

Bladder inversion and secondary hematuria in a 6-month-old domestic shorthair cat

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Case Description—A 6-month-old female domestic shorthair cat was admitted for evaluation of intermittent clinical signs of hematuria and inappropriate urination for the past 2 months.

Clinical Findings—Transabdominal ultrasonography revealed a multilayered mass in the urinary bladder apex consistent with full-thickness invagination of the bladder wall.

Treatment and Outcome—Exploratory surgery was performed, and partial inversion of the urinary bladder was confirmed. The invaginated bladder apex was manually reduced, and partial cystectomy was performed to remove the invaginated section of bladder wall. Histologic findings were consistent with vascular congestion and edema secondary to partial invagination. Bacterial culture of a section of the bladder mucosa demonstrated concurrent bacterial urinary tract infection. Clinical signs resolved following surgical resection of the bladder apex and antimicrobial treatment for the concurrent urinary tract infection.

Clinical Relevance—Partial invagination of the urinary bladder should be considered in the differential diagnosis for cats with clinical signs of hematuria, stranguria, and inappropriate urination. A diagnosis may be made on the basis of detection of invaginated tissue in the bladder apex during abdominal ultrasonography. (*J Am Vet Med Assoc* 2011;239:370–373)

A 4-month-old female domestic shorthair cat was examined by the general practice service at The Ohio State University Veterinary Medical Center because of hematuria, stranguria, and inappropriate urination of 24 hours' duration. There was no history of clinically relevant health problems; the cat had been found as a stray at 4 weeks of age. Results of tests for FeLV and FIV infection, performed at 8 weeks of age, were negative, and routine vaccinations had been administered. Results of a complete physical examination were unremarkable, aside from blood-tinged fluid at the vulva. The urinary bladder was small, and signs of pain were not evident during palpation of the urinary bladder. Ultrasound-guided cystocentesis was performed to obtain a urine sample, and an intraluminal mass was noted at the apex of the bladder. The mass was interpreted as a potential blood clot. Approximately 2 mL of red-colored urine was aspirated from the bladder, and dipstick analysis revealed a pH of 6, no glucose or ketones, 1+ leukocytes, and 3+ protein. Numerous cocci were seen during examination of the urine sediment, but a complete urinalysis and bacterial culture of a urine sample were declined by the client. Amoxicillin-clavulanic acid (15 mg/kg [6.8 mg/lb], PO, q 12 h) was prescribed for 30 days for treatment of the suspected urinary tract infection; no reason was given in the medical record to explain the extended duration of antimicrobial treatment. Buprenorphine (0.03 mg/kg [0.014 mg/lb], applied to the buccal mucosa, q 12 h) was prescribed for

3 days. Clinical signs resolved within 2 days after initiation of antimicrobial and analgesic treatment.

Two months later, the cat was examined by the internal medicine service at The Ohio State University Veterinary Medical Center because of a recurrence of clinical signs. Results of physical examination were unremarkable. On palpation, the bladder was small; signs of pain were not evident during palpation of the urinary bladder. Ultrasonography of the urinary system revealed a 2.2 × 2.2 × 1.4-cm mass with multiple alternating hyperechoic and hypoechoic layers located in the apex of the bladder (Figure 1). The outer margin of the apex of the urinary bladder was blunted, and an indentation of the apex was present. Hyperechoic urinary bladder serosa could be traced from the indentation at the cranial aspect of the bladder and extending caudally to the center of the mass (Figure 2). Color Doppler ultrasonography revealed moderate blood flow in the mass, which was most apparent in the central region of the mass. The ultrasonographic appearance of the kidneys was unremarkable. A small amount of peritoneal effusion was present adjacent to the urinary bladder. Differential diagnoses for the mass included bladder wall inversion, congenital anomaly, and, less likely, neoplasia.

The cat was admitted for exploratory surgery. A ventral midline approach was made to the caudal aspect of the abdomen, and the urinary bladder was exteriorized. Adhesions were noted between the cranial aspect of the urinary bladder and adipose tissue in the median and lateral ligaments of the bladder. The apex of the urinary bladder and approximately a third of the cranial bladder tissue were inverted caudally into the bladder lumen. Bladder inversion resolved during traction on the median ligament, and the affected region of the

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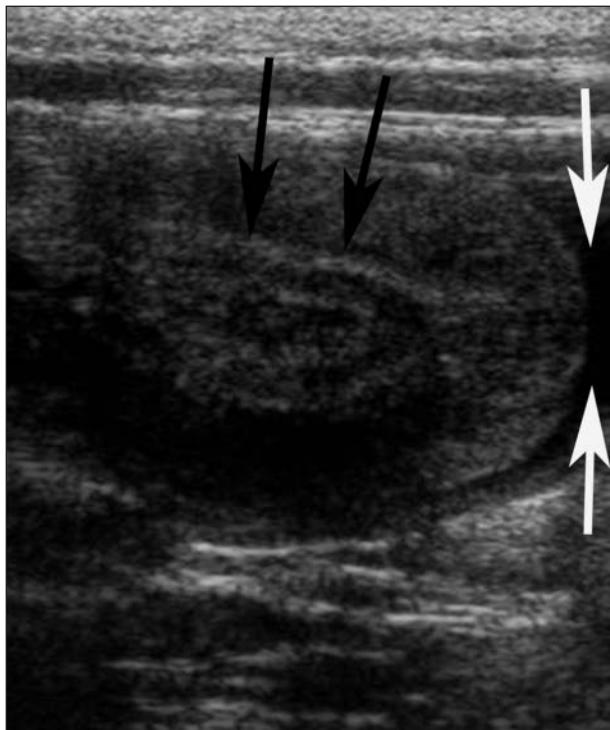


Figure 1—Sagittal ultrasonographic image of the cranial aspect of the urinary bladder in a 6-month-old cat examined because of hematuria and inappropriate urination. Notice the mass consisting of multiple alternating hyperechoic and hypoechoic layers (black arrows) in the lumen of the apex of the urinary bladder. Anechoic urine is present caudal to the mass (white arrows).

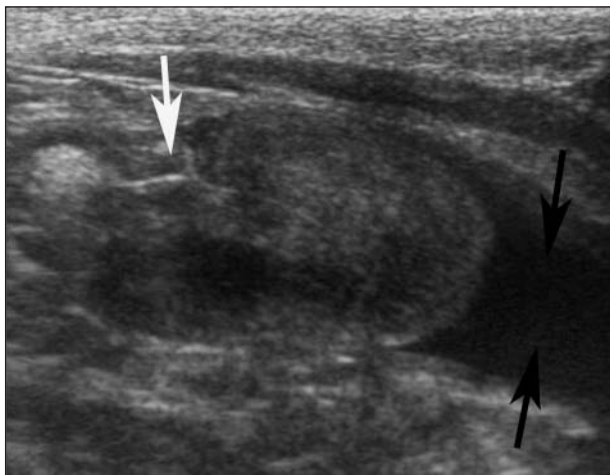


Figure 2—Sagittal ultrasonographic image of the left craniolateral aspect of the urinary bladder of the cat in Figure 1. There is an indentation (white arrow) at the cranial aspect of the urinary bladder. Hyperechoic urinary bladder serosa extends caudally into the center of the mass at the indentation. Anechoic urine is located in the bladder lumen caudal to the mass (black arrows).

bladder apex was found to be hemorrhagic, edematous, and thickened (Figure 3). The uterus was fused to the bladder neck at the cranial aspect of the uterine body, near the confluence of the uterine horns (Figure 4). No other abnormalities were noted during examination of the urogenital tract. The urinary bladder was isolated with laparotomy sponges, and partial cystectomy was

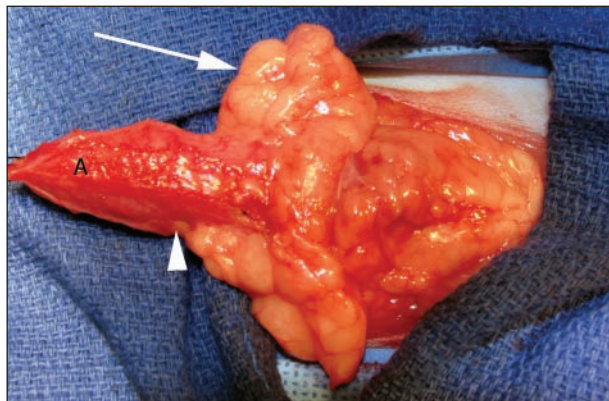


Figure 3—Intraoperative photograph of the ventral aspect of the urinary bladder of the cat in Figure 1. The inverted bladder apex (A) was reduced, and edematous, adhered fat (arrow) was bluntly dissected from the cranial aspect of the bladder. Notice the marked hyperemia and vascularization of the serosa cranial to the previous area of inversion (arrowhead).

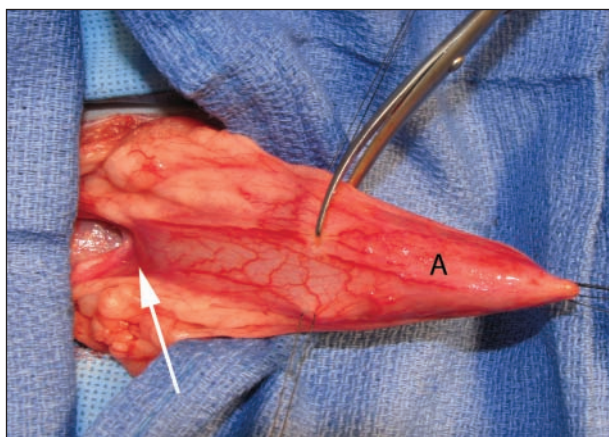


Figure 4—Intraoperative photograph of the dorsal aspect of the urinary bladder of the cat in Figure 1 during resection of the involved portion of the bladder apex (A) and approximately a third of the overall bladder volume. An abnormal fusion of the uterine horns and body with the dorsal aspect of the bladder neck can be seen (arrow).

performed, resulting in removal of all of the grossly abnormal tissue at the cranial aspect of the bladder (Figures 4 and 5). The cystectomy incision was closed in a simple continuous pattern with 4-0 poliglecaprone 25, and the bladder was tested for leaks. Ovariohysterectomy was performed, with ligation of the uterine horns just cranial to the abnormal area of fusion with the uterine body, and the abdomen was closed routinely. The excised portions of the urinary bladder and genital tract were submitted for histologic analysis. A portion of the urinary bladder mucosa was also submitted for bacterial culture and antimicrobial susceptibility testing. The cat recovered from anesthesia without complications and was discharged the next day. Meloxicam (0.1 mg/kg [0.045 mg/lb], PO, q 24 h for 3 days) and buprenorphine (0.01 mg/kg [0.0045 mg/lb], applied to the buccal mucosa, q 8 h, as needed) were prescribed. Bacterial culture of the urinary bladder sample yielded growth of *Escherichia coli*, and marbofloxacin (5 mg/kg [2.3 mg/lb], PO, q 24 h, for 10 days) was prescribed.

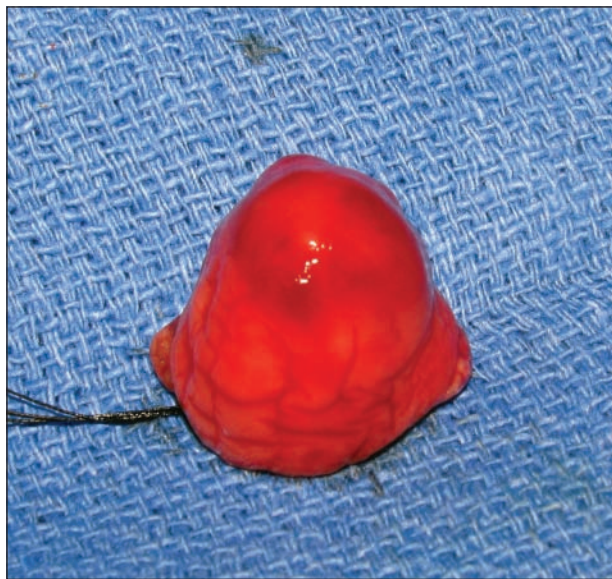


Figure 5—Gross appearance of the resected bladder apex from the cat in Figure 1. The apex has been inverted to reveal the mucosal edema and hemorrhage that occurred during chronic urinary bladder inversion.

A follow-up urine sample was obtained 7 days after completion of antimicrobial treatment and submitted for bacterial culture; no growth was obtained. At the time of suture removal, all clinical signs had resolved.

Histologic examination of the apex of the bladder revealed edema with widespread mucosal and intramuscular congestion, presumably secondary to bladder inversion. Histologic examination of the uterus and ovaries did not reveal any abnormalities. Although gross and histologic evidence of bladder inversion were identified, an underlying cause was not.

Discussion

Inversion of the urinary bladder is an extremely rare condition that has been reported exclusively in postmenopausal women,¹⁻¹³ mares,¹⁴⁻¹⁷ and cows.¹⁸ In humans and large animals, the condition is termed bladder eversion, as the most commonly recognized form involves complete transurethral eversion of the entire urinary bladder.⁶ Other types of bladder eversion that have been described include inversion of a bladder diverticulum, inversion of only the mucosal layer, and partial inversion of the bladder apex involving all 4 layers of the bladder wall.⁶ Because of the occurrence of this condition in aged women, it is suspected to be related to stretching of lateral ligaments of the bladder and weakness of the pelvic diaphragm after childbirth. Bladder eversion can occur spontaneously in women, although predisposing causes include infection,⁶ traumatic removal of a Foley urinary catheter,¹ obstetric labor,¹⁹ and uterovaginal prolapse.^{1,6} Prior to the present report, every previous report¹⁴⁻¹⁸ of bladder inversion in domestic animals has involved complete prolapse of the urinary bladder and has been associated with parturition. Although no definitive cause for bladder inversion was detected in the cat described in the present report, it is possible that the urinary tract infection and

secondary stranguria led to increased intra-abdominal pressure and partial inversion of the urinary bladder through a mechanism similar to that which occurs during the forceful abdominal contractions of parturition. A minor congenital malformation involving incomplete separation of the uterine body from the dorsal bladder neck was noted at surgery, but we have no evidence to suggest that this anomaly contributed to the development of bladder inversion.

In women and large animals, complete bladder inversion is typically diagnosed on the basis of visualization of the prolapsed portion of the inverted urinary bladder protruding into the vestibule or through the vulva.⁶ Because of the extracorporeal location of the urinary bladder, abdominal imaging was not commonly used as a diagnostic technique in previous reports. The partial bladder inversion in the cat described in the present report was not detectable during physical examination, and because of the infrequency of this condition, we were unable to find previous documentation of the characteristic ultrasonographic appearance of partial bladder inversion in any species. In this cat, the unique multiple alternating hypoechoic and hyperechoic layers in the mass corresponded to the layering of the urinary bladder wall and allowed preoperative diagnosis of the condition by use of noninvasive techniques.

Conservative treatment consisting of manual reduction of the prolapsed bladder with the aid of regional or general anesthesia has been described in women and domestic animals with complete bladder prolapse.^{6,17} Definitive surgical correction that has been described in women includes hysterectomy, reconstruction of the pelvic diaphragm, urethral imbrication, and complete colpocleisis (surgical obliteration of the vaginal lumen).⁶ In large animals, the condition has been treated by means of partial cystectomy, with incision of the urethral sphincter to allow reduction of the edematous bladder.¹⁷ Severe edema and thrombosis of the bladder wall secondary to chronic complete transurethral bladder inversion can lead to a poor prognosis because this prevents reduction of the inversion and passage of the bladder through the urethral lumen.¹⁸ In the cat described in the present report, surgical exploration was recommended to obtain a histologic diagnosis and to search for any correctible anatomic factors that may have contributed to the development of the condition.

Findings in the present case suggest that partial bladder inversion may be considered in the differential diagnosis for cats evaluated because of hematuria, stranguria, and inappropriate urination in which a cranially located bladder mass is identified. In this instance, the condition was suspected on the basis of the unique ultrasonographic appearance consisting of a multilayered alternating hypoechoic and hyperechoic intraluminal mass in the cranial aspect of the urinary bladder. Surgical resection of the bladder apex and appropriate treatment for the associated urinary tract infection led to resolution of clinical signs.

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