Bracco Diagnostics, Princeton, NJ
^d Weasel wire, Infiniti Medical, Menlo Park, CA
^e Vascular Introducer Sheath, Infiniti Medical LLC, Menlo Park, CA
^f Balloon catheter, Cook[®] Medical Inc., Bloomington, IN
^g Angiocath[™], Becton, Dickinson and Company, Franklin Lakes, NJ
^h Vascular Introducer Sheath, Infiniti Medical LLC, Menlo Park, CA
ⁱ Berenstein catheter, Infiniti Medical LLC, Menlo Park, CA
^j Microcatheter, Infiniti Medical LLC, Menlo Park, CA
^k Weasel wire, Infiniti Medical, Menlo Park, CA
^l Tornado Embolization Microcoils, Cook[®] Medical Inc., Bloomington, IN
^m Octyl/butyl cyanoacrylate (GLUture[®]), Abbott Animal Health, Abbott Park, IL
ⁿ Lipiodol[®], Guerbet LLC, Bloomington, IN
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Conflict of Interest Declaration: Authors disclosed no conflict of interest.

Off-label Antimicrobial Declaration: Authors declare no off-label use of antimicrobials.

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