Successful replacement of an obstructed ureter with an ileal graft in a cat

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Case Description—A 10-year-old spayed female domestic shorthair cat with a 1-week history of vomiting, lethargy, and anorexia was examined.

Clinical Findings—Abdominal radiography and ultrasonography revealed that calculi and a nonpatent stricture obstructed the right ureter, which resulted in secondary dilatation of the ureter proximal to the obstruction and severe hydronephrosis. The left kidney was small and suspected to be failing. Concentrations of BUN and creatinine were elevated. Despite administration of fluids, azotemia persisted.

Treatment and Outcome—Surgery was performed. The obstructed right ureter was replaced with a vascularized segment of ileum. Azotemia resolved, and the cat improved with regard to clinical signs. The cat was clinically normal for > 36 months after the surgery.

Clinical Relevance—An ileal graft can successfully be used as a surgical option for ureteral obstruction in cats. (*J Am Vet Med Assoc* 2011;238:1173–1175)

A 10-year-old spayed female domestic shorthair cat with a 1-week history of vomiting, lethargy, and anorexia was referred to WestVet Animal Emergency and Specialty Center. The referring veterinarian diagnosed postrenal azotemia secondary to ureteral calculi. The cat was referred for surgical evaluation.

At admission to the referral facility, the cat weighed 4.9 kg (10.8 lb). Physical examination revealed that the cat was lethargic, thin, and fractious. Palpation of the abdomen revealed that the right kidney was larger than the left. Initial serum biochemical analysis revealed elevated BUN (174 mg/dL; reference range, 15 to 35 mg/dL) and creatinine (14.2 mg/dL; reference range, 0.6 to 2.0 mg/dL) concentrations. A urine sample for urinalysis was not obtained during the initial assessment.

A catheter was placed in a cephalic vein, and administration of fluids was initiated. The cat received physiologic saline (0.9% NaCl) solution at a rate of 20 mL/h for 48 hours (total volume administered, 960 mL). Abdominal radiography revealed a large right kidney (4.5 cm in length) and calculi in the proximal portion of the right ureter. The left kidney was small (3.5 cm in length). Serum biochemical analysis of a sample obtained after administration of fluids revealed a decrease in BUN and creatinine concentrations; however, azotemia (BUN concentration, 57 mg/dL; creatinine concentration, 3.6 mg/dL) persisted.

Abdominal ultrasonography revealed dilatation of the proximal portion of the right ureter (0.5 cm in width) and renal pelvis (2.9 cm), which were consistent with hydronephrosis. Multiple calculi were detected in the midproximal and distal portions of the right ureter. The left kidney was small (3.2 cm in length). On the basis of results of the ultrasonographic examination, it was determined that the right kidney was likely to be functional but that the right ureter was obstructed. The left kidney was thought to be failing on the basis of its small size and the presence of azotemia. Surgical removal of the calculi was recommended.

Exploratory abdominal surgery revealed a large right kidney and a grossly distended proximal portion of the right ureter. The left kidney was extremely small. Ureterotomy was performed in the proximal portion of the right ureter. A calculus present in the midportion of the ureter was removed. A complete, fibrous stricture of the ureter was detected immediately distal to the point at which the calculus was lodged. Patency of the ureter could not be reestablished, and the ureter was of insufficient length and diameter to allow resection and anastomosis. A decision was made to obtain an ileal graft for replacement of the obstructed ureter.

A 7-cm section of ileum was isolated and resected. The associated mesenteric arteries and veins supplying this segment were preserved. A functional end-to-end anastomosis of the remaining intestine was performed with anastomotic surgical stapling devices.[a,b] The ileal graft was prepared by thoroughly flushing it with dilute (2%) povidone-iodine solution. Ends of the graft were clamped with doyen forceps. Dilute povidone-iodine solution was injected into the lumen of the ileal graft, and the graft was allowed to soak in the dilute povidone-iodine solution for 10 minutes. The oral end of the ileal segment was closed with staples.[b] A 2-cm enterotomy was performed just lateral to the antimesenteric border of the graft at a point 3 cm from the stapled end. A small (0.5-cm) stab incision was made on the mesenteric border of the graft opposite the enterotomy; care was taken to ensure the mesenteric vasculature was preserved. Regional removal of the intestinal mucosa was performed.

The right ureter was transected proximal to the stricture and incised longitudinally. The proximal segment of

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the incised ureter was inserted through the stab incision in the ileal graft, and the ureteral mucosa was sutured to the intestinal mucosa with 5-0 polydioxanone[c] in a simple interrupted pattern. Five sutures were required to perform the anastomosis. The enterotomy was then closed with 4-0 polydioxanone in a simple continuous pattern. The oral end of the ileal graft was secured to the capsule of the right kidney with 4-0 polypropylene[d] in a simple interrupted pattern. The aboral end of the ileal graft was prepared by removal of a circumferential portion of mucosa; the aboral end was then incised longitudinally. The urinary bladder was isolated, and a ventral cystotomy was performed. A 1.5-cm-diameter portion of the bladder apex was excised, and the aboral end of the ileal graft was inserted through the hole. The mucosa of the ileal graft was then sutured to the bladder mucosa with multiple 4-0 polydioxanone sutures in a simple interrupted pattern. Additional sutures were placed between the ileal serosa and bladder serosa to reduce tension on the mucosal sutures. The cystotomy was then closed with 4-0 poliglecaprone 25[e] in a simple continuous pattern. The abdomen was closed in a routine manner by use of 2-0 polydioxanone, 4-0 poliglecaprone 25, and skin staples.

Clinical improvement was evident the day after surgery. The cat appeared more alert and began eating and drinking. Follow-up serum biochemical analyses revealed that the BUN and creatinine concentrations decreased substantially the day after the surgery and were within the respective reference ranges by the third day after surgery. Intravenous pyelonephrography was performed 48 hours after the surgery. Results confirmed that the ileal graft was patent and functional (**Figure 1**). The renal pelvis measurement was 1.2 cm. Peristalsis was detected in the graft; contrast material was observed moving from the right kidney into the urinary bladder. Follow-up abdominal ultrasonography was not performed after the surgery.

The cat was discharged from the hospital 5 days after the surgery. Follow-up evaluations were performed by the referring veterinarian. A suture reaction was detected in the subcutaneous tissues 3 weeks after surgery. This condition resolved with administration of antimicrobials (amoxicillin-clavulanate; 13 mg/kg [5.9 mg/lb], PO, q 12 h for 14 days).

The calculi in the right ureter were submitted for evaluation. Analysis revealed that the calculi were composed of 100% calcium oxalate monohydrate.

One year after surgery, the cat had signs of a urinary tract infection. Bacterial culture of a urine sample was performed. A light growth of *Staphylococcus* spp was cultured in enrichment broth and was considered a possible contaminant. The staphylococci were susceptible to several antimicrobials, and the cat was treated with amoxicillin-clavulanate[f] (13 mg/kg, PO, q 12 h for 14 days). Follow-up bacterial culture of a subsequent urine sample was not performed.

Intravenous pyelonephrography was performed 18 months after surgery, and results confirmed that the ileal graft continued to function well with no evidence of recurring calculi.

The cat was clinically normal for > 36 months after surgery. During that period, the cat was fed a diet of canned food and the BUN and creatinine concentrations remained within the respective reference ranges.

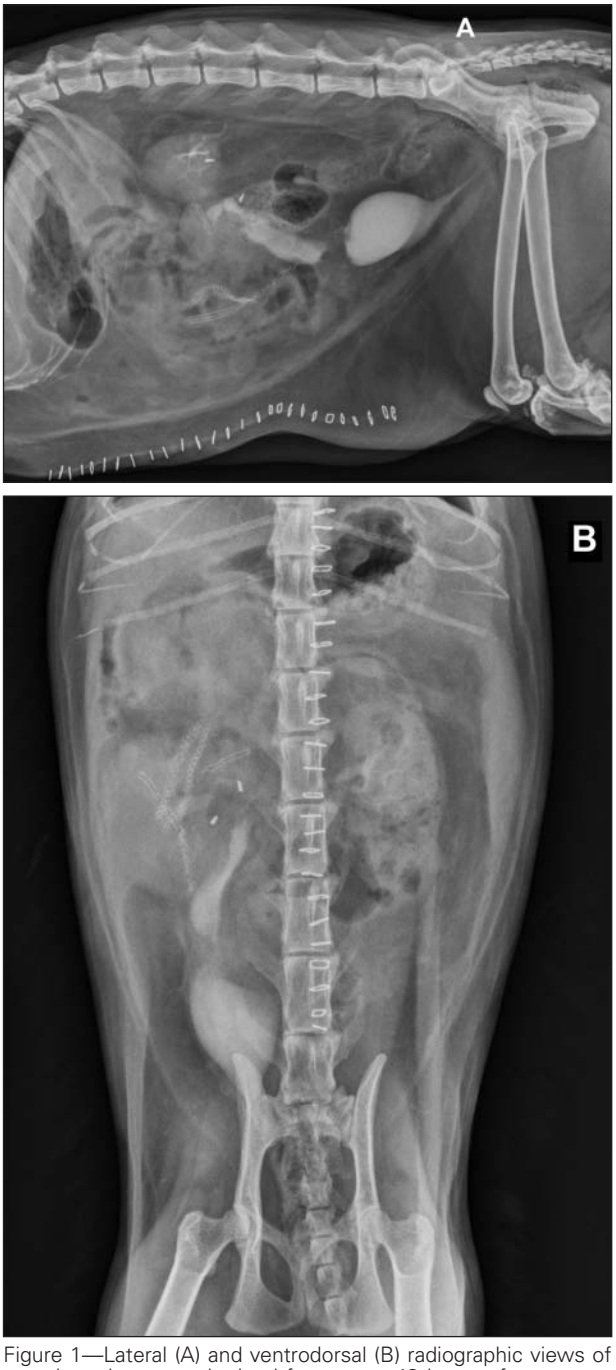

Figure 1—Lateral (A) and ventrodorsal (B) radiographic views of a pyelonephrogram obtained from a cat 48 hours after surgery to replace an obstructed right ureter with an ileal graft. Contrast enhancement can be seen within the ileal graft and urinary bladder. Notice the peristaltic wave within the graft segment. Results of pyelonephography confirmed that the ileal graft was patent and functional.

Discussion

Ileal-ureteral substitution has been performed successfully in humans when standard ureteral treatment options were not feasible. The procedure has been used to replace dysfunctional, stenotic, traumatized, and necrotic ureters.[1] Minor complications, including pyelonephritis, fever of unknown origin, and recurrent urolithiasis, were reported in 17.9% of human patients.[2]

Major complications, including stricture of the anastomosis, obstruction of the ileal graft, wound dehiscence, and chronic renal failure, were reported in 10.5% of human patients.[2] Long-term results are generally favorable, with 83% of humans having good function of the kidney for > 5 years after the surgery.[3] Follow-up nuclear renography on humans who received an ileal-ureteral substitution revealed no loss of renal function and no evidence of functional obstruction.[4] Additionally, no major metabolic changes were detected, and the incidence of calculus recurrence in humans with urolithiasis did not appear to increase.[4]

Concerns about reflux of urine from the ileal segment into the renal pelvis during peristalsis raised questions about the need for an antireflux procedure in humans. However, a study[5] revealed that there was no detrimental effect on renal function in adults with substituted ileal ureters; therefore, an antireflux procedure has not been deemed necessary in humans.

The ureters of cats provide many challenges to veterinary surgeons. Current options for a stenotic feline ureter include resection and anastomosis, division of the ureter proximal to the obstruction and reimplantation into the bladder (ureteroneocystostomy), nephrectomy, and anastomosis into the contralateral ureter to provide diversion of the urine flow. The small diameter and limited length of the ureters of cats make it difficult to perform resection and anastomosis, even with high-powered magnification. Postoperative complications, including stricture and urine leakage, complicate recovery and reduce the chances for a successful outcome. Because of a lack of ureter length, strictures in the mid to proximal portion of the ureter, as in the cat described here, may eliminate the option of performing a ureterneocystostomy, even with cranial mobilization of the urinary bladder and caudal mobilization of the kidney.

In the cat of the present report, discrepancy in size and a severe reduction in lumen diameter between the proximal and distal segments of the ureter were evident, which prevented a secure, patent anastomosis. The diameter of the lumen of the distal portion of the ureter was exceptionally small, likely related to the intramural fibrosis secondary to the multiple calculi. Nephrectomy was not selected as a surgical option because of concerns about the function of the contralateral (left) kidney. Cats with ureteral calculi and azotemia often have questionable renal function of 1 or both kidneys, which is a contraindication for nephrectomy.

Ileal-ureteral substitution has been performed experimentally in cats[g] and dogs.[6] Ureterocolonic anastomosis has been reported in dogs with transitional cell carcinoma[7]; however, the procedure has been associated with pyelonephritis and neurologic and metabolic abnormalities. To the author's knowledge, clinical use of ileal-ureteral substitution has not been reported in veterinary medicine. Replacement of the ureter of a cat with a vascularized segment of ileum offers many advantages. The length of the ileum allows for a substantial graft that will span from the kidney to the urinary bladder. Length of the ileal graft can be easily modified to adjust for variations in the amount of viable ureter. The large diameter of the ileal graft reduces the chance for strictures and obstructions, which can lead to the development of calculi. The ileal graft also maintains a generous blood supply that is beneficial for healing. The risk of pyelonephritis may be mitigated by preparing the graft as described here and soaking and flushing it in an antiseptic solution, such as 2% povidone iodine. Peristalsis of the ileal graft also helps to prevent reflux of urine and therefore reduces the chances for pyelonephritis.

Ileal-ureteral substitution was a viable option for surgical management of ureteral disease in the cat described here. This procedure should be considered in any animal with a condition, such as ureteral neoplasia, trauma, or stenosis, in which a ureter is severely compromised. This procedure may also be used as a salvage technique for animals in which a primary ureteral repair has failed. Severe disease or injury within the proximal portion of a ureter or the renal pelvis would preclude the usefulness of this technique. Further prospective studies are required to determine the morbidity and rate of success of this procedure in cats.

a. EndoGIA 50, Covidien, Mansfield, Mass.
b. TA55, Covidien, Mansfield, Mass.
c. PDS, Ethicon, New Brunswick, NJ.
d. Prolene, Ethicon, New Brunswick, NJ.
e. Monocryl, Ethicon, New Brunswick, NJ.
f. Clavamox, Pfizer Animal Health, New York, NY.
g. Reimer SB, Lotsikas PJ, Merkley DF, et al. A novel surgical technique: feline ureteral replacement with an autogenous ileal graft (abstr), in *Proceedings*. Am Coll Vet Surg Meet 2005.

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