Diagnostic Ultrasound of Polypoid Cystitis in Dogs

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ABSTRACT. Polypoid cystitis is a rare disease of the urinary bladder in dogs characterized by chronic inflammation, epithelial proliferation, and development of a polypoid mass or masses without histopathologic evidence of neoplasia. The ultrasonographic appearances of eight dogs with polypoid cystitis are described. Ultrasonography confirmed the presence of a bladder mass or masses in all patients. Ultrasonographic findings are mucosal projections and a polypoid to pedunculated mass of variable size and shape. Although a polypoid mass tends to be located in the cranioventral bladder mucosa, the polyps also could arise in the craniodorsal bladder mucosa. Ultrasonographic images are well correlated with contrast radiographic studies and gross morphological appearance. Ultrasound is a non-invasive, very useful diagnostic tool for detecting bladder polyps, but histopathology is required for definitive diagnosis.

KEY WORDS: canine, polypoid cystitis, ultrasonography.

Polypoid cystitis is a rare disease of the urinary bladder in dogs, characterized by inflammation of the bladder mucosa and development of a polypoid mass or masses without histopathologic evidence of neoplasia [7, 8, 11]. It is important for the clinician to recognize that polypoid cystitis is an inflammatory lesion, because not all urinary masses are neoplasms and the therapy and prognosis are different for dogs with polypoid cystitis from those with bladder cancer such as transitional cell carcinoma [9]. Histopathological analysis is required for accurate diagnosis because some neoplasms can have a similar gross morphologic appearance to polypoid cystitis [3, 4, 8, 14, 15].

The cause of bladder polyps in dogs is still unknown [8, 10]. In humans, this disorder is often associated with chronic irritation of the bladder mucosa from indwelling urinary catheters. A recent report by Martinez et al. demonstrated the clinical and laboratory features of polypoid cystitis in dogs [10], but ultrasonographic findings of this disorder have not been well characterized.

The purpose of this study was to describe more detailed ultrasonographic findings in dogs with polypoid cystitis.

MATERIALS AND METHODS

Eight dogs with histologically confirmed polypoid cystitis were identified from medical records of the Hokkaido University Veterinary Teaching Hospital between December 2000 and May 2004. Dogs were included in this study only if there was histopathologic evidence of polypoid cystitis in urinary bladder tissue samples obtained at cystotomy or partial cystectomy. Dogs with histopathologic evidence of malignant neoplasia of the urinary bladder in addition to polypoid cystitis were excluded from the study. Patient signalment (age and breed), clinical history, physical examination, urinalysis results, hematologic and biochemical results, radiographic and ultrasonographic findings, and histopathologic results were reviewed for each dog.

During diagnostic evaluations, several different imaging procedures were used to assess the urinary bladder, including survey abdominal radiography (n=8), double-contrast cystography (n=2), positive contrast cystography (n=1), and abdominal ultrasonography (n=8).

Ultrasonography was performed by using a 7.5 MHz curvilinear or a 7.5–13 MHz linear transducer. The 7.5 MHz curvilinear transducer was used for only dog 1, simply because the 7.5–13 MHz transducer was not available at that time of examination. The dogs were placed in dorsal recumbency and prepared in a routine manner. Ultrasound evaluation was performed with complete distention of the urinary bladder. This was achieved by imaging the animal first thing in the morning or by filling the urinary bladder with sterile saline solution [1].

RESULTS

The patients included 6 males and 2 females. The age of the dogs ranged from 2 to 14 years with a mean age of 7.5 years. Breeds of dogs in this report were, Dalmatian (n=1), Hokkaido (n=1), Mongrel (n=2), Shiba (n=2), Shih-tzu (n=1), and Toy Poodle (n=1) (Table 1).

The most common clinical sign at presentation was macroscopic hematuria (n=7). The timing of hematuria was indicated in the medical records, appearing at the end of the urine stream in 4 dogs (dogs 2, 3, 5 and 8) and being continuous in 3 dogs (dogs 1, 4 and 7). In the remaining dog without history of hematuria (dog 6), polyps were discovered as an incidental finding (during diagnostic evaluation of the uterus, suspected pyometra). Other clinical signs included pollakiuria in 5 dogs, polyuria and polydipsia in 2 dogs, and vaginal discharge in 1 dog.

The duration of clinical signs before final diagnosis ranged from 2 weeks to 3 months. Seven of the 8 dogs had...
Hematuria was confirmed in all 8 dogs by dipstick analysis and urine sediment examination. Bacteriuria was identified in 4 dogs (dogs 3, 4, 5 and 7) by microscopic observation of bacterial organisms in urinary sediments. Six dogs had crystalluria, including calcium oxalate in 2 (dogs 3 and 8), struvite in 3 (dogs 2, 4 and 7), and ammonium urate in 1 (dog 1).

Survey abdominal radiography was performed in all 8 dogs. Cystic calculus was identified in 2 dogs (dogs 3 and 7). Positive or double contrast cystograms were performed in 3 dogs (dogs 1, 2 and 5), and in all of them, a mass or masses were identified in the cranial portion of the urinary bladder (Figs. 1A and 2A).

Abdominal ultrasonography was performed in all 8 dogs and disclosed bladder masses in all dogs, and cystic calculi in 3 dogs (dogs 3, 7 and 8). The ultrasonographic features of each dog are summarized in Table 1. The ultrasonographic appearance of the masses was polypoid to pedunculated (Figs. 1B and 2B) in 6 dogs, ovoid nodular with a short stalk (Fig. 2B) in 1 dog, and characterized by multiple mucosal projections (Fig. 4) in 1 dog. Multiple lesions were identified in 5 dogs. The size of the masses ranged from 2.5 mm to 24 mm in diameter (major axis). Distribution of the bladder masses was cranioventral (n=4), cranioventral to craniodorsal (n=1), and craniodorsal (n=3). The echogenicity of the masses was generally isoechoic compared to the bladder wall. Hypoechoic foci were sometimes seen within the mass. In dog 2, a large, ovoid, hypoechoic (compared to bladder wall) mass with a falcated echogenicity was imaged. This falcated echogenicity was found to originate in a blood clot attached to the mass at surgery. All 8 dogs had a variably thickened bladder wall. The location of the

Table 1. Patients with polypoid cystitis and ultrasonographic description of bladder masses

<table>
<thead>
<tr>
<th>Dog #</th>
<th>Breed</th>
<th>Gender</th>
<th>Age</th>
<th>Sonographic appearance of the bladder masses</th>
<th>Location</th>
<th>Figure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dalmatian</td>
<td>M</td>
<td>2</td>
<td>Multiple polypoid, isoechoic (to bladder wall)</td>
<td>CV</td>
<td>1B</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mildly thickened bladder wall (approx. 4 mm)</td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td>Shiba</td>
<td>FS</td>
<td>6</td>
<td>Single ovoid, hypoechoic (to bladder wall) with a short stalk and falcated echogenicity</td>
<td>CV</td>
<td>2B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Moderately thickened bladder wall (approx. 8 mm)</td>
<td></td>
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<tr>
<td>3</td>
<td>T. Poodle</td>
<td>MC</td>
<td>10</td>
<td>Two pedunculated, isoechoic (to bladder wall) with hypoechoic foci</td>
<td>CV</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Mildly thickened bladder wall (approx. 4 mm)</td>
<td></td>
<td></td>
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<tr>
<td>4</td>
<td>Mongrel</td>
<td>M</td>
<td>4</td>
<td>Single pedunculated and multiple mucosal projections, isoechoic (to bladder wall)</td>
<td>CV-CM</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Mildly thickened bladder wall (approx. 5.5 mm)</td>
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</tr>
<tr>
<td>5</td>
<td>Mongrel</td>
<td>M</td>
<td>14</td>
<td>Single pedunculated, irregular, isoechoic (to bladder wall) with hypoechoic foci</td>
<td>CD</td>
<td>3</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Moderately thickened bladder wall (approx. 6 mm)</td>
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<tr>
<td>6</td>
<td>Hokkaido</td>
<td>F</td>
<td>10</td>
<td>Multiple mucosal projections, isoechoic (to bladder wall)</td>
<td>CD</td>
<td>4</td>
</tr>
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<td></td>
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<td></td>
<td></td>
<td>Mildly thickened bladder wall (approx. 5 mm)</td>
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<tr>
<td>7</td>
<td>Shiba</td>
<td>M</td>
<td>8</td>
<td>Multiple irregular pedunculated, isoechoic (to bladder wall)</td>
<td>CV</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Severely thickened bladder wall (approx. 12 mm)</td>
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<tr>
<td>8</td>
<td>Shih-tzu</td>
<td>M</td>
<td>6</td>
<td>Single pedunculated, isoechoic (to bladder wall)</td>
<td>CD</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td>Mildly thickened bladder wall (approx. 4.5 mm)</td>
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</table>

M = Male; MC = Male Castrated; F = Female; FS = Female Spayed; CV = Cranioventral; CD = Craniodorsal
bladder thickening was diffuse in 3 dogs, and adjacent only to the polyps in the remaining 5 dogs. Sublumbar lymphadenopathy was not recognized in any cases. In general, ultrasonographic images were well correlated with contrast radiographic studies (Figs. 1 and 2) and gross pathology.

All 8 dogs underwent surgical cystotomy to evaluate the urinary bladder and to obtain tissue samples for histopathology. An obvious bladder mass was found in 7 dogs (88%), and in one dog (dog 6) multiple irregular projections with macroscopic mucosal proliferation were observed at surgery. The location of the masses was the same as that detected by ultrasonography. Gross appearance of the lesions was polypoid to pedunculated in 6 dogs (dogs 1, 3, 4, 5, 7 and 8), nodular in 1 dog (dog 2), and multiple mucosal projections in 1 dog (dog 6), which was well correlated with ultrasonographic findings. The ovoid nodular mass from dog 2 had a short stalk. All dogs had a thickened bladder wall to various degrees. Cyst calculi were found in 3 dogs. Calculi were composed of struvite in 1 dog (dog 7), and calcium oxalate in 2 dogs (dogs 3 and 8).

Histopathology was the means of definitive diagnosis in all 8 dogs. Surgical tissue samples were obtained in all 8 dogs. Polypoid cystitis was diagnosed by histology in 8 dogs. The histologic criteria for a diagnosis of polypoid cystitis were (1) microscopically detectable polypoid projections of mucosa and stroma into the lumen, (2) evidence of epithelial proliferation, (3) stromal edema, (4) inflammation, and (5) stromal hemorrhage and hemosiderin accumulation, as previously described [10].

Lesions that appeared to be characteristic of polypoid
Cystitis were epithelial down-growth, marked hemorrhage and hemosiderosis, and intraepithelial cystlike lesions, as previously reported [10].

**DISCUSSION**

Polypoid cystitis is a rare lower urinary tract disease of dogs characterized by chronic inflammation in which a variable number of polypoid lesions protrude from the mucosa of the urinary bladder into its lumen. The polyps are covered by epithelium over a core of proliferated connective tissue densely infiltrated with mononuclear leukocytes [11].

Because of the small number of previously reported dogs with polypoid cystitis, no sex predisposition had been reported. Although recent paper by Martinez et al. showed strong sex predisposition to female [10], the opposite result (predominance of males: 75%) was found in the present study. Additional study should be needed to determine sex predisposition.

Macroscopic hematuria was the most common clinical sign, occurring in 7 of 8 (88%) of the affected dogs in this study. Hematuria occurred at the end of micturition in 4 of 7 dogs (57%), and this finding is consistent with a previous report [10].

The cause of polyp formation in dogs remains unknown. In the present study, bacteriuria was detected in 4 dogs (50%). Three dogs had cystic calculi, and one dog had a cystic calculus removed 6 months before presentation. Three dogs had both urinary tract infection and calculi. Additionally, 6 dogs (75%) had crystalluria. Thus, the presence of crystals and cystic calculi or persistent urinary tract infection could irritate the bladder mucosa, and these irritations could stimulate the development of a bladder polyp as an inflammatory hyperplastic reaction.

In humans, polypoid cystitis has been observed with chronic bladder irritation associated with the use of indwelling bladder catheters, and more than 80% of chronically catheterized patients have actually developed polyps [4, 6, 12, 15]. This correlation is supported by the tendency for lesions in humans to appear in the bladder at the location of the catheter tip, and an increased prominence of lesions with longer duration of the catheter placement [4, 6]. In other studies, however, polypoid cystitis was reported in humans without a history of urinary catheterization [3, 14]. In addition, it was associated with trauma in 1 patient [13]. Thus, factors other than indwelling catheterization can contribute to the development of bladder polyps. Because no dogs had indwelling urinary catheters placed before presentation in this study, the causative factors are unlikely to be the same as those observed in affected human patients.

 Ultrasonography was successful in detecting bladder polypoid lesions in all 8 dogs in this study. The size and shape of these masses varied. The characteristic ultrasonographic appearance of the mass was polypoid to pedunculated. Although dog 2 had an ovoid nodular mass, the mass had a short stalk. Therefore, this ovoid mass could be included in a pedunculated mass. The echogenicity of the masses were generally isoechoic compare to the bladder wall, except it was hypoechoic in dog 2. Histological analysis of the mass from dog 2 disclosed a nodule of loosely arranged fibrous tissue with inflammatory infiltrates characterized by numerous eosinophils. In contrast, the masses except from dog 2 basically consisted of proliferating epithelium. This difference in tissue component appeared to reflect the echogenicity. Considering the histopathologic findings and ovoid gross morphological appearance, it might be suitable to name the lesion eosinophilic cystitis, as previously reported [5], but eosinophilic cystitis could be a variant of polypoid cystitis, in which eosinophils are a predominant component. Apart from the name of the disease, further cases are needed to clarify the echogenicity of bladder polyps in dogs.

An additional ultrasonographic finding is hypoechoic foci detected within the mass (dogs 3 and 5), which appeared to be due to edematous changes and/or epithelial cystic lesions identified at histopathology. A variably thickened bladder wall was also identified in all 8 dogs, indicating a chronic inflammatory process in this disease.

There are several entities that may mimic the ultrasonographic appearance of polypoid cystitis in dogs. These include blood clots and tumors. Blood clots usually move when the bladder is agitated. If a focal hypoechoic mass is seen, it is most likely a tumor [9]. The location of the polyps within the urinary bladder was cranioventral (n=4), cranioventral to craniodorsal (n=1), and craniodorsal (n=3) in this study. A previous report suggested that polypoid lesions strongly tend to arise in the cranioventral bladder mucosa [10]. In this study, however, the lesions were found in the craniodorsal bladder mucosa in 50% of cases. Thus, although polypoid lesions undoubtedly tend to be located in the cranial portion of the urinary bladder, these lesions could arise in the craniodorsal portion as well as the cranioventral one. This finding can be contrasted with the typical location of malignant canine bladder tumors such as transitional cell carcinoma, which has a predilection for the bladder neck or trigone region [11].

The urinary bladder is superbly suited for ultrasonic evaluation because of the excellent acoustic properties of fluid and its superficial location [2]. Ultrasonography provides an opportunity for a three-dimensional view of the urinary bladder to assess volumetric measurements, size and shape. Ultrasonography can provide information relative to the capacity of the bladder, change in bladder outline, changes in wall thickness and identification of mural and luminal masses. In addition, ultrasonographic guidance for biopsy procedures can aid in obtaining a cytologic sample from focal intraparenchymal lesions [8]. It also allows the evaluation of the retroperitoneal region for lymphadenopathy.

Conventional diagnostic imaging of the urinary bladder includes double-contrast cystography and intravenous urography. Compared to ultrasonography, these methods are more time-consuming, relatively more invasive, require patient and operator exposure to ionizing radiation, and are more likely to require tranquillization or general anesthesia.
Technical factors are important in the sonographic detection of bladder masses. The examination is aided by a fluid-filled urinary bladder [9]. Catheterization of the urinary bladder and injection of saline may help distend the urinary bladder but care must be taken not to simultaneously inject air bubbles, which may significantly impair ultrasonographic interpretation. An alternative is to perform the examination early in the morning; this also decreases the risk of infection introduced by retrograde procedures. Evaluation not only from the ventral but also the lateral aspect of the abdomen is helpful, especially when small masses are present.

The authors usually recommend sonographic evaluation as the first diagnostic imaging method in patients presented with hematuria. Its clinical value is its ability to evaluate the entire urinary tract (except the distal urethra) non-invasively without sedation or anesthesia. If the extent of the disease cannot be adequately evaluated, we do believe that conventional radiographic methods should be used as a diagnostic complement.

In conclusion, ultrasonographic appearance of polypoid cystitis in dogs was polypoid to pedunculated bladder mass with variable size and shape as well as a variably thickened bladder wall, but a mucosal projection without an obvious luminal mass cannot rule out polypoid cystitis. Although bladder polyps have been thought to tend to be located in the cranioventral bladder mucosa, this study clearly shows that the polyps also could arise in the craniodorsal bladder mucosa. Ultrasound is non-invasive, and a very useful diagnostic tool for detecting bladder polyps, but histopathological examination of the lesion is required for definitive diagnosis.

REFERENCES