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Diagnostic yield of uroendoscopy compared to ultrasonography for evaluating lower urinary tract disorders in dogs

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Abstract

Background: Cystourethroscopy and vaginoscopy (uroendoscopy) is often used in the diagnostic evaluation of dogs with lower urinary tract disorders (LUTD).

Objective/Hypothesis: To evaluate if uroendoscopy is warranted in dogs with various LUTD, the agreement between uroendoscopic and ultrasonographic diagnoses were compared. Dogs with recurrent urinary tract infections (rUTI) will have the highest diagnostic agreement between uroendoscopy and ultrasonography (US) compared to dogs presenting for other LUTD.

Animals: Two hundred thirty-seven dogs presenting between 2014 and 2019 with lower urinary tract signs (LUTS) that had US within 60 days preceding uroendoscopy.

Methods: Retrospective study. Dogs were categorized by primary indication for ultrasound. Pertinent uroendoscopic findings were recorded and agreements (κ analysis) between the final uroendoscopic diagnosis were compared with the final ultrasonographic diagnosis.

Results: Pertinent uroendoscopic findings were recorded for 69/237 (29%) cases. For dogs presenting primarily for urinary incontinence (UI), agreement between uroendoscopy and US was 71% (46/65; $\kappa = 0.47$, 95% CI 0.28-0.66), for dogs with stranguria, 58% (29/50; $\kappa = 0.47$, 95% CI 0.31-0.62) and for dogs with rUTI the agreement was substantial at 87% (26/30; $\kappa = 0.70$, 95% CI 0.43-0.98). Urethral strictures were the majority (14/21; 67%) of pertinent uroendoscopic findings for dogs with stranguria, of which 12 were male dogs.

Conclusions and Clinical Importance: Agreement between uroendoscopy and US was moderate for all dogs. Based on these data, recommendation for uroendoscopy should be tailored to individual clinical presentation and signalment; transabdominal US is not the preferred modality for urethral lesions.

Abbreviations: CT, computed tomography; LUT, lower urinary tract; LUTD, lower urinary tract disorders; LUTS, lower urinary tract signs; rUTI, recurrent urinary tract infections; UC, VMTH University of California, Davis Veterinary Medical Teaching Hospital; UI, urinary incontinence; US, ultrasonography; UTI, urinary tract infection; VVSR, vestibulovaginal septal remnant.

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KEYWORDS

cystoscopy, imaging, urinary diseases, urinary incontinence, urinary tract infection

1 | INTRODUCTION

Common lower urinary tract signs (LUTS) in dogs include stranguria, periuria, pollakiuria, dysuria, urinary incontinence (UI), hematuria; no one sign is specific for any specific disorder. Imaging modalities such as planar radiography, contrast radiography, ultrasonography (US), computed tomography (CT) and cystourethroscopy/vaginoscopy (uroendoscopy) are frequently performed for evaluating dogs with chronic LUTS. Uroendoscopy is also performed for interventional procedures such as laser lithotripsy of cystic calculi or ablation of ectopic ureters. Radiographs and US are often performed early in the diagnostic plan, as both modalities are more readily available, less invasive and less expensive compared to uroendoscopy or CT, yet the latter are considered by many to be superior for the diagnosis of some lower urinary tract disorders (LUTD).¹⁻⁴ Cystourethroscopy and CT, for example, have greater sensitivity for identifying ectopic ureters compared with excretory urography and are considered better modalities for identifying the ureters within the lower urinary tract.²⁻³

The utility of uroendoscopy in dogs with recurrent urinary tract infection (rUTI) is less clear. In dogs with rUTI, nonspecific cystourethroscopic and vaginoscopic findings such as mucosal edema, lymphoid follicles and vestibulovaginal septal remnants were noted in 45/53 (85%) cases, but no comparisons were made between endoscopic and ultrasonographic findings in that study.⁴ In addition, that study did not determine if these findings were clinically relevant or related to the LUTS for which the dog was being evaluated. In 163 women with rUTI, cystourethroscopy rarely (3.8%) identified a unique lesion (ie, pertinent uroendoscopic finding) that was not previously identified by US (111 women) or contrast CT (22 women).⁵ In 118 women with rUTI, only 8% of women (9/118) had pertinent uroendoscopic findings and 7 women were >50 years of age, suggesting that signalment should be considered when recommending cystourethroscopy in women with rUTI.⁶ Furthermore, when imaging studies (primarily US) were considered normal, the cystourethroscopic examination was also likely to be normal, with a negative predictive value of 99%.⁶ These data suggest that cystourethroscopy should not be part of the diagnostic workup for women without risk factors for rUTI, and uroendoscopy rarely provides additional information in the face of unremarkable imaging.⁶ Uroendoscopy and US diagnoses comparisons in dogs with rUTI as well as other LUTD or chronic LUTS have not been critically evaluated.

The objective of this study was to compare the agreement between the uroendoscopy diagnosis and the US diagnosis in dogs presenting for a variety of LUTS and LUTD. We hypothesized that dogs with rUTI would have the highest agreement between uroendoscopy and US compared to dogs presenting for other LUTD. We also aimed to evaluate the overall pertinent lower urinary tract (LUT) uroendoscopic findings in dogs with LUTD, which included findings

on uroendoscopy that were not identified on US as well as the absence of abnormalities on uroendoscopy that were identified on US.

2 | MATERIALS AND METHODS

2.1 | Data collection

Records of dogs at the University of California, Davis Veterinary Medical Teaching Hospital (UCD VMTH) presenting between January 2014 to December 2019 undergoing uroendoscopy for various LUTS and LUTD were reviewed. Dogs that had uroendoscopy performed no longer than 60 days after transabdominal US was performed were included. Signalment, primary indication for US as determined by the attending clinician, and number of days from ultrasonographic to uroendoscopic examination were recorded. LUT ultrasonographic diagnoses for the bladder and urethra in male and female dogs and uterine stump and cranial cervix for female dogs were recorded. If uroendoscopy provided adjunct clinical information, which could include an abnormality not reported on ultrasound or the absence of an abnormality noted on ultrasound, the cases were considered a nonagreement.

To determine if uroendoscopy provided adjunct clinical pertinent LUT findings in each dog (and not in agreement with the US diagnosis), ultrasonographic upper urinary tract and prostatic changes were not recorded because uroendoscopy cannot be utilized to evaluate these anatomical locations.⁵⁻⁶ Similar to human studies, nonspecific, subjective findings noted on uroendoscopy suggestive of inflammation such as bladder mucosal edema, glomerulations, or lymphoid follicles, and findings that do not alter the management of the case or provide a definitive diagnosis, were not recorded in the data set.⁵⁻⁸ Overt urogenital abnormalities such as foreign bodies were recorded, but hymenal remnants and paramesonephric septal remnants were not retrieved from the uroendoscopic reports because US cannot reliably visualize this area. If an abnormality was suspected on US but not confirmed with uroendoscopy, the diagnoses were considered a nonagreement. If an abnormality was suspected via US and confirmed with uroendoscopy, the diagnoses were considered an agreement. Urethral findings noted on uroendoscopy were recorded, because although transabdominal US is not ideal for urethral examination, the extraabdominal portion of the urethra is often assessed during US for various LUTD.

Based on the history and US request report, indications for transabdominal US were categorized as follows: (1) UI (unconscious urine leaking), (2) stranguria without other LUTS or concurrent urinary tract infection (UTI), (3) rUTI without concurrent UI as defined above (if UI was the primary reason for US, but concurrent subclinical bacteriuria/UTI

was noted, the dog was classified in the UI category), (4) urolithiasis, (5) suspected mass lesion(s) that were noted by the referring veterinarian via cursory bladder US or suspected due to signalment and physical examination findings, (6) hematuria only without other LUTS or concurrent UTI, (7) multiple LUTS with an undefined cause, and (8) non-LUT related indications for US (eg, vomiting and diarrhea, penile bleeding, vaginal discharge, polyuria and polydipsia) where subsequent uroendoscopy was recommended by the attending clinician based on clinical signs and US findings within the lower urinary or genital tract.

2.2 | Data analysis

Descriptive statistics were utilized for continuous data. Cohen's kappa coefficients (κ) were calculated to assess agreements between the final ultrasonographic and uroendoscopic diagnoses. Agreements were considered none ($\kappa \leq 0$), none to slight ($\kappa = 0.01-0.20$), fair ($\kappa = 0.21-0.40$), moderate ($\kappa = 0.41-0.60$), substantial ($\kappa = 0.61-0.80$) and almost perfect ($\kappa = 0.81-1.0$).⁹ Values of $P < .05$ were considered significant. Statistical software (SPSS 22.0 for Windows, IBM Corp., Armonk, New York) was used for the analyses.

3 | RESULTS

3.1 | Study cohort

Two hundred thirty-seven dogs were included, of which 139 (59%) were females and 98 (41%) were males. The median age of female dogs was 4 years (range, 0.25-0.15 years), and the median age of male dogs was 7 years (range, 0.25-0.16 years). The 8 most common breeds were Labrador retriever ($n = 26$), Golden retriever ($n = 21$), German shepherd ($n = 14$), Pitbull terrier ($n = 10$), Siberian husky ($n = 8$), Shih Tzu ($n = 6$), Rhodesian ridgeback ($n = 6$), and English bulldog ($n = 6$). The median time between US and uroendoscopic

examination was 1 day (range, 0-60 days). Agreement between the final US and uroendoscopic diagnosis was moderate for all dogs ($\kappa = 0.60$, 95% CI 0.52-0.68), regardless of sex ($\kappa = 0.60$, 95% CI 0.49-0.71 females; $\kappa = 0.58$, 95% CI 0.47-0.70 males). When considering all cases, uroendoscopy provided clinically pertinent diagnoses and findings in 69/237 (29%) dogs. These included unique findings that were confirmed using uroendoscopy that were not reported on US, and the absence of abnormalities on uroendoscopy that were previously noted during US.

3.2 | Agreements between uroendoscopy and US among various indications for uroendoscopy

The most common clinical indications for requesting US were UI, stranguria and evaluation for rUTI. The agreement between the uroendoscopic and ultrasonographic diagnoses among the different indications for US was fair to substantial for all dogs (Table 1) or when evaluated by sex (Table 2).

3.3 | Pertinent uroendoscopic findings

For the 3 most common indications for ultrasound (ie, UI, stranguria and rUTI), pertinent uroendoscopic findings were noted in 21/50 (42%), 19/65 (29%), and 4/30 (13%) dogs, respectively. Uroendoscopic diagnoses not in agreement with the ultrasonographic diagnoses are listed in Table 3.

3.3.1 | Urinary incontinence

The median age of all dogs presenting for UI was 1.5 years (range, 0.25-14). When evaluating all cases, ectopic ureters were suspected during US examination in 11 dogs, but not confirmed by uroendoscopy; 8 of these dogs were ≤ 2 years of age. Four dogs with normal

TABLE 1 Kappa (κ) agreement evaluating uroendoscopic diagnoses compared to ultrasonographic diagnoses in all dogs categorized by the primary indication for an ultrasound examination

Primary indication for ultrasound	Number (%) of dogs in agreement ($n = 237$)	κ agreement (95% confidence interval)	κ interpretation
UI	46/65 (71%)	0.47 (0.28, 0.66)	Moderate
Stranguria	29/50 (58%)	0.47 (0.31, 0.62)	Moderate
rUTI	26/30 (87%)	0.70 (0.43, 0.98)	Substantial
Non-LUT related	20/28 (71%)	0.59 (0.35, 0.83)	Moderate
Mass lesion(s)	17/21 (81%)	0.42 (-0.05, 0.89)	Moderate
Urolithiasis	16/19 (84%)	0.45 (0.06, 0.85)	Moderate
Hematuria	6/14 (43%)	0.21 (-0.11, 0.53)	Fair
Multiple LUTS	8/10 (80%)	0.68 (0.31, 1.00)	Substantial

Note: Agreements were considered none ($\kappa \leq 0$), none to slight ($\kappa = 0.01-0.20$), fair ($\kappa = 0.21-0.40$), moderate ($\kappa = 0.41-0.60$), substantial ($\kappa = 0.61-0.80$) and almost perfect ($\kappa = 0.81-1.0$).⁸

TABLE 2 Kappa (κ) agreement evaluating uroendoscopic diagnoses compared to ultrasonographic diagnoses in female and male dogs categorized by the primary indication for performing an ultrasound examination

Primary indication for ultrasound	Number (%) female dogs	κ agreement (95% confidence interval)	κ interpretation	Number (%) male dogs	κ agreement (95% confidence interval)	κ interpretation
UI	31/46 (67%)	0.37 (0.13, 0.61)	Fair	15/19 (79%)	0.66 (0.40, 0.92)	Substantial
Stranguria	15/19 (79%)	0.64 (0.39, 0.90)	Substantial	14/31 (45%)	0.31 (0.11, 0.50)	Fair
rUTI	23/26 (88%)	0.69 (0.36, 1.00)	Substantial	3/4 (75%)	0.64 (0.05, 1.00)	Substantial
Non-LUT related	11/15 (73%)	0.54 (0.16, 0.92)	Moderate	9/13 (69%)	0.61 (0.29, 0.92)	Substantial
Hematuria	4/10 (40%)	0.19 (-0.14, 0.52)	Slight	2/4 (50%)	0.20 (-0.45, 0.85)	Slight
Multiple LUTS	4/5 (80%)	0.67 (0.18, 1.00)	Substantial	4/5 (80%)	0.69 (0.16, 1.00)	Substantial

Note: Agreements were considered none ($\kappa \leq 0$), none to slight ($\kappa = 0.01-0.20$), fair ($\kappa = 0.21-0.40$), moderate ($\kappa = 0.41-0.60$), substantial ($\kappa = 0.61-0.80$) and almost perfect ($\kappa = 0.81-1.0$).⁸

TABLE 3 Pertinent uroendoscopic findings noted in dogs for cases that had a different diagnosis on uroendoscopy compared to ultrasonography (US)

Primary indication for ultrasound examination			
UI 19/65 (29%)	Stranguria 21/50 (42%)	rUTI 4/30 (13%)	Non-LUT signs 8/28 (29%)
Absence of ectopic ureter(s) (11) Ectopic ureter (4) Urethral obstruction from implant (1) Urethral abnormality (2) • Diverticulum (1) • Short urethra/hypoplastic vestibule (1) Dual vagina (1)	Urethral stricture (14) Urethral mass lesion (4) Cystic urolithiasis (2) Urethral urolithiasis (1)	Absence of urachal remnant (1) Cystic mass lesion (1) Urethral mass lesion (1) Rectourethral fistula (1)	Absence of bladder mass (1) Absence of fractured os penis (1) Absence of urachal remnant (1) Cystic urolithiasis (1) Urethral stricture (1) Rectovestibular fistula (1) Ureterovesicular junction stenosis/absence of ectopic ureter (1) Urethral mass (1)
Primary indication for ultrasound examination			
Mass lesions 4/21 (19%)	Urolithiasis 3/19 (16%)	Hematuria 8/14 (57%)	Multiple LUTS 2/10 (20%)
Absence of bladder mass (2) Urethral mass (2)	Urethral stricture (2) Gross hematuria from ureterovesicular junction (1)	Gross hematuria from ureterovesicular junction (5) Bladder wall vascular abnormality (1) Absence of ectopic ureter (1)	Urethral stricture (1) Urethral mass (1)

Note: These include findings noted during the uroendoscopy that were not reported via US as well as the absence of abnormalities on uroendoscopy that were noted during the US. Dogs were categorized by the primary indication for their ultrasound examination as deemed by the attending clinician.

urogenital tracts noted on US had ectopic ureters confirmed via uroendoscopy. Uroendoscopy confirmed the presence of an ectopic ureter in 7 dogs where this anomaly was suspected by US; these cases were considered an agreement. The kappa agreement between uroendoscopic and US diagnoses for dogs with UI ≤ 2 years of age and >2 years of age was still moderate for both ($\kappa = 0.44$, 95% CI 0.20-0.67; $\kappa = 0.51$, 95% CI 0.20-0.83, respectively). Pertinent uroendoscopy findings for dogs presenting for evaluation of UI were noted in 15/46 (33%) female dogs compared to 4/19 (21%) male dogs.

3.3.2 | Stranguria

The median age of all dogs presenting for stranguria was 8.5 years (range, 0.25-13). The majority (17/21; 81%) of stranguria cases with pertinent uroendoscopy findings were noted in dogs >2 years of age.

The kappa agreement between uroendoscopic and ultrasonographic diagnoses for dogs with stranguria ≤ 2 years of age and >2 years of age was moderate ($\kappa = 0.51$, 95% CI 0.17-0.85; $\kappa = 0.45$, 95% CI 0.28-0.61, respectively). The most common pertinent finding found only on uroendoscopy but not identified via US was the presence of a urethral stricture (14/21; 67%), more commonly observed in males (12/14; 86%) compared to females (2/14; 14%). Other pertinent uroendoscopic findings are noted in Table 3.

3.3.3 | Recurrent urinary tract infections

The median age of all dogs presenting for rUTI was 3 (range, 0.33-11). Uroendoscopy provided pertinent clinical findings compared to US in only 4/30 (13%) dogs. In 1 dog, the ultrasonographer suspected a urachal remnant, which was not detected by uroendoscopy and in 3 dogs,

US was considered unremarkable, but pertinent findings were noted on uroendoscopy (Table 3). The kappa agreement between uroendoscopic and ultrasonographic diagnoses for dogs with rUTI ≤ 2 years of age and >2 years of age was substantial in both groups ($\kappa = 0.69$, 95% CI 0.28-1.00; $\kappa = 0.70$, 95% CI 0.33-1.00, respectively).

3.3.4 | Nonlower urinary tract related concerns

The median age of dogs that initially had US performed for nonlower urinary tract related concerns was 6 years (range, 0.5-15). A variety of pertinent uroendoscopic diagnoses were noted (Table 3). The kappa agreement between uroendoscopic and ultrasonographic diagnoses for dogs with nonlower urinary tract related issues ≤ 2 years of age and >2 years of age was fair ($\kappa = 0.37$, 95% CI -0.01 to 0.75) and substantial ($\kappa = 0.65$, 95% CI 0.38-0.92), respectively.

3.3.5 | Mass lesions and urolithiasis

The median age of all dogs presenting for mass lesions and urolithiasis was 10.5 (range, 4-13) and 7 (range, 1.5-11), respectively. For the 21 dogs where mass lesions were suspected by the clinician, uroendoscopy, and US diagnoses were in agreement in all except for 4 (19%) dogs; 2 of these dogs had no pertinent US findings but were diagnosed with urethral masses via uroendoscopy, and 2 dogs had a suspected cystic mass lesion noted on US but had a normal uroendoscopic examination. The agreement among dogs with suspected urolithiasis was 16/19 (84%). In 2 dogs, urethral strictures were noted on uroendoscopy, and in 1 dog pigmenturia (suspected gross hematuria) was identified from 1 of the ureteral jets. Too few numbers of cases were identified in these groups to provide kappa agreements by sex.

3.3.6 | Hematuria

The median age of all dogs presenting for only hematuria was 5 (range, 1-10). Uroendoscopy confirmed the presence of suspected gross hematuria from a ureteral jet in 5/14 (35%) dogs; 4 of these dogs had a normal US and 1 had a suspected bladder mass. Uroendoscopy identified a suspected bladder vascular abnormality in 1 dog. A normal uroendoscopic examination was reported for 1 dog where US findings were suspicious for a left intramural ectopic ureter. The kappa agreement between uroendoscopic and ultrasonographic diagnoses for dogs with hematuria ≤ 2 years of age and >2 years of age was none ($\kappa = 0$) and fair ($\kappa = 0.29$, 95% CI -0.08 to 0.67), respectively.

3.3.7 | Multiple lower urinary tract signs

The median age of all dogs presenting for multiple LUTS was 6.75 (range, 0.6-12). Kappa agreement for dogs presenting with multiple LUTS was substantial ($\kappa = 0.68$, 95% CI 0.31-1.00) but only 10 dogs

were classified to this category. A urethral stricture at the level of the os penis was noted in 1 dog, where only benign prostatic hypertrophy was reported on US. On uroendoscopy a urethral mass (transitional cell carcinoma, or TCC) was identified in another dog where only mild bladder wall thickening (nonspecific lesion) was noted on US. The kappa agreement between uroendoscopic and ultrasonographic diagnoses for dogs with multiple LUTS ≤ 2 years of age and >2 years of age was almost perfect ($\kappa = 1$, 95% CI 1.00) and substantial ($\kappa = 0.62$, 95% CI 0.19-1.00), respectively.

4 | DISCUSSION

Overall, agreement between uroendoscopy and US was moderate but varied based on the reason for ultrasound, the sex of the dog, and occasionally by age. Based on our findings, uroendoscopy is a very useful adjunct diagnostic tool but its added benefit varies among reason for evaluation. The results of this study suggest that a tailored approach for performing uroendoscopy in dogs with LUTS should be made based on presenting complaint and signalment. In dogs evaluated for UI, 29% had pertinent findings identified only by uroendoscopy, which altered the case management. Uroendoscopy in dogs with UI <2 years of age had a lower agreement than older dogs and, in most cases, uroendoscopy did not confirm the presence of a suspected ectopic ureter noted on US examination. It is likely the ultrasonographer's knowledge regarding the signalment of dogs in this group added bias to the final ultrasonographic interpretation as ectopic ureters are often 1 of the top differentials in a young dog with UI. Prior to uroendoscopy becoming more commonplace, a CT scan or surgical exploration would have been recommended in dogs with suspected ectopic ureters, however, uroendoscopy is less invasive (compared to surgery) and is the gold standard for locating the ureterovesicular junctions.² Ultrasound and fluoroscopic excretory urography correctly identified only 20% and 44% of ectopic ureters, respectively in 1 study compared to uroendoscopy.¹⁰ In a small scale study of 14 dogs, both contrast radiography and US confirmed ureteral ectopia in 91% of 14 cases with ectopic ureters confirmed by surgery or necropsy; uroendoscopy was not routinely performed at the time of that publication.¹¹ In our study, ectopic ureters were suspected in 11 dogs presenting for UI based on the US report, which were not confirmed by uroendoscopy. Sonographically, ureteral jets are not always present during US, rendering the identification of the exact location of the ureterovesicular junctions more difficult. Intravenous furosemide might improve ureteral jet detection but is not routinely used in our institution.¹² Uroendoscopy is more sensitive for detecting ectopic ureters and should be recommended to confirm or refute the diagnosis, particularly in younger, female dogs with a history of UI. Moreover, if confirmed, laser ablation to correct the abnormality can be performed during the same anesthetic episode.¹³⁻¹⁴ Clinicians also perform fluoroscopic contrast retrograde ureterograms and cystourethrograms which could provide more accurate assessments of the LUT but investigating this imaging modality was beyond the scope of this study.

Of the 50 dogs presenting for stranguria, 21 (42%) had pertinent findings identified on uroendoscopy that were in disagreement with US. The kappa agreement between uroendoscopy and US was considered substantial for female dogs, but only fair for male dogs. The majority of these cases (67%) had a urethral stricture identified, of which 12 were male dogs. Standard transabdominal US is not the preferred imaging modality to diagnose urethral strictures in dogs, so the larger number of cases with pertinent uroendoscopic urethral lesions was expected. In men, the diagnosis of urethral stricture is confirmed by cystourethroscopy, retrograde urethrogram/voiding cystourethrogram or by the passage of a urethral catheter, and measurement of the stricture length should be obtained by 1 of the imaging studies.¹⁵ Uroendoscopy is also considered a confirmatory study for suspected urethral strictures in women.¹⁶ Transabdominal US of the urethra is limited by interference of the pubis.¹⁷ Other techniques such as transrectal US and contrast enhanced transperineal US are more sensitive for lesions of the intrapelvic urethra and adjacent structures, however, these techniques were not employed in this study, affecting the agreement between uroendoscopy and US in these dogs.^{18,19} The absence of abnormalities on uroendoscopy in stranguric dogs should be considered relevant, as this allows the clinician to exclude a mechanical obstruction as the reason for the clinical signs. Contrast urethrography could also be considered for these cases, but we did not evaluate that imaging modality in this study.

While we noted pertinent uroendoscopic findings in only 4/30 (13%) dogs presenting for rUTI, this is higher than reported for women using similar criteria where cystourethroscopy identified 9 (5.5%) cases that had “significant clinical findings,” including 5 (3.8%) that were uniquely identified on cystourethroscopy and missed on other imaging (primarily US) modalities.⁵ When imaging was unremarkable, only 6.1% of the women who underwent cystourethroscopy had abnormal findings. Clinical risk factors were not associated with higher risk of having an abnormal cystourethroscopy and the authors concluded cystourethroscopy was a low yield diagnostic test in this human population.⁵ Similar findings were noted in a retrospective study of women undergoing cystourethroscopy for rUTI; 9/118 (8%) women had pertinent abnormalities on their cystourethroscopy not reported on US, and most were older than 50 years of age, suggesting that women without risk factors for rUTI and normal imaging could omit cystourethroscopy as part of their diagnostic workup entirely.⁶ Our canine population had a higher percentage (13%) of pertinent uroendoscopic findings, however we had a much lower case number and further data should be investigated. In humans, flexible cystourethroscopy is often utilized for women⁶ and men, while rigid cystourethroscopy is utilized for female dogs and flexible cystourethroscopy for male dogs in this study. It is possible that the use of rigid cystourethroscopy in female dogs might provide better visualization and lead to a lower agreement in our canine population.

Cystourethroscopic anomalies are reported in 45/53 (85%) dogs evaluated for rUTI, however many of these abnormalities could be considered nonspecific (eg, bladder and urethral mucosal edema and lymphoid follicles) regardless of the severity, rather than a pertinent uroendoscopic finding that would likely alter case management.^{4,20}

Common findings in cystourethroscopy include vestibulovaginal abnormalities, such as vestibulovaginal stenosis. The latter has been reported as a potential contributing comorbidity in dogs with rUTI but was not included as a pertinent finding in our study. Although a vestibulovaginal ratio of <0.2 is considered a “contributing factor” for LUTS (eg, UI, UTI, vaginitis),²¹ no association has been found between the vestibulovaginal ratio and the presence of a UTI. Bacteriuria was present in 8/10 of those dogs but there was no differentiation between a clinical UTI versus subclinical bacteriuria.²¹ Furthermore, 8/12 healthy spayed dogs were found to have vestibulovaginal stenosis (ratio <0.35), suggesting this abnormality can be found in otherwise healthy animals.²² While 36 dogs with vestibulovaginal septal remnants (VVSR) had a UTI (or subclinical bacteriuria) that improved with laser ablation of the hymenal remnant, 32/34 (94%) dogs also had concurrent urogenital anomalies and 30/36 (83%) had ectopic ureters diagnosed. Although a significant decrease in the rate of UTI was noted after laser ablation of the VVSR, 25 of those dogs had ectopic ureters corrected during the same procedure, therefore it is difficult to ascertain if the VVSR, ectopic ureter correction or a combination of these 2 decreased rUTI in this population.²³ In our institution, VVSR is not considered a pertinent uroendoscopic finding in every case and might be seen in continent dogs and dogs without UTI. Therefore, in this canine population, presence or absence of VVSR was not considered when evaluating agreement with US. Our data suggests that uroendoscopy might not provide additional information in most dogs presenting for rUTI and the risks versus benefits of this procedure should be evaluated. Uroendoscopy does offer a minimally invasive method for obtaining biopsies for histopathology or culture, however treatment for rUTI is recommended based on clinical signs, thus the need for biopsies in subclinical dogs should be considered prior to recommending the procedure.²⁴

Too few cases and variables were available when evaluating agreement for males and females with mass lesions, urolithiasis, hematuria or multiple LUTS, so these agreements should be interpreted with caution. While the kappa agreement between US and uroendoscopy was moderate for dogs with urolithiasis, uroendoscopy could have been performed for laser lithotripsy, and not to confirm a final diagnosis. However, the uroendoscopist should be prepared for lesions that may not have been discovered using standard transabdominal US (eg, urethral strictures) which might preclude success of the intended interventional therapy. The low agreement for dogs presenting for only hematuria was expected; essential renal hematuria was suspected in these cases and US cannot detect gross hematuria from ureteral jets, which uroendoscopy identified in 5 dogs.

This study had several limitations. As a retrospective study there was some case selection bias, where the clinician recommended uroendoscopy expecting to find abnormalities that had not already been noted via US. On this assumption we expected the agreements to be lower, but the agreements were higher in some categories even with this biased selection. This study also excluded cases that had sonographic diagnosis of disease in which uroendoscopy was not chosen (eg, gross neoplasia with a cytologic diagnosis). A variety of

radiologists, imaging residents, and uroendoscopists performed the procedures, interpreted the findings, and wrote the available reports. However, only cases that had an US or uroendoscopy completed by or reviewed by a boarded radiologist or internist, respectively, were included. While this does increase the variability, this was thought to represent and reflect real-life practice similar to human studies.⁵⁻⁶ As mentioned previously, for some cases uroendoscopy may have been recommended and pursued for interventional therapies (eg, ectopic ureter laser ablation or laser lithotripsy) in addition to or in lieu of investigating anatomical abnormalities or obtaining a definitive diagnosis. A complete evaluation of the urethra is difficult using noncontrast enhanced transabdominal US. Finally, several of the categories evaluated in this study had small case numbers.

5 | CONCLUSION

Based on the low agreements in some categories of LUTD we evaluated, uroendoscopy can be a clinically useful adjunct diagnostic. However, because the agreement was variable, a tailored case approach is important when determining whether to recommend uroendoscopy for each dog that presents for LUTS.

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CONFLICT OF INTEREST DECLARATION

Authors declare no conflict of interest.

OFF-LABEL ANTIMICROBIAL DECLARATION

Authors declare no off-label use of antimicrobials.

INSTITUTIONAL ANIMAL CARE AND USE COMMITTEE (IACUC) OR OTHER APPROVAL DECLARATION

Authors declare no IACUC or other approval was needed.

HUMAN ETHICS APPROVAL DECLARATION

Authors declare human ethics approval was not needed for this study.

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REFERENCES

- Morgan M, Forman M. Cystoscopy in dogs and cats. *Vet Clin North Am Small Anim Pract.* 2015;45(4):665-701.
- Cannizzo KL, McLoughlin MA, Mattoon JS, et al. Evaluation of transurethral cystoscopy and excretory urography for diagnosis of ectopic ureters in female dogs: 25 cases (1992-2000). *J Am Vet Med Assoc.* 2003;223(4):475-481.
- Samii VF, McLoughlin MA, Mattoon JS, et al. Digital fluoroscopic excretory urography, digital fluoroscopic urethrography, helical computed tomography, and cystoscopy in 24 dogs with suspected ureteral ectopia. *J Vet Intern Med.* 2004;18(3):271-281.
- Llido M, Vachon C, Dickinson M, Beauchamp G, Dunn M. Transurethral cystoscopy in dogs with recurrent urinary tract infections: retrospective study (2011-2018). *J Vet Intern Med.* 2020;34(2):790-796.
- Pagano MJ, Barbalat Y, Theofanides MC, Edokpolo L, James MB, Cooper KL. Diagnostic yield of cystoscopy in the evaluation of recurrent urinary tract infection in women. *NeurourolUrodyn.* 2017;36:692-696.
- Lawrentschuk N, Ooi J, Pang A, et al. Cystoscopy in women with recurrent urinary tract infection. *Int J Urol.* 2006;13:350-353.
- Acar O, Tarcan T. Cystoscopic evaluation and clinical phenotyping in interstitial cystitis/bladder pain syndrome. *J Turk Ger Gynecol Assoc.* 2019;20:117-122.
- Furuya R, Masumori N, Furuya S, Oda T, Takahashi S, Takeuchi M. Glomerulation observed during transurethral resection of the prostate for patients with lower urinary tract symptoms suggestive of benign prostatic hyperplasia is a common finding but no predictor of clinical outcome. *Adult Urol.* 2007;70(5):922-926.
- McHugh M. Interrater reliability: the kappa statistic. *Biochem Med.* 2012;22(3):276-282.
- North C, Kruger JM, Venta PJ, et al. Congenital ureteral ectopic in continent and incontinent-related Entlebucher Mountain dogs: 13 cases (2006-2009). *J Vet Intern Med.* 2012;94(5):1055-1062.
- Lamb CR, Gregory SP. Ultrasonographic findings in 14 dogs with ectopic ureter. *Vet Radiol Ultrasound.* 1998;39(3):218-223.
- Gremillion C, Cohen EB, Vaden S, Seiler G. Optimization of ultrasonographic ureteral jet detection and normal ureteral jet morphology in dogs. *Vet Radiol Ultrasound.* 2021;62:583-590.
- Berent AC, Weisse C, Mayhew PD, Todd K, Wright M, Bagley D. Evaluation of cystoscopic-guided laser ablation for intramural ectopic ureters in female dogs. *J Am Vet Med Assoc.* 2012;240(6):716-726.
- Berent AC, Mayhew PD, Porat-Mosencio Y. Use of cystoscopic-guided laser ablation for treatment of intramural ureteral ectopia in male dogs: four cases (2006-2007). *J Am Vet Med Assoc.* 2008;232(7):1026-1034.
- Wessells H, Angermeier KW, Elliott S, et al. Male urethral stricture: American Urological Association guideline. *J Urol.* 2017;197(1):182-190.
- Spilotos M, Malde S, Solomon E, et al. Female urethral stricture: a contemporary series. *World J Urol.* 2017;35(6):991-995.
- Hecht S. Diagnostic imaging of lower urinary tract disease. *Vet Clin North Am Small Anim Pract.* 2015;45(4):639-663.
- Trikoupi G, Papadopoulou P, Papadopoulou F, Theodoridis A, Papazoglou L, Patsikas M. Contrast-enhanced voiding urosonography: a new, radiation-free, alternative method for imaging of urinary bladder and urethra in healthy dogs. *Vet Radiol Ultrasound.* 2020;61(4):453-460.
- Culp W, Johnson E, Giuffrida M, et al. Use of transrectal ultrasonography for assessment of the size and location of prostatic carcinoma in dogs. *Am J Vet Res.* 2019;80(11):1012-1019.
- Nickel JC, Wilson J, Morales A, et al. Value of urologic investigation in a targeted group of women with recurrent urinary tract infections. *Can J Surg.* 1991;34(6):591-594.
- Crawford JT, Adams WM. Influence of vestibulovaginal stenosis, pelvic bladder, and recessed vulva on response to treatment for clinical signs of lower urinary tract disease in dogs: 38 cases (1990-1999). *J Am Vet Med Assoc.* 2002;221(7):995-999.
- Wang KY, Samii VF, Chew DJ, et al. Vestibular, vaginal and urethral relationships in spayed and intact normal dogs. *Theriogenology.* 2006;66(4):726-735.

23. Burdick S, Berent AC, Weisse C, Langston C. Endoscopic-guided laser ablation of vestibulovaginal septal remnants in dogs: 36 cases (2007-2011). *J Am Vet Med Assoc.* 2014;244(8): 944-949.
24. Weese J, Blondeau J, Boothe D, et al. International Society for Companion Animal Infectious Diseases (ISCAID) guidelines for the diagnosis and management of bacterial urinary tract infections in dogs and cats. *Vet J.* 2019;247:8-25.

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