

DIAGNOSIS OF ABNORMAL URETERAL EMPTYING IN DOG BY ULTRASONOGRAPHY - 2 CASE STUDIES.

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Abnormalities in ureteral emptying are results of congenital ectopic ureters where the ureters open into a site other than the bladder trigone or occlusion of the normal ureteral openings by intra or extra luminal masses or depositions. B-mode and colour Doppler ultrasonography are convenient methods to diagnose these conditions. This communication discusses 2 case studies of abnormal ureteral emptying diagnosed by ultrasonography. Case study 1 (C1) was a 13 year old, female, Dachshund with complaints of chronic mild haematuria, mild urinary incontinence and pollakiuria. Case study 2 (C2) was a 10 month old, female, crossbred dog with the complaint of urinary incontinence since birth. Both patients were subjected to B-mode and colour Doppler ultrasonographic examinations. In C1, a mildly distended bladder lumen containing echogenic debris suspected as blood clots, and an acquired pseudo ureterocoele created by densely accumulated debris were identified. Right ureteral jet was identified but the left ureteral jet was absent. Following the treatment which targeted to control cystitis and cystic haemorrhage, the pseudo ureterocoele was absent and both ureteral jets were visible. In C2, with hydration and inducing diuresis, an ectopic ureter was visible, which could be traced cranially to the distended left renal pelvis and extended caudally beyond the neck of the bladder. Only the right ureteral jet was visible in C2 as well. C2 was treated for urinary tract infection (UTI) and subsequently subjected to corrective surgery of ectopic ureter. Urinary incontinence was significantly reduced in C2 post surgically. B-mode and colour Doppler ultrasonography

with the combination of diuresis are useful methods to diagnose abnormal ureteral emptying.

Keywords: ectopic ureter, ureterocoele, ureteral obstruction, ureteral jets.

Ureters are parts of the upper urinary tract which are the transporting tubules of urine from the renal pelvis to the urinary bladder. They open into the urinary bladder at the left and right urinary papillae located at the bladder trigone (Lamb and Gregory, 1994). Abnormal positioning or occlusion of a ureteral opening impairs the rate of emptying of urine into the bladder. Intra or extra luminal causes such as tumors, polyps, uroliths, blood clots, severe cystitis and ureteritis at the level of urethral papillae could obstruct the of ureteral opening (Leville et al., 1992, d' Anjou, 2008). Congenital ectopic ureter, which is more prevalent in young females is the most common cause for malpositioning of ureteral opening in dog (Holt and Moore, 1995, Forrester, 2005). In this condition, a single ureter or both ureters either open into the vagina, urethra, uterus or the bladder wall instead of the bladder lumen (Thrall, 2002, Dean and Bojrab, 1988). When the ectopic ureter opens into the urethra, the urine flow is uncontrolled, resulting urinary incontinence, often with concurrent complication of ascending bacterial UTI (Lane, et al. 1995, Forrester, 2005, Nyland et al., 2002). When the ectopic ureter opens into the bladder wall, because of the stenosis of the ureteral meatus and urine accumulation, a non vascular, anechoic, thin walled cyst like structure (ureterocoele) is formed projecting into the bladder lumen

(Stiffler et al., 2002, Nyland et al., 2002, Takiguchi et al., 1997, Patterson and Klutzier, 2010). Ureteroceles often create hydroureter and ipsilateral renal pelvis dilatation (Nyland et al., 2002).

Ectopic ureters and occluded ureters can be identified by plain and contrast radiography (excretory urography, positive or double contrast cystography, fluoroscopy and retrograde urethrography) and computed tomography, which are time consuming procedures (d' Anjou, 2008, Forrester, 2005). B-mode ultrasound and colour Doppler ultrasound examinations are practical and efficient methods to use in diagnosing ectopic ureters and the patency of ureteral openings. These techniques have equal sensitivity with contrast radiography if done by an experienced examiner (Lamb et al., 1998, Nyland et al., 2002). Emptying of urine into the bladder can be identified by B-mode ultrasonography and colour Doppler, by observing the echogenic smoke like ureteral jets or red or blue colour jets consecutively. Visibility of the ureteral jets depends on the difference in specific gravity of urine in ureters and the bladder, or when there is a turbulence created by ureteral emptying (Dubbins et al., 1981, Price et al., 1989). Hydrating the patient and inducing diuresis by injecting a low dose of furosemide intravenously (IV) can create the necessary specific gravity difference to observe clearly identifiable ureteral jets when the ureteral openings are patent (Nyland et al., 2002).

A normal ureter cannot be identified by ultrasound because of the small diameter (Lamb, 1998). The ectopic ureters, often can be identified coursing cranially along the bladder wall into the ipsilateral renal pelvis, and caudally towards the urethra. In these cases the ectopic ureters are identified because they are distended with urine (hydro ureters) (d' Anjou, 2008, Lang, 2006, Nyland et al., 2002).

Absence of single or both ureteral jets indicates either the presence of ectopic ureters or ureteral occlusion (Nyland et al., 2002).

Following communication deals with 2 case reports of dogs with abnormal ureteral emptying, which were presented to the Veterinary teaching Hospital (VTH), Faculty of Veterinary Medicine, University of Peradeniya. Case 1 (C1) was of a 14 year old, female, Dachshund with an acquired pseudo ureterocoele and the case 2 (C2) was of a 10 month old, female, crossbred with a congenital ectopic ureter. The aim of this communication is to demonstrate the ease and simplicity of employing B-mode and Doppler ultrasound techniques in diagnosing ureteral obstructions.

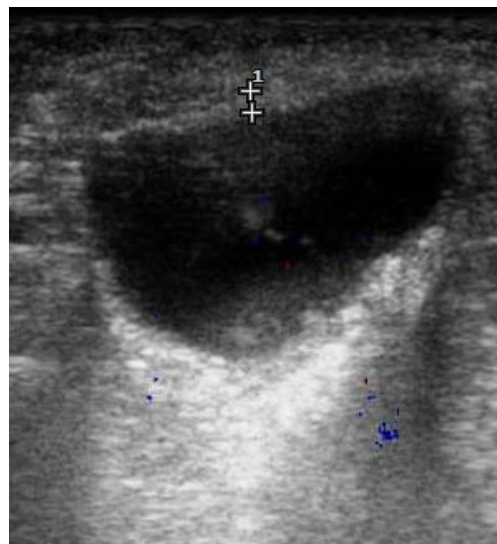
C1: Acquired pseudo ureterocoele in a 14 year old female Dachshund:

A 14 year old, female, Dachshund weighing 13 kg was presented to the VTH, with a complaint of mild haematuria, mild urinary incontinence and pollakiuria. This patient had a long history of recurrent signs of cystitis for 3 years with intervals between episodes being 6 months to 1 year. During each visit the patient was symptomatically treated with ciprofloxacin, vitamin C and tranexamic acid, which temporarily held the condition at bay until the discontinuation of the treatment, subsequent to which the clinical signs recurred which followed repeated visits to the facility. An ultrasonographic examination done about a year ago during such a visit revealed a growth at the trigone of the bladder which was tentatively diagnosed as a polyp.

At the current presentation the complaint was the same; presence of mild haematuria, mild urinary incontinence and pollakiuria, although no signs of dysuria or stranguria were observed. The overall condition, activity and the appetite of the patient were normal. The vital parameters were normal as well (T 101.5°F, normal pulse quality, 2 sec capillary refilling time (CRT), 124 beats/minute heart rate (HR), 24 breaths/minute respiratory rate (RR)). During general clinical examination (GCE), a swollen and hyperemic vulva was identified and the abdominal examination revealed caudal abdominal pain.

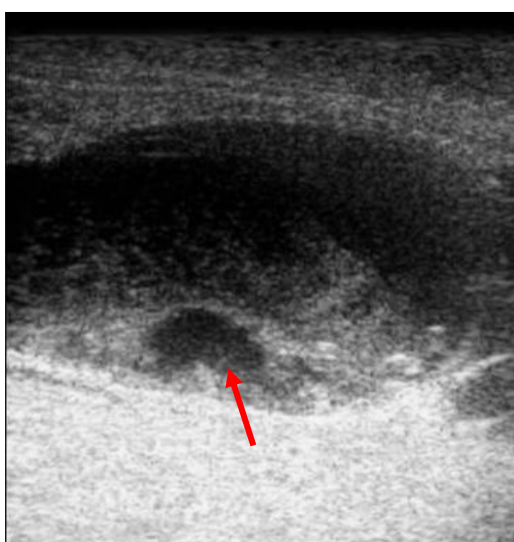


1a

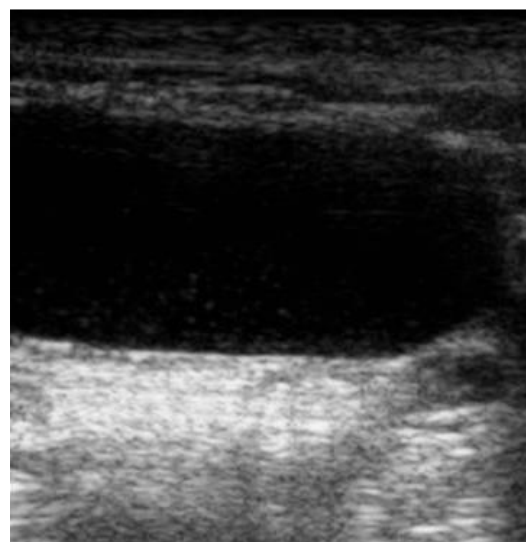


1b

1a. Initial B mode; Cystic intra luminal dense echogenic material and depositions on the dorsal wall. 1b. Follow up B-mode; presence of echogenic particles but the density was reduced.



2a



2b

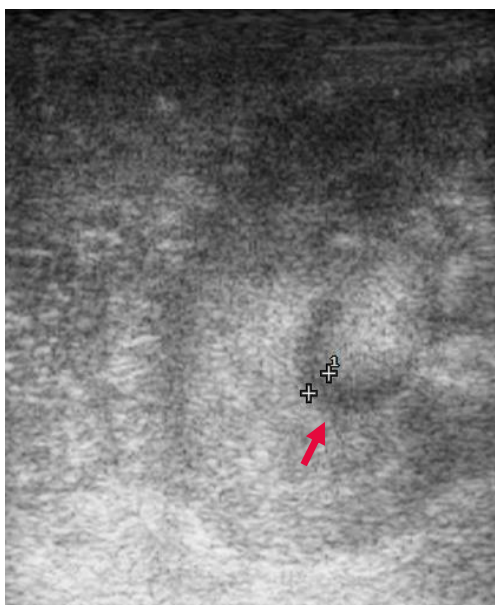
2a. Initial B-mode; anechoic, acquired pseudo ureterocoele at the dorsal wall of the bladder (red arrow). 2b. Follow up B-mode; absence of the acquired pseudo ureterocoele at the dorsal wall of the bladder.

Full blood count (FBC) results showed normal white blood cell (WBC) $20.01 \times 10^3/\mu\text{l}$ ($5 - 21.5 \times 10^3/\mu\text{l}$), red blood cell (RBC) $5.47 \times 10^6/\mu\text{l}$ ($3.4 - 7.6 \times 10^3/\mu\text{l}$), haematocrit (Hct) 38.7% (25 - 47%), mean corpuscular hemoglobin concentration (MCHC) 27.6% (34 - 42%) and normal hemoglobin concentration (Hb) 10.7 g/dl (9 - 19 g/dl). Thrombocyte count was slightly below the normal; $178 \times 10^3/\mu\text{l}$ ($200 - 500 \times 10^3/\mu\text{l}$). Biochemical panel was normal; blood urea

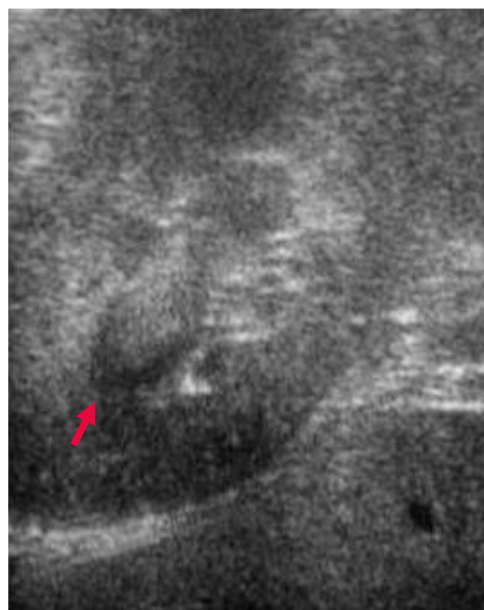
nitrogen level (BUN); 15.62 mg/dl (10.00 - 28.00 mg/l), total protein (TP); 7.02 g/dl (5.00 - 8.80 g/dl), albumin 2.91 g/dl (2.60 - 3.30 g/dl).

Differential diagnoses recorded as; chronic urinary tract infection, urolithiasis and chronic cystitis.

Ultrasound examination revealed a moderately distended bladder with mildly thickened wall of 2.4 mm. A large quantity of echogenic, non shadowing movable

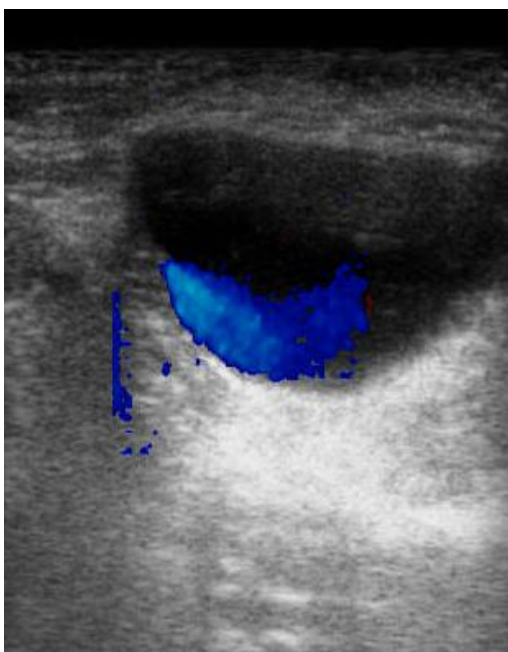


3a

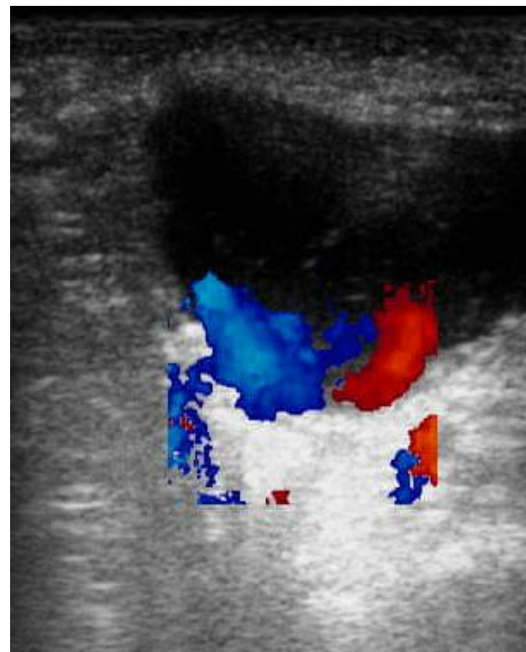


3b

3a. Initial B-mode; distended left renal pelvis (red arrow). 3b. Follow up B-mode: normal left renal pelvis (red arrow).



4a



4b

4a. Initial colour Doppler; only a the right ureteral jet (blue) present. 4b. Follow up colour Doppler; presence of both left (red) and right (blue) ureteral jets.

particles were observed within the bladder lumen. On the dorsal wall of the bladder, the debris which probably could be blood clots, fragments of blood clots and cellular debris were accumulated and organized (image 1a). Within the organized area of the debris, a thin walled anechoic cyst like structure (4.5 x 11.7 mm) similar to a ureterocoele was

visible (image 2a). In addition, the left kidney pelvis was mildly dilated at the height of 2.4 mm (image 3a). No hydro ureter was observed and left kidney additionally, had a single renal cyst. Height of the right renal pelvis was normal at 1.8 mm. Colour Doppler ultrasound examination elicited a single ureteral jet from the right

side of the bladder trigone but not from the left side (image 4a). Further colour Doppler evaluation after diuresis by furosemide was not carried out to avoid unnecessary complications.

The diagnosis was made as mild cystitis with impaired emptying of the left ureter into the bladder lumen at the level of left urethral papilla by an organized and attachment of blood clots and debris forming a pseudo ureterocoele. Treatment rationale was addressed at controlling the cystic haemorrhage and managing the cystitis.

The patient was placed on antibiotics and tranexamic acid for 2 weeks and requested for a follow up.

On the follow up visit, the haematuria, pollakiuria and urinary incontinence were non existing. The overall condition, activity, appetite and vital parameters were normal. Vulval swelling or hyperemia was not observed and the abdominal examination did not elicit any pain.

B-mode ultrasound examination revealed a moderately distended bladder with 2.0 mm thick wall. Echogenic particles were seen floating in the urine (image 1b). However, the density and amount of echogenic debris were markedly reduced. The acquired pseudo ureterocoele was absent (image 2b). The left renal pelvis height was normal at 2 mm (d' Anjou, 2008) (image 3b).

A low dose of furosemide (0.5 mg/kg) was injected IV for the clear visualization of ureteral jets and both ureteral jets were observed at the trigone (image 4b). The same treatment protocol was asked to continue for another 2 weeks with no follow up visit.

C2: Congenital ectopic ureter in a 10 month old female crossbred dog:

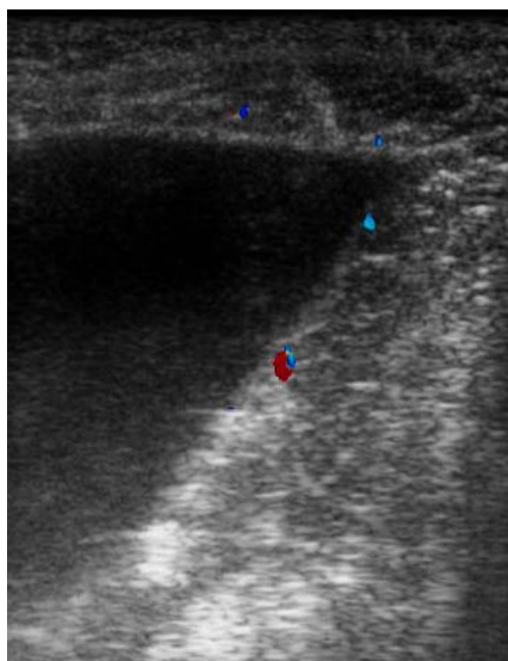
Ten month old cross bred female dog weighing 13 kg was presented with the complaint of urinary incontinence that has been observed since birth. The patient was treated for UTI periodically with antibiotics from the age of 2 months without any improvement.

The overall condition, activity and the appetite of the patient were normal. The vital parameters were normal as well: normal

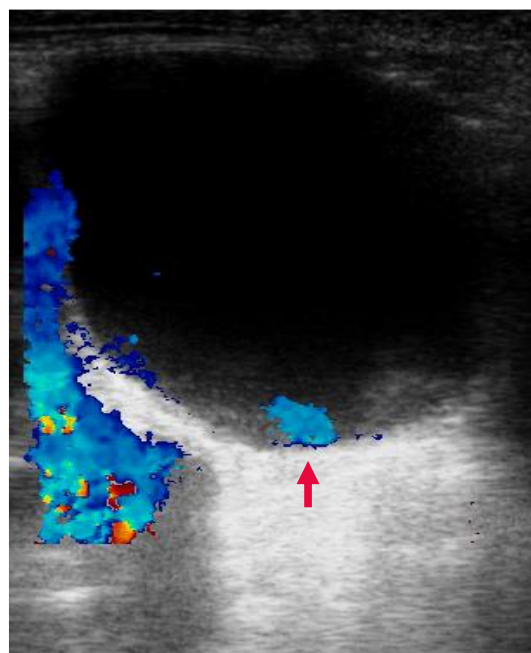
pulse quality, 2 sec CRT, 120 beats/minute HR, 23 breaths/minute RR, with the exception of the temperature which was 102.8°F. The patient was about 5% dehydrated, even though the water intake was reported to be normal. The client has deprived providing water to the patient in the morning and the travelling distance from the home and the veterinary facility was considerable. During GCE, vulva was found to be hyperemic with the perivulvar region was urine stained and scalded (Forrester, 2005).

FBC showed normal counts of WBC; $17.65 \times 10^3/\mu\text{l}$, RBC; $5.13 \times 10^6/\mu\text{l}$, Hct; 34.5%, MCHC; 35.3% and Hb; 12.2 g/dl. Thrombocyte count was slightly below the normal; $138 \times 10^3/\mu\text{l}$. Biochemical panel was also normal with the creatinine level; 1.14 mg/dl (0.5 - 1.5 mg/dl), TP; 7.02 g/dl and Alb; 2.91 g/dl. Results of analysis of a voided urine sample showed pH 5.5, S.G. 1.025, moderate presence of neutrophils, presence of bacteria, and RBC with protein level of 0.3 mg/dl. Differential diagnosis recorded as: ectopic ureter and UTI.

Initial ultrasound examination did not show any abnormality except a small amount of echogenic debris floating within a moderately filled bladder (image 5a). Colour Doppler examination failed to show ureteral jets at the trigone (image 5a). The second ultrasound examination was carried out 2 hours later, after 100 ml of 0.9% saline slow IV) infusion and 0.5 mg/kg IV furosemide injection at the time of ultrasound examination. Colour Doppler ultrasound examination showed right ureteral jet but the left ureteral jet was absent (image 5b). Within a minute after furosemide injection, the left ureter became visibly distended to 5 mm (image 6a). The distended left ureter (hydro ureter) was seen coursing along the dorsal bladder wall past the bladder trigone and into the pelvic inlet where it could not be traced any more (image 6b). The left hydro ureter could be traced cranially back to the left renal pelvis which was also distended to 6 mm (image 7a). The right ureter was not visible and the right renal pelvis was not distended (image 7b).

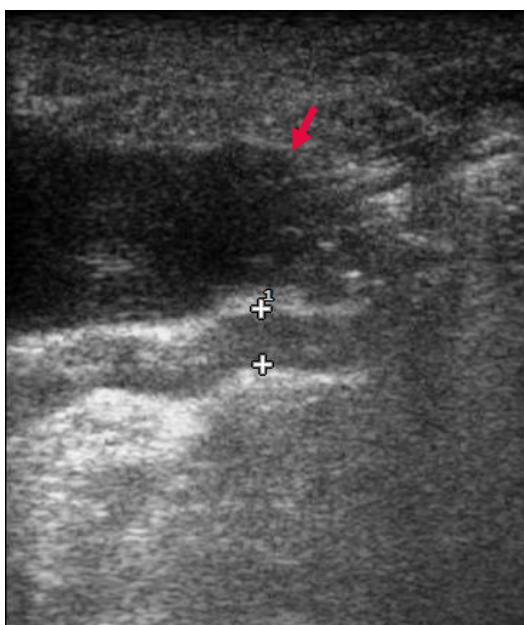


5a

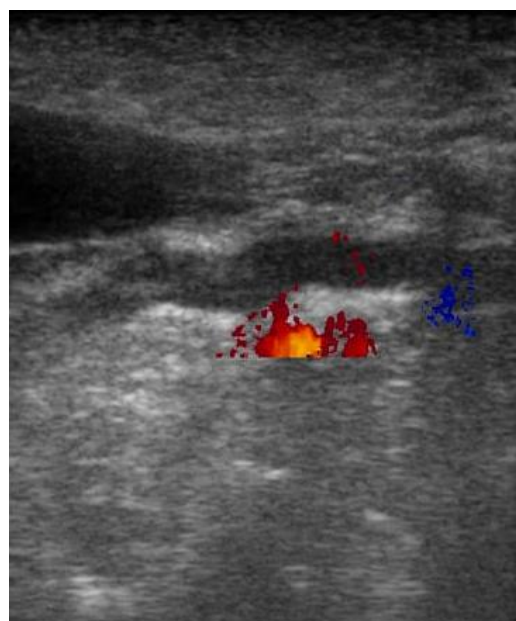


5b

5a. Initial colour Doppler; absence of ureteral jets at the trigone. 5b. Post diuresis colour Doppler; only the right (blue) ureteral jet present (red arrow).



6a



6b

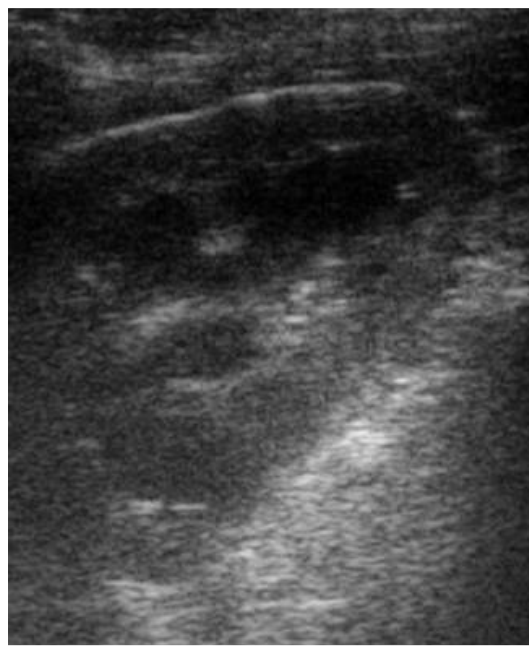
6a. Post diuresis B- mode; left hydro ureter. 6b. Post diuresis B- mode; left hydro ureter coursing caudally, beyond the bladder neck (red arrow).

Diagnosis was made as congenital left ectopic ureter with mild UTI. Treatment rationale was to treat the UTI prior to the surgical correction of the ectopic ureter. The patient was placed on antibiotic therapy consisted of ciprofloxacin at 10 mg/kg orally twice daily and metronidazole at 20 mg/kg

orally twice daily for 2 weeks. The corrective surgery was scheduled after two weeks. The first follow up after the surgery showed significant improvement of the urinary incontinence and the disappearance of vulval hyperemia.



7a



7b

7a. Post diuresis B- mode; distended left renal pelvis and the left hydro ureter. 7b. Post diuresis B- mode; normal right renal pelvis and absence of a hydro ureter.

DISCUSSION

The long history of recurrent cystitis, concurrent haematuria and the previous observation of a presence of a polyp was the reason for the B- mode ultrasound examination of C1 on the first visit. Moderately distended bladder with 2.4 mm thick wall indicated increased thickness of the bladder wall, when compared with the thickness of a moderately distended normal bladder wall at 1.4 mm (Geisse et al., 1997). Increased thickness of the bladder wall was consistent with the diagnosis of cystitis.

The urinary bladder contained echogenic debris which could be either blood clots or cellular debris. Uroliths were ruled out as the echogenic debris did not cast acoustic shadows (Cartee, et al., 1980, Biller et al., 1990). As C1 was an adult dog, ectopic ureter was not included as a differential diagnosis. Identification of left acquired ureteral obstruction in C1 was an incidental finding. Finding of an acquired pseudo ureterocoele was unusual and to the authors knowledge such phenomenon was not published previously. In patients with ureterocoeles, the stenosis of the ureteral opening is caused by congenital anatomical defects (McLoughlin, 1989). In contrast, the

formation of the ureterocoele like structure seen in C1, was probably be due the compression of the left ureteral meatus by the organized debris collected at the top of the opening and causing the urine accumulation. Presence of the ureterocoele like structure at the level of left urinary papilla and the distention of the ipsilateral (left) renal pelvis indicated abnormal emptying of the left ureter. The colour Doppler in C1 was able to show the ureteral jet on the right side without diuresis been induced, probably because of the increased turbulence created by forceful ejection of urine from the right ureter. Together with the right ureteral jet and the normal height of the right renal pelvis in C1 indicated the normal right ureteral emptying.

On the follow up visit, the amount of echogenic debris was reduced and the bladder wall thickness was slightly reduced. The acquired pseudo ureterocoele has completely disappeared and the luminal debris accumulation was also reduced, indicating the positive response of cystitis and haemorrhage to the treatment. Disappearance of the acquired pseudo ureterocoele could be attributed to the reduced debris formation and organization

of the blood clot, and that must have been removed the obstruction previously created at the ureteral opening.

Complaint of urinary incontinence in a young female dog since birth and not responding to treatment is a hallmark in identifying congenital ectopic ureters (McLoughlin and Chew, 2000, Ross and Lamb, 1990). C2 showed a classical history and clinical signs related to congenital ureteral abnormality. B-mode ultrasound examination would only identify ectopic ureter if there is presence of hydro ureter or ureterocoele. Ureteral jets by colour Doppler would not be identifiable in some dogs without inducing diuresis. Initial examination of C2, did not show hydro ureter or ureteral jets. C2 was mildly dehydrated at the presentation, and thus, the ureteral emptying may not have being forceful. After hydrating and injecting furosemide, urine production was stimulated. The patent right ureteral emptying of C2 was identified as the blue colour ureteral jet (image 5b). The ectopic left ureter became visible as a hydro ureter, with the accumulation of urine after diuresis. As mentioned earlier, ectopic ureters have abnormal sites of emptying as well as abnormal stenotic openings. A stenotic ureteral opening would cause the slowing down of ureteral emptying and thus temporarily distending the ectopic ureter. Presence of the pubic bone of the pelvis prevented tracking of the distal opening of the ectopic ureter, which is a limitation of this technique (Nyland et al., 2002). But observing of the hydro ureter extending beyond the neck of the bladder indicated that the opening is not located at the bladder. Cranial tracking of the hydro ureter showed it entering into the left renal pelvis, which was considerably distended (d' Anjou, 2008). Backflow of urine into renal pelvis caused the dilation of left renal pelvis. Right ureter was not visible and right renal pelvis was not distended, indicating normal right ureteral emptying.

The elevated core body temperature, presence of neutrophils and bacteria in urinalysis of the C2 could be due to the concurrent presence of UTI. The

dehydration observed could have been due to the water deprivation and dehydration occurred during travelling. Vulval hyperemia observed in both C1 and C2 in the initial examination could be due to the scalding of the vulval mucosa by urine. Once the urinary incontinence was controlled, the hyperemia also was resolved. The mild thrombocytopenia observed in the FBC results in both cases could be technical.

CONCLUSION

Combined methods of B - mode and Doppler ultrasonography together with diuresis were able to efficiently identify the abnormal ureteral emptying in both C1 and C2. Availability, convenience and good sensitivity of these techniques make them attractive diagnostic tools for the small animal practitioner.

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