Use of a balloon-expandable metallic stent to relieve malignant urethral obstruction in a cat

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Case Description—A 19-year-old neutered male domestic shorthair cat was evaluated because of signs of urinary tract obstruction.

Clinical Findings—Physical examination findings were consistent with urethral obstruction, and a mass could be palpated in the region of the bladder neck. Abdominal ultrasonography and thoracic radiography revealed a mass in the trigone of the urinary bladder and a solitary mass in the left caudal lung lobe. Cytologic examination of the urine sediment, samples obtained by means of traumatic urethral catheterization, and fine-needle aspirates of the bladder mass did not result in a diagnosis.

Treatment and Outcome—A balloon-expandable metallic stent was placed in the proximal portion of the urethra to relieve the malignant obstruction. After stent placement, the cat had signs of urinary incontinence and detrusor atony, both of which resolved with medical treatment. The cat was euthanized 1 month after stent placement because of progressive azotemia. Histologic examination of necropsy samples revealed grade III urothelial carcinoma and papillary pulmonary adenocarcinoma.

Clinical Relevance—Findings suggested that stent placement may be a viable palliative treatment in cats with malignant urinary obstruction. (J Am Vet Med Assoc 2009;234:236–239)

A 19-year-old 3.4-kg (7.5-lb) neutered male domestic shorthair cat was evaluated at the Michigan State University Veterinary Teaching Hospital because of signs of urinary tract obstruction, including a large firm bladder and signs of pain during abdominal palpation, and a palpable mass in the region of the bladder neck. Hyperthyroidism and renal insufficiency had been diagnosed 1.5 years previously, and the cat was being treated with methimazole (0.73 mg/kg [0.33 mg/lb], PO, q 12 h). Two months prior to referral, the cat had developed polyuria and polydipsia and reportedly was urinating inappropriately. At that time, a presumptive diagnosis of idiopathic feline lower urinary tract disease had been made on the basis of results of cytologic examination of the urine sediment (RBCs too numerous to count and 2 to 3 WBCs/hpf) and a lack of growth following bacterial culture of a urine sample.

The cat had begun dribbling urine 4 days prior to referral, and the referring veterinarian reported that a partial obstruction at the level of the bladder neck was encountered during urethral catheterization. Clinico-pathologic abnormalities detected by the referring veterinarian included azotemia (BUN, 72 mg/dL [reference range, 16 to 36 mg/dL]; creatinine, 4.8 mg/dL [reference range, 0.8 to 2.4 mg/dL]), mild hyperphosphatemia (7.7 mg/dL; reference range, 3.1 to 7.5 mg/dL), hypernatremia (170 mmol/L; reference range, 150 to 165 mmol/L), and hyperchloremia (132 mmol/L; reference range, 112 to 129 mmol/L). Results of a CBC were unremarkable. The referring veterinarian treated the cat with saline (0.9% NaCl) solution (6.1 mL/kg/h [2.8 mL/lb/h], IV) and amoxicillin-clavulanate (13.75 mg/kg [6.23 mg/lb], PO, q 12 h). After 35 hours of IV fluid treatment, serum creatinine concentration had decreased to 2.7 mg/dL, and BUN concentration had decreased to 49 mg/dL. The referring veterinarian did not perform a urinalysis while the cat was hospitalized.

On initial examination at the veterinary teaching hospital, heart and respiratory rate and rectal temperature were within reference limits. Abnormalities identified during a physical examination included a unilateral thyroid gland nodule, a gallop heart rhythm, and a mass in the caudal aspect of the abdomen in the area of the bladder neck. Serum creatinine concentration was 1.8 mg/dL (reference range, 0.8 to 2.2 mg/dL), and BUN concentration was 38 mg/dL (reference range, 20 to 35 mg/dL); results of other serum biochemical analyses were unremarkable. Analysis of a urine sample obtained by means of catheterization revealed a specific gravity of 1.014 and pH of 6.3; examination of the urine sediment revealed 4 to 6 WBCs/hpf, > 60 RBCs/hpf, and rare squamous and transitional epithelial cells.

Abdominal ultrasonography revealed a 2.5 × 1.8-cm cystic area in the liver along with a cluster of smaller intrahepatic cystic structures that were > 1 cm in diameter. The right renal pelvis was mildly dilated, and the left renal pelvis and ureter were moderately dilated, consistent with chronic partial outflow obstruction. Both kidneys measured 3.3 cm and had hyperechoic corticomedullary junctions. There was soft tissue thickening...
at the trigone of the bladder measuring 3.3 × 1.4 cm. The entire bladder wall was mildly thickened (4 mm), and the mucosal surface appeared rough. There were 2 large, mottled mesenteric lymph nodes measuring 3.1 × 1.3 cm and 4.2 × 1.4 cm. A small amount of free peritoneal fluid and a small hypoechoic nodule at the distal end of the right side of the pancreas (2.5 mm in diameter) were also identified. Thoracic radiography revealed a 1.0 × 1.5-cm soft tissue opacity in the left caudal lung lobe (Figure 1), along with incomplete ventral bridging spondylodiscitis of the caudal thoracic and lumbar portions of the vertebral column.

Cytologic examination of a sample obtained by means of traumatic urethral catheterization revealed neutrophilic inflammation with intracellular bacterial rods and mild atypia of the transitional epithelial cells. Cytologic examination of fine-needle aspirates of the large mesenteric lymph nodes revealed reactive lymphadenitis, but results of cytologic examination of fine-needle aspirates of the area of bladder wall thickening were inconclusive. There was insufficient peritoneal effusion to obtain a sample.

Because of the urinary tract infection, the cat was hospitalized and treated with lactated Ringer’s solution (8 to 12 mL/h, IV), ampicillin (20 mg/kg [9.2 mg/lb], IV, q 8 h), and enrofloxacin (5 mg/kg [2.3 mg/lb], IV, q 24 h). An indwelling, 3.5-F red rubber urinary catheter was inserted.

Thirty hours after antimicrobial treatment was initiated, a urethral stent was placed. For this procedure, the cat was premedicated with buprenorphine (0.009 mg/kg [0.004 mg/lb], IV) and midazolam (0.2 mg/kg [0.09 mg/lb], IV) and anesthetized with propofol (6.58 mg/kg [2.96 mg/lb], IV). An endotracheal tube was placed, and anesthesia was maintained with isoflurane.

The cat was positioned in right lateral recumbency, and the perineal region was surgically prepared.

A 0.035-inch hydrophilic guidewire was inserted into a marker catheter with radiopaque markers spaced 10 mm apart so that the tip of the guidewire was exposed approximately 2 mm beyond the tapered tip of the marker catheter. The guidewire was advanced into the descending colon, and the marker catheter was advanced over the guidewire under fluoroscopic guidance.

Under fluoroscopic guidance, a 0.018-inch hydrophilic guidewire was inserted in the urethra and advanced into the urinary bladder. Two attempts to advance a 5-F vascular sheath over the guidewire were unsuccessful because the distal portion of the urethra was too small to accommodate the sheath. However, a 4-F vascular sheath was successfully introduced, and the guidewire was subsequently removed.

Retrograde urethrocystography was performed by injecting 35 mL of a 50:50 solution of diatrizoate (760 mg/mL) and sterile saline solution through the vascular sheath, and width and length of the urethral obstruction and maximum diameter and length of the urethra were measured (Figure 2).

A stent was chosen with a diameter no more than 10% greater than the maximum diameter of the urethra. Because the obstruction appeared focal on urethrocystographic images, the shortest available stent of the appropriate diameter was chosen.

For introduction of the stent, the vascular sheath was removed, and a 0.010-inch guidewire with hydrophilic tip was advanced through the urethra into the bladder. A nitinol coronary BEMS measuring 5 × 28 mm was placed over the guidewire, and a pressure inflator was used to slowly expand the stent until the waist created in the balloon by the obstruction was minimal. Care was taken to not exceed the rated bursting pressure of the balloon of 14 atmospheres. Following stent expansion, the balloon was deflated, and the stent delivery system was removed, leaving the stent in place within the urethra (Figure 3). Urine flowed freely from the urethra after completion of the stenting procedure.

The cat was again dribbling urine after recovering from anesthesia and had developed perineal dermatitis by the following day. The bladder remained distended on palpation, but was easily expressed. Therefore, a urinary catheter was inserted under fluoroscopic guidance through the urethral stent, and the cat was treated with buprenorphine (0.008 mg/kg [0.0036 mg/lb], IV, as needed) to reduce pain associated with the dermatitis and with bethanechol (0.74 mg/kg [0.33 mg/lb], PO, q 12 h) because of the presumed detrusor atony.
The cat was discharged 8 days after admission, at which time the owner elected not to pursue additional diagnostic testing or medical treatment. Ten days after stent placement, the owner reported that the cat had regained urinary continence.

One month after stent placement, the owner elected to euthanize the cat because of clinical signs of uremia (ie, anorexia, vomiting, salivating, and lethargy). The cat was not actively urinating at this time and had severe azotemia (BUN, > 130 mg/dL; creatinine, 8.9 mg/dL). No further diagnostic testing was performed prior to euthanasia.

A limited necropsy was performed, and portions of the urinary bladder, left caudal lung lobe, liver, and kidneys were submitted for histologic examination. Examination of the urinary bladder specimen revealed a transmural mass composed of sheets, nests, fronds, and acini of neoplastic cells surrounded by a densely packed fibrocollagenous stroma (scirrhous response). There were areas of necrosis and mineralization and 1 to 5 mitotic figures/hpf. The final diagnosis was grade III urothelial carcinoma with extensive lamina propria invasion, extensive necrosis, and mineralization. Examination of the left caudal lung lobe revealed a highly invasive multilobular mass consisting of anastomosing tubules and ducts of neoplastic cells. The cells exhibited moderate anisocytosis and were columnar or cuboidal with a single basally located nucleus. There were 1 to 4 mitotic figures/hpf. The final diagnosis was papillary pulmonary adenocarcinoma. One of the liver sections contained a biliary cystadenoma, and the kidney sections had severe, diffuse chronic-active tubulointerstitial nephritis, suspected moderate multifocal glomerular amyloidosis, and mild multifocal and coalescing medullary interstitial amyloidosis.

**Discussion**

Tumors of the urinary bladder are reportedly rare in domestic cats. A recent report described 20 cats with TCC of the urinary bladder, of which 13 were male and 9 had tumors involving the trigone. Only 3 of the cats in that report had signs of urinary obstruction at the time of initial examination, and survival times for all 3 were short (0, 2, and 38 days).

In recent years, placement of a self-expanding metallic stent has been recommended for relief of malignant urethral obstruction in dogs. In the cat described in the present report, we choose to place a BEMS because the penile urethra was too small to accommodate the delivery system required for deployment of a self-expanding metallic stent. Self-expanding metallic stents are often preferable because they are easy to deploy; have good flexibility, and will return to their nominal diameter after being compressed. Coronary BEMS were developed to prevent coronary restenosis after coronary angioplasty and are designed to hold the coronary vessels open following dilatation. Advantages of BEMSs include their high radial force strength and minimal foreshortening during expansion, which allows for precise placement. Disadvantages include that they will not return to their nominal diameter if they are crushed and have poor flexibility. In addition, there is some experimental evidence in cats that BEMS may result in a greater inflammatory reaction in areas of preexisting inflammation.

Stent diameter is an important consideration in stent selection. For urethral stenting, the diameter of the stent should be approximately the same as or slightly (ie, < 10%) greater than the maximum diameter of the unaffected urethra adjacent to the obstruction. Use of a stent slightly larger than the maximum urethral diameter will ensure apposition with the urethral wall, but use of an excessively large stent has been associated with development of tissue edema, which could potentially result in obstruction. For the cat described in the present report, maximum diameter of the urethra was 4.41 mm, and a stent that was 5 mm in diameter was used.

Several technical considerations related to placement of the BEMS in the cat described in the present report warrant discussion. The initial ultrasonographic evaluation in this cat revealed evidence of ureteral and renal pelvis dilation, most likely resulting from partial ureteral or urethral obstruction, urinary tract infection, fluid therapy, or a combination of these factors. Theoretically, deployment of a urethral stent might have altered the position of the tumor sufficiently to cause obstruction of the ureteral papillae. In a previous study, however, this was not identified as a problem in dogs undergoing stent placement because of malignant urethral obstruction. Follow-up ultrasonography or excretory urography may have been useful in confirming ureteral obstruction, and it is possible that the severe azotemia in this cat immediately prior to euthanasia may have been a result of ureteral obstruction.

In a previous study in which urethral stents were placed in 12 dogs with malignant urethral obstruction, 4 of the dogs developed severe urinary incontinence after stent placement. Although 2 of the 4 dogs regained continence within 1 week after the procedure, the other 2 remained severely incontinent. In the cat described in the present report, urinary incontinence was evident immediately after stent placement, but the cat regained continence 10 days after stent placement. We attributed the initial urinary incontinence to urinary overflow sec-

![Figure 3—Right lateral (a) and ventrodorsal (b) fluoroscopic images of the cat in Figure 1 following placement of a BEMS in the urethra.](image)
ondary to detrusor muscle dysfunction. In addition, the stent was placed across the preprostatic and prostatic portions of the urethra, which may have contributed to the initial incontinence. The distal portion of the urethra in cats (ie, from the postprostatic portion of the urethra caudally) is composed of striated muscle and is able to generate high urethral pressures. Because this portion of the urethra was not affected by the stent, we speculate that function of this portion of the urethra allowed the cat to regain continence. On the other hand, the distal portion of the urethra is not required for continence in male cats because most male cats are continent after undergoing perineal urethrostomy.

The present case represented a diagnostic challenge because examination of the urine sediment, samples obtained by means of traumatic catheterization, and fine-needle aspirates did not reveal a diagnosis. The mild atypia seen on cytologic examination of samples obtained by means of traumatic catheterization was thought to be associated with lower urinary tract infection. Similarly, in a previous study of 20 cats with TCC of the urinary bladder, the diagnosis was made ante mortem in only 6. Examination of the urine sediment is diagnostic in only about 30% of dogs with TCC, and fine-needle aspiration is typically avoided owing to concerns about the risk of seeding tumor cells into the abdomen and body wall. The lack of exfoliation of tumor cells in the present case was likely attributable to the scirrhous response within the mass.

It has been suggested that the pattern of metasta-
sis in cats with TCC may vary from that seen in dogs with TCC in that the lung may be a preferred metastatic site over lymphoid tissues in cats. The pulmonary nodule detected during the initial examination of the cat described in the present report was a small solitary lesion, and results of histologic examination indicated that it was unrelated to the urinary bladder tumor.

Major complications that developed in the cat de-
scribed in the present report were perineal dermatitis as a consequence of urinary incontinence following stent placement and detrusor atony secondary to chronic partial urinary obstruction. Both of these complications resolved within a short time with medical management. Survival time for this cat following stent placement was short because of progressive azotemia, and no additional treatment for the tumor was given. Our findings suggest that placement of BEMS in cats with malignant urethral obstruction requires further evaluation.

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