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Bilateral Ureterocystostomy to Correct Left Ureteral Atresia and Right Ureteral Ectopia in an 8-Month-Old Standardbred Filly

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Objectives—To report the diagnosis and outcome after surgical correction of bilateral distal ureteral anomalies in a Standardbred filly.
Study Design—Clinical case report.
Animal—An 8-month-old, 310 kg Standardbred filly with left ureteral atresia and right ureteral ectopia.
Methods—The filly was admitted for evaluation of incontinence since birth and severe urine scalding of the hindquarters. Diagnosis was made by both direct (cystoscopy and vaginoscopy) and indirect (intravenous pyelography, ultrasonography, and scintigraphy) evaluation of the ureters and bladder. The filly had left ureteral atresia, hydronephrosis, and decreased left-sided renal function and right ureteral ectopia before surgery. Surgical correction was performed on the left by an end-to-side stapled anastomosis technique and on the right by a side-to-side hand-sewn anastomosis technique.
Results—Surgical correction was successful. The filly had no postoperative complications and remained continent 18 months after surgery. Left renal function improved.
Conclusion—Ureteral anomalies can be successfully repaired in larger (>300 kg) foals and some renal function may be restored after surgical correction.
Clinical Relevance—Scintigraphy should be considered in diagnosis of ureteral anomalies, assessing renal function, and determining prognosis for horses with hydronephrosis caused by ureteral ectopia and atresia.

Key words: ureter, ectopic ureter, ureterocystostomy, urinary incontinence, scintigraphy, intravenous pyelography, horse.

INTRODUCTION

URETERAL ECTOPIA, the most commonly reported congenital anomaly of the equine urinary tract, is a rare cause of urinary incontinence in horses,[1,2] caused by faulty differentiation of the metanephric and mesonephric ducts during development. Ectopic ureter may occur unilaterally or bilaterally, without apparent side predisposition.[1–4] No breed or sex predilection has been reported although the clinical presentation of males may differ from that of females.[1] Females most commonly have urinary incontinence noted shortly after birth with secondary dermatitis and scalding of the hindquarters and perineum.[1–3,5] Affected males may go undiagnosed because of retrograde urine flow from the ectopic ureter into the bladder, resulting in a normal appearance to urination.[1] Unilaterally affected animals or those with urethral termination allowing retrograde flow of urine into the bladder are typically observed to urinate normally at times.[1,2]

Presumptive diagnosis of ectopic ureter can be made when given a history of urinary incontinence since birth in the absence of any neurologic deficits. Physical examination, renal function testing, and serum biochemistry

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values are usually within normal limits, unless the condition has become chronic and led to the development of hydronephrosis.[1–3] Diagnosis is confirmed by locating the ectopic opening either directly (using a vaginal speculum, vaginoscopy, or cystoscopy) or indirectly (contrast radiography or ultrasonography).[1–5] Systemic administration of dyes to discolor the urine may be useful for diagnosis of ectopic ureter.[1–6] Surgical correction is the definitive treatment for ectopic ureter.[1–3,5,6]

We report the use of direct and indirect methods for diagnosis of bilateral ectopic ureteral anomalies in an 8-month-old Standarbred filly and the outcome after surgical correction.

CASE REPORT

An 8-month-old, 310 kg Standardbred filly was admitted for evaluation of urinary incontinence. Signs of incontinence had been present since birth and ectopic left ureter had been presumptively diagnosed. On admission, there was marked urine scalding of the hindquarters and perineum. Urine dribbled intermittently but normal urination was occasionally observed. The filly was in otherwise good condition; no other abnormalities were detected, there was no evidence of neurologic deficit and initial hematology and biochemical profiles were considered normal.

Vaginoscopy and cystoscopy were performed (standing sedation) using a flexible video endoscope (Olympus GIF-1T140 Gastroscope, Olympus America Inc., Melville, NY) to identify the ureteral orifices. Neither urine pooling nor ectopic ureteral openings were identified in the vagina. On cystoscopy there was an abnormally positioned right ureteral orifice, which opened caudal to the trigone of the bladder just inside of the urethra. The left ureteral orifice could not be identified. A diagnosis of ectopic right ureter with an undetermined left ureteral orifice was made.

Ultrasonography

Transabdominal (4 MHz curvilinear transducer) and transrectal (8.5 MHz curvilinear transducer) ultrasonography (Technos MPX, Biosound Esaote Inc., Indianapolis, IN) was performed with the filly standing and sedated as has been previously described.[7] The right kidney was normal in echogenicity and size (12.9 cm × 5.7 cm; normal up to 14 cm long).[7] The right ureter was normal in diameter (1.06 cm as it exited the renal pelvis) and course to the bladder but was observed inserting caudal to the trigone. The left kidney was enlarged (17.1 cm × 8.8 cm) because of marked distention of the renal pelvis with hypoechoic urine but had a normal echogenicity; therefore, a diagnosis of moderate hydronephrosis was made. The left ureter was markedly dilated at its origin (2.74 cm) and distended throughout its visible length (ranging from 2.46 to 2.65 cm) but could not be traced to the bladder. Insertion of the left ureter into the bladder or reproductive tract could not be established.

Pyelography

Intravenous (IV) pyelography was performed using 120 mL of 66% diatrizoate meglumine/10% diatrizoate sodium (Hypaque® -76, Nycomed Inc., Princeton, NY) with standing lateral radiographs obtained at 5, 10, and 15 minutes after injection. Both kidneys were faintly radiopaque, and 1 ureter was identified coursing toward the bladder; the bladder contained contrast material. A 2nd radiopaque round structure similar to the bladder was seen in the caudal abdomen just ventral to the bladder; however, further interpretation was difficult because of the filly's size.

Scintigraphy

^{99m}Tc mercaptoacetyltriglycine (TechneScan MAG3®, Mallinckrodt Inc., Hazelwood, MO) was administered IV (90 mCi). Both kidneys were considered functional based on uptake and clearance of radiopharmaceutical, although clearance from the right kidney was faster than the left. The left ureter was approximately twice normal size and appeared to end in a blind sac near the expected position of the bladder. The right ureter emptied caudal to the expected position of the bladder, which could not be identified (Fig 1). A diagnosis of right ectopic ureter inserting caudal to the trigone and left atretic ureter ending in a blind sac with normal right kidney and decreased left kidney function was confirmed.

Surgical Procedure

Feed was withheld for 24 hours. Ceftiofur sodium (2.2 mg/kg IV) and flunixin meglumine (1.1 mg/kg IV) were administered perioperatively. The foal was anesthetized, positioned in dorsal recumbency, and sterile 18 g polyethylene (PE) tubing (Intramedic® PE 190, Fischer Scientific International Inc., Hampton, NH) was inserted retrograde from the right ureteral orifice into the ureter under endoscopic guidance to aid in identification during surgery. The ventral abdomen was clipped and aseptically prepared for surgery. After ventral median celiotomy (30 cm extending from the udder cranially), the ascending colon was exteriorized and protected by saline (0.9% NaCl) solution soaked laparotomy sponges.

The filly was repositioned into Trendelenburg position (tilted forward 15°) to facilitate cranial displacement of the viscera. The body wall was manually retracted by 2

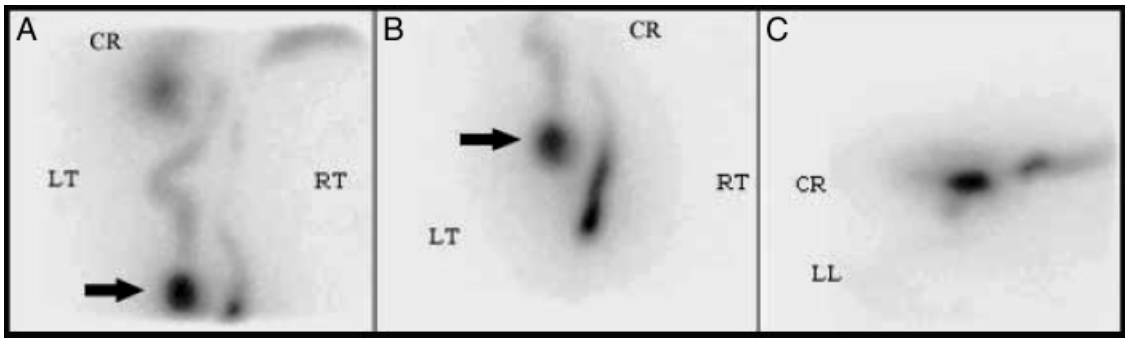

Fig 1. Preoperative scintigraphy: craniodorsal (A), caudodorsal (B), and lateral (C) views. The ureters can be followed from the kidneys but are seen to terminate at different structures. The left ureter is notably larger than the right. No distinct bladder is seen. On the lateral view 2 separate urine-containing structures are visible. Arrows point to the atretic ending of the left ureter. CR, cranial; LT, left; RT, right; LL, left lateral.

assistants. The dilated left ureter was palpable exiting the left kidney and coursing caudally terminating in a 3 cm diameter sac, located left and dorsal to the bladder. Aspirated content was a cloudy, flocculent fluid similar in appearance to urine. Electrolyte (sodium 53 mEq/L, potassium 27.12 mEq/L, chloride 21 mEq/L) and creatinine (29.59 mg/dL) concentrations were consistent with urine. The contents of the sac were evacuated by aspiration to avoid contamination of the abdomen, and an end-to-side ureterocystostomy was performed between the greatly distended left ureteral sac and the bladder. This was carried out by first placing 3-0 polyglactin-910 simple continuous sutures in the seromuscular layer of both structures and then using a gastrointestinal anastomosis and stapling instrument (GIA 50, US Surgical, Norwalk, CT) to create a 1.5 cm stoma.

The right ureter was identified by palpation of the PE tubing and traced to its origin at the kidney. It appeared to be normal in size and course toward the bladder, but its termination into the urethra could not be seen or palpated. A side-to-side ureterocystostomy was performed on the right side of the bladder proximal to the ectopic opening, near the level of the previous anastomosis (mid-bladder). A 1 cm long stoma was created using a 2-layer, hand-sewn technique of simple continuous 3-0 polyglactin 910. The PE tubing was left in position to facilitate suturing and to act as a stent post operatively. The distal portion of the ureter was not ligated. The ascending colon was lavaged, repositioned in the abdomen, and the celiotomy closed. No complications were encountered during surgery. Recovery from general anesthesia was uneventful; however, the PE tubing in the right ureter became dislodged and was removed once the filly was standing.

Postoperative Progress

Normal urination was observed within 2 hours after recovery, and no further episodes of urinary incontinence were observed. Dexamethasone sodium phosphate (0.03 mg/kg IV) was administered once to decrease potential inflammation at the surgical sites. Ceftiofur sodium (2.2 mg/kg, every 12 hours, IV) and flunixin meglumine (1.1 mg/kg, every 12 hours, IV) were continued for 3 days. After 1 week, the filly's dermatitis began to resolve.

Postoperative Scintigraphy and Ultrasonography

Scintigraphy was repeated on day 9 (Fig 2). Kidney function was considered normal, with both the left and right kidneys having similar clearance times of radiopharmaceutical. The left ureter was dilated, but both ureters emptied into the bladder. The left atretic sac now appeared to silhouette with the bladder. On ultrasonography (day 11) there was resolution of the left hydronephrosis; the left kidney was now a normal size (12.7 cm × 5.2 cm) and the pelvis was no longer dilated with fluid. Patency of both ureterocystostomy sites was also confirmed. Cystoscopy on day 10 revealed a large, ~1.5 cm stoma on the left and a smaller ~0.5 cm stoma on the right; active urine flow was observed from both ureters. The bladder was moderately inflamed, suggestive of cystitis. Trimethoprim/

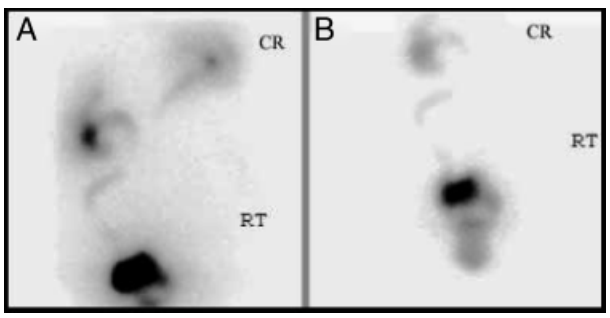

Fig 2. Postoperative scintigraphy: craniodorsal (A) and caudodorsal (B) views. Both ureters terminate at the bladder, which can now be distinctly seen. The left ureter is less distended than in the preoperative study.

sulfamethoxazole (25 mg/kg, orally, every 12 hours for 2 weeks) was administered. Repeat cystoscopy on day 24 revealed a normal appearance to the bladder mucosa; active urination was visible from both ureters. The skin on the hindquarters and perineum was almost completely healed. Follow-up information obtained from the owner at 18 months post operatively revealed that the filly was in race training and continued to urinate normally without signs of incontinence.

DISCUSSION

In horses with unilateral ectopic ureter, options for surgical correction include unilateral nephrectomy or ureterovesicular anastomosis. For bilaterally affected horses, ureterovesicular anastomosis of at least 1 side is the only option.[2,3,6] Reported techniques for ureterovesicular anastomosis in horses include an end-to-side technique with or without submucosal tunneling of the ureter through the bladder, a side-to-side technique, and a drop-in mucosal apposition technique.[2,6,8] Although some authors suggest that submucosal tunneling is essential for preventing vesicuoureteral reflux and subsequent development of hydronephrosis or pyelonephrosis, others question its necessity and note that it is not a viable option for ureters that are moderately distended.[2,5,6,9,10]

Of 13 reported horses with surgical correction of ectopic ureter, 3 had nephrectomy and 10 had ureterocystostomy.[4,9–17] Of those 10, 4 had the submucosal tunneling technique performed. Results were most favorable for nephrectomized horses—3 of 3 survived, whereas 3 of 4 horses with the submucosal tunneling technique and 3 of 6 without submucosal tunneling survived. All surviving horses eventually had complete resolution of clinical signs. Follow-up times ranged from 2 months to 4.5 years. In the filly we report, submucosal tunneling was not an option on the left side because of the enlarged size of the atretic ureteral ending. Although it would have been possible to tunnel the ureter on the right side, we opted not to do so to decrease surgical time and because of the lack of consensus on the value of this technique.

The filly in this report presented a diagnostic challenge that resulted in an unconventional diagnostic workup. To our knowledge there is only 1 report of ureteral atresia in a horse, which was diagnosed in an 11-day-old Thoroughbred colt and occurred bilaterally.[12]Although the right ectopic ureter caused the clinical signs in this case, the anatomy of the left ureter needed to be determined before attempted surgical correction. IV pyelography did not definitively identify the anatomy of the left ureter, possibly because the volume of contrast agent used (120 mL) was less than the recommended dose of 2 mL/kg (610 mL); however, using such a large volume seemed impractical. The chosen dose did allow for contrast material to be seen clearly on radiographs, and it is more likely that the limiting factor of the exam was the filly's large size, which made identification of abdominal structures difficult.

In addition to our inability to definitively identify the termination of the left ureter, we were also concerned about left renal function because of the ultrasonographic changes that were seen. Scintigraphy has not been reported as a diagnostic tool for horses with ectopic ureter but it proved invaluable in this case. ^{99m}Tc MAG3 was used as a renal imaging agent; the dose was extrapolated from the suggested human dose of 10 mCi for an adult. It has been used extensively in human medicine because it allows quantitative measurements of effective renal plasma flow to be made and the resultant image quality is typically excellent.[18] ^{99m}Tc MAG3 has also been reported to provide excellent image quality in dogs, and has been used as a method of assessing renal function by evaluating effective renal plasma flow in horses and dogs.[19,20] Although this filly's preoperative blood urea nitrogen and creatinine concentrations were within normal limits, changes in these variables will not occur until $>75\%$ of renal function is lost. Scintigraphy allowed us to determine that although hydronephrotic, the left kidney was functional before surgery. Scintigraphy was safe, non-invasive, easy to perform, and helped determine prognosis postoperatively.

Although not performed, repeat cystoscopy at a later date (6 months–1 year) would have been ideal to assess the size of the healed stomas, as well as to rule out potential complications such as calculus formation secondary to use of the staples. The development of urinary calculi associated with staples used for the repair of a ruptured bladder in a colt has been reported, and clinical signs did not occur until 7 months post operatively.[21] Although the use of staples was a concern, we felt the benefit of decreasing surgical time outweighed the potential risk of developing calculi. Should calculi form, we theorized that as a female the foal would be able to pass them unassisted because of the relatively large size of her urethra compared with that of a male.

For years, surgical correction of ectopic ureter in foals >255 kg was not attempted, leading to the assumption that ureteral surgery may be difficult in larger foals because of inadequate access to the urinary tract.[13,14,22,23] Ureterovesicular anastomosis was successfully performed in 2 foals >300 kg, [9,11] and our filly weighed 310 kg. In this filly and the 2 previously reported foals, adequate exposure was obtained by withholding feed to reduce intestinal visceral content and use of Trendelenburg position for surgery.[9,11] The successful outcome in these 3 foals suggests that surgery of the ureter is feasible in large foals and small horses.

We were unable to find references to horses with similar ureteral anomalies that had successful surgical correction. Uniquely, we established the presence of left ureteral atresia, hydroureter, hydronephrosis, and decreased renal function before surgery, all of which appeared to resolve after surgical correction. Similar findings of improvement of hydronephrosis after surgical repair of ectopic ureter have been reported in dogs, but to our knowledge there are no reports on the postoperative progress of hydronephrosis secondary to ureteral atresia in horses.[24] These findings suggest that some kidney function can be restored in horses, even after having a functionally occluded ureter for the first 8 months of life. This should be taken into account when assessing the prognosis for other horses with ectopic or atretic ureters and hydronephrosis.

REFERENCES

1. Blikslager AT, Green EM: Ectopic ureters in horses. Compend Contin Educ Pract Vet 14:802–807, 1992
2. Schott II HC: The urinary system, in Reed SM, Bayly WM (eds): Equine Internal Medicine. Philadelphia, PA, Saunders, 1998, pp 807–817
3. Robertson JT, Embertson RM: Surgical management of congenital and perinatal abnormalities of the urogenital tract. Vet Clin N Am Equine Pract 4:359–379, 1988
4. Blikslager AT, Green EM, MacFadden KE, et al: Excretory urography and ultrasonography in the diagnosis of bilateral ectopic ureters in a foal. Vet Radiol Ultrasound 33: 41–47, 1992
5. Richardson DW: Urogenital problems in the neonatal foal. Vet Clin N Am Equine Pract 1:179–188, 1985
6. Juzwiak JS: Surgery of the ureter, in Wolfe DF, Moll DH (eds): Large Animal Urogenital Surgery. Baltimore, MD, Williams & Wilkins, 1999, pp 79–80
7. Matthews HK, Toal RL: A review of equine renal imaging techniques. Vet Radiol Ultrasound 37:163–173, 1996
8. Morisset S, Hawkins JF, Frank N, et al: Surgical management of a ureteral defect with ureterorrhaphy and of ureteritis with ureteroneocystostomy in a foal. J Am Vet Med Assoc 220:354–358, 2002
9. Jansson N, Thofner M: Ureterocystostomy for treatment of unilateral ureteral ectopia in a 300 kg horse. Equine Vet Educ 11:132–135, 1999
10. Pringle JK, Ducharme NG, Baird JD: Ectopic ureter in the horse: three cases and a review of the literature. Can Vet J 31:26–30, 1990
11. Squire KRE, Adams SB: Bilateral ureterocystostomy in a 450-kg horse with ectopic ureters. J Am Vet Med Assoc 201:1213–1215, 1992
12. Jean D, Marcoux M, Louf CF: Congenital bilateral distal defect of the ureters in a foal. Equine Vet Educ 10:17–20, 1998
13. Sullins KE, McIlwraith CW, Yovich JV, et al: Ectopic ureter managed by unilateral nephrectomy in two female horses. Equine Vet J 20:463–466, 1988
14. Houlton JEF, Wright IM, Matic S, et al: Urinary incontinence in a Shire foal due to ureteral ectopia. Equine Vet J 19:244–247, 1987
15. Modransky PD, Wagner PC, Robinette JD, et al: Surgical correction of bilateral ectopic ureters in two foals. Vet Surg 12:141–147, 1983
16. Tomlinson JE, Farnsworth K, Sage AM, et al: Percutaneous ultrasound-guided pyelography aided diagnosis of ectopic ureter and hydronephrosis in a 3-week-old filly. Vet Radiol Ultrasound 42:349–351, 2001
17. Christie B, Haywood N, Hilbert B, et al: Surgical correction of bilateral ureteral ectopia in a male appaloosa foal. Aust Vet J 57:336–340, 1981
18. Itoh K: 99mTc-MAG3: review of pharmacokinetics, clinical application to renal diseases and quantification of renal function. Ann Nucl Med 15:179–190, 2001
19. Woods PR, Drost WT, Clarke CR, et al: Use of 99mTc-Mercaptoacetyltriglycine to evaluate renal function in horses. Vet Radiol Ultrasound 41:85–88, 2000
20. Lora-Michiels M, Anzola K, Amaya G, et al: Quantitative and qualitative scintigraphic measurement of renal function in dogs exposed to toxic doses of gentamicin. Vet Radiol Ultrasound 42:553–561, 2001
21. Edwards III RB, Ducharme NG, Hackett RP: Laparoscopic repair of a bladder rupture in a Foal. Vet Surg 24:60–63, 1995
22. Ordidge RM: Urinary incontinence due to unilateral ureteral ectopia in a foal. Vet Rec 98:384, 1975
23. MacAllister CG, Perdue BD: Endoscopic diagnosis of unilateral ectopic ureter in a yearling filly. J Am Vet Med Assoc 197:617–618, 1990
24. Ross LA, Lamb CR: Reduction of hydronephrosis and hydroureter associated with ectopic ureters in two dogs after ureterovesical anastomosis. J Am Vet Med Assoc 196:1497–1499, 1990