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Multimodal-imaging characteristics of a prolapsed ureterocele causing an acute urethral obstruction in a dog

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Abstract: A 2-year-old Yorkshire Terrier was presented with haematuria and dysuria. On the ultrasonography, an irregularly shaped, cystic, intraluminal urinary bladder mass was identified at the left ureterovesical junction. The computed tomographic excretory urography and magnetic resonance imaging revealed a pouch-like cystic mass arising from the distal ureter embedded at the ureterovesical junction. The distal portion of the mass prolapsed into the proximal urethra and obstructed the urethral lumen. The multimodal imaging findings were consistent with a prolapsed ureterocele and were further confirmed with surgery and histopathology. After surgical removal of the mass, the clinical signs clearly improved. To the best of our knowledge, this is the first report of multimodal imaging characteristics and the outcome of a prolapsed ureterocele in a dog.

Keywords: dog; ureterocele; CT; MRI; urethral obstruction

A ureterocele is a congenital anomaly that results in the dilation of the ureter at the ureterovesical junction (UVJ) (Green et al. 2011). Based on its anatomical position, location, and presence of any concurrent anomalies, it is classified as orthotropic, ectopic, intravesical, or extravesical types in humans (Xie et al. 2017). The degree of vesicoureteral reflux depends on the type, and cases of ureterocele may present with infection, inflammation, haematuria, and urinary incontinence in humans (Chowdhary et al. 2014).

A prolapsed ureterocele, also known as a cecoureterocele, is defined as a part of a ureterocele that has elongated and collapsed into the urethra (Hill 2004; Mendez-Gallart et al. 2013; Sinha et al. 2014). Because it is located at the vesicular neck, the prolapse may obstruct the urethral outflow, resulting in urinary retention (Sinha et al. 2014). Although various types have been reported in dogs (Lautzenhiser and Bjorling 2002; Tattersall and Welsh 2006; Green et al. 2011; Secrest et al. 2011), a prolapsed ureterocele causing a urethral obstruction and its multimodal imaging characteristics have not been reported in dogs.

Here, we report a case of prolapsed ureterocele confirmed with histopathology, its multimodal imaging characteristics, including ultrasonography, computed tomographic excretory urography (CT-EU), and magnetic resonance imaging (MRI), and its clinical outcome after the surgical treatment.

Case description

A 2-year-old, spayed, female Yorkshire Terrier, weighing 2 kg, presented with a 2-day history

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of haematuria and dysuria. The physical examination was unremarkable and the complete blood count and serum biochemistry were within the reference range. The urinalysis revealed haematuria without the detection of infectious agents.

An ultrasonographic examination of the abdomen (Aplio i800, Cannon Medical System; Tokyo, Japan) with a linear-array (10–13 MHz) probe identified a 11 × 9 mm, irregular shaped, space-occupying mass near the left side of the trigone (Figure 1). The intraluminal anechoic cavity of the mass communicated with the lumen of the urinary bladder via a 0.9-cm orifice. The distal portion of the mass prolapsed into the urethra, obstructing the urethral lumen. Some hyperechoic foci were visible in the irregularly thickened wall of the mass. A left hydroureter, with a maximal diameter of 5-mm, was identified. On the colour Doppler imaging, a moderate vascular response was detected along the thickened wall of the mass.

Based on the findings, which included the anatomical location of the mass, the urethral involvement, and the shape of the mass, a uroepithelial tumour and a prolapsed ureterocele were considered as the differential diagnoses.

To evaluate the urinary tract, a CT (Brivo CT385; GE Healthcare, Waukesha, WI, USA; 100 kVp, 200 mAs, 0.625 mm in slice thickness) was perfored under general anaesthesia with the dog in ventral recumbency. Before the CT scan, the dog received intravenous furosemide (1 mg/kg, Lasix; Myungmoon Pharmaceutical, Seoul, Republic of Korea) to improve the depiction of the ureters using a CT-EU (Secrest et al. 2013). To obtain the post-contrast

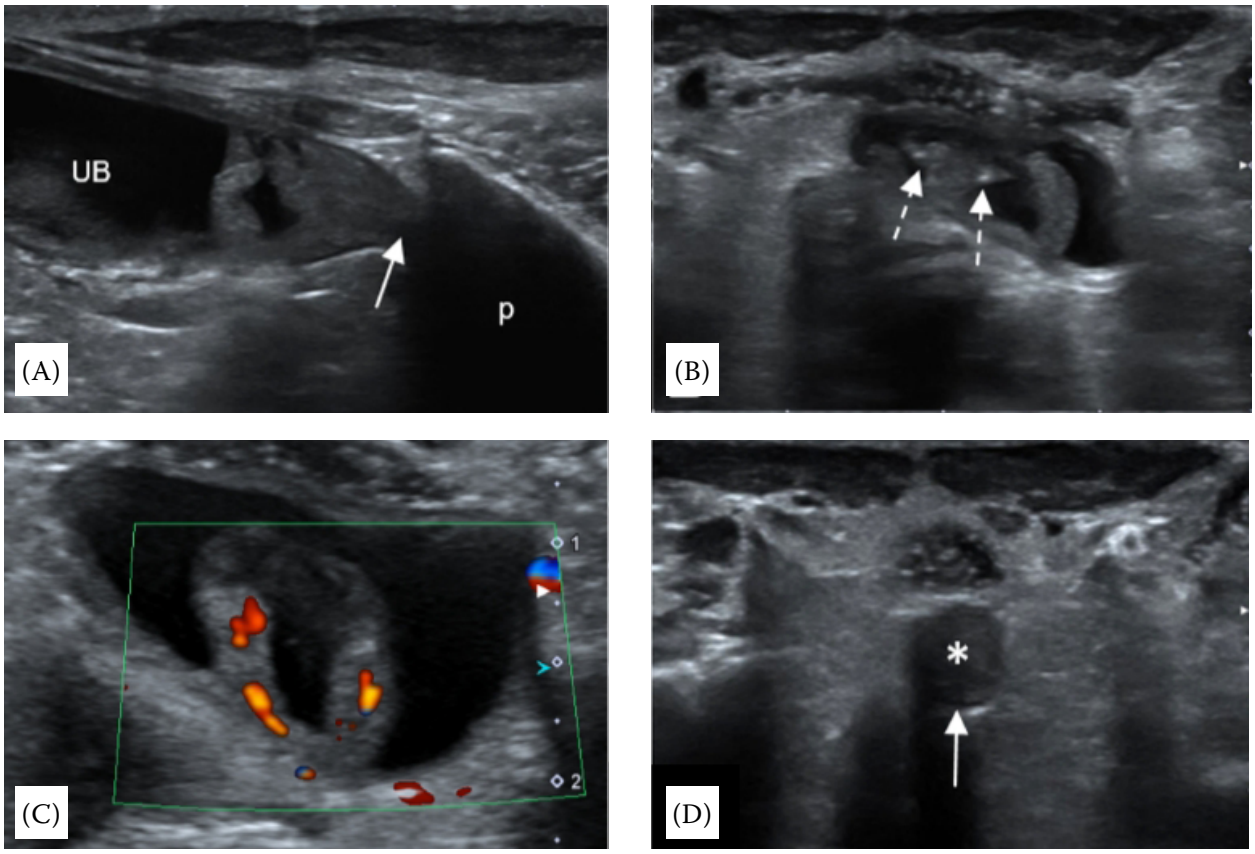

Figure 1. Ultrasonographic images of the urinary bladder (A), the trigone of the urinary bladder (B and C), and the proximal urethra (D). (A) An irregularly shaped intraluminal mass is seen at the region of the trigone. The mass has a thin wall and shows the presence of an anechoic cavity. The distal portion of the mass demonstrates the collapse into the proximal urethra (arrow). (B) The mass shows the presence of an orifice and shows communication with the bladder. Hyperechoic foci are present in the irregularly thickened wall of the mass (dashed arrows). (C) The colour Doppler image shows a mild to moderate vascular response along the wall of the ureterocele. (D) The collapsed soft-tissue mass occludes the lumen of the proximal ureter (asterisk). A = sagittal plane; B, C, and D = transverse plane
p = pubic bone; UB = urinary bladder

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images, a non-ionic iodine contrast material (iohexol, Omnihexol 300; Korea United Pharmaceutical; Seoul, Republic of Korea) at 600 mg iodine/kg was rapidly injected into the left cephalic vein. Following the conventional CT scan, a CT-EU was performed following a 10-min delay to evaluate the relationship between the UVJ and the mass. On the transverse CT images, a soft-tissue attenuated cystic structure (11 × 6 mm) with moderate contrast enhancement was identified at the UVJ. On the CT-EU, a moderate hydroureter was identified without hydronephrosis (Figure 2). The contrast medium stagnated in the cystic structure and was gradually excreted into the bladder, indicative of a communication between the mass and lumen of the bladder. Additionally, some amount of contrast medium was identified at the distal portion of the mass and visualised as a sac-like pouch, implying that it had prolapsed into the proximal urethra.

After the CT scan, an MRI was performed using a 1.5-T system (Signa HDxt; GE Healthcare, Waukesha, WI, USA). The dog was positioned in dorsal recumbency on an 8-channel phased-array spine coil. T2-weighted images using a fast spin echo (FSE) sequence were obtained to evaluate the anatomic relationships between the mass, UVJ, and proximal urethra. The parameters of the MRI scans for the T2-weighted transverse images were

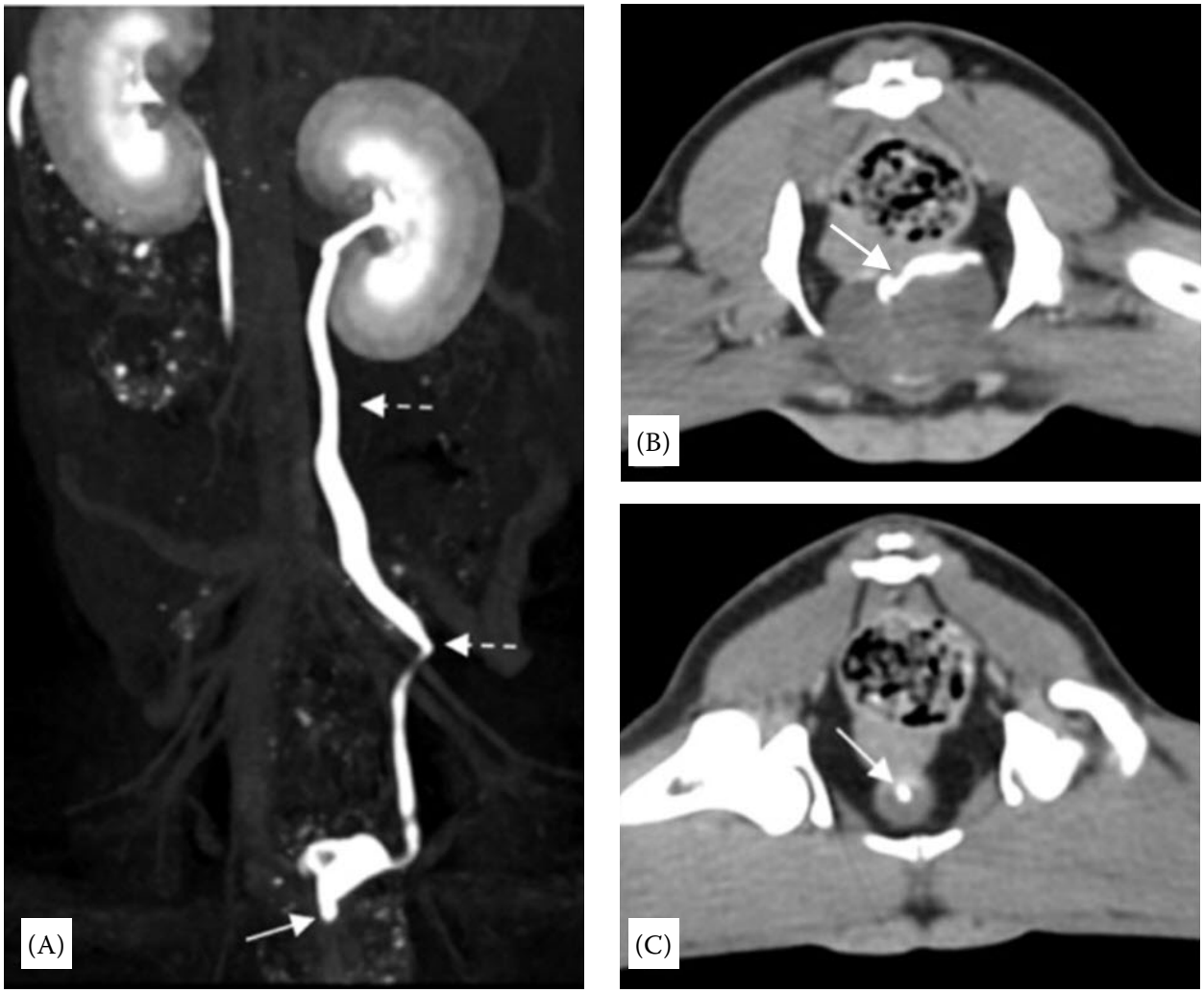

Figure 2. Maximal intensity projection (A) and transverse images (B and C) of the computed tomographic excretory urography. (A) The dilated left ureter (dashed arrows) with a mild pyelectasia is identified in the dorsal plane image. Accumulation of the contrast medium is observed in the cystic dilation at the vesicoureteral junction. Note that the distal portion of the cystic dilation elongates into the proximal urethra (arrow). (B and C) On the transverse images, the ureterocele has an irregularly collapsed lumen (arrows). A = maximal intensity projection; B and C = transverse plane of the urinary bladder and proximal urethra

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as follows: relaxation time, 3 183 ms; echo time, 110 ms; flip angle, 160°; slice thickness, 1-mm; and spacing, 1.1-mm. A distinctly collapsed cystic mass with a soft-tissue signal intensity and an isointense wall were identified. The urethral walls and the mass were clearly visible and formed a double-wall structure, implying that the mass had prolapsed into the urethral lumen. Based on the multimodal imaging characteristics, the mass was diagnosed as a ureterocele that had prolapsed into the urethra (Figure 3).

To relieve the dog's symptoms, a cystotomy was performed to remove the mass, and it was located on the dorsolateral mucosal surface of the urinary bladder, at the orifice of the left ureter. Haematuria and pollakiuria were noted after the surgery, but not evident at the one-week follow-up. The histopathological assessment revealed the presence of a normal transitional epithelium on the internal and external lining of the mass. There was a mild submucosal inflammatory infiltration, without evidence of any neoplastic changes (Figure 4). The case was finally diagnosed as a single and orthotopic ureterocele that had prolapsed into the proximal urethra and caused the urethral obstruction.

DISCUSSION AND CONCLUSIONS

Although the formation of ureteroceles are determined by genetic factors, the exact mechanism of a prolapse is not clear as to whether it is congenital or acquired in humans (Taori et al. 2011; Ramart 2017; Xie et al. 2017). In human medicine, an ac-

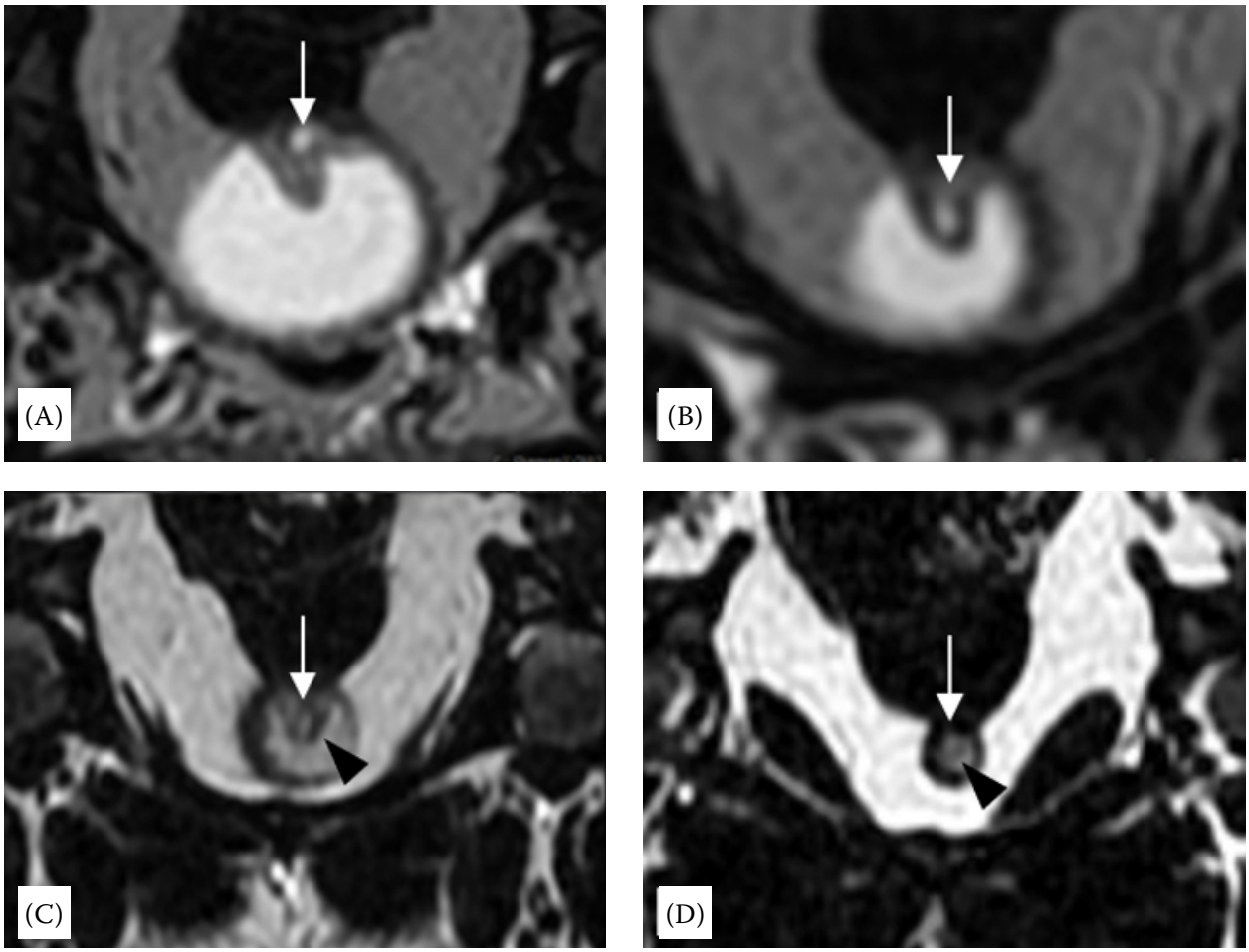

Figure 3. Transverse, T2-weighted magnetic resonance images at the level of urinary bladder (A), the trigone of the urinary bladder (B), the vesicourethral junction (C), and the proximal urethra (D). An isointense, collapsed, thin-walled cystic structure, consistent with a prolapsed ureterocele, is visualised at the vesicoureteral junction (arrows). Note that the wall of the ureterocele is distinctly visible and elongates into the proximal urethra, forming a double walled structure (arrowheads)

https://doi.org/10.17221/63/2020-VETMED

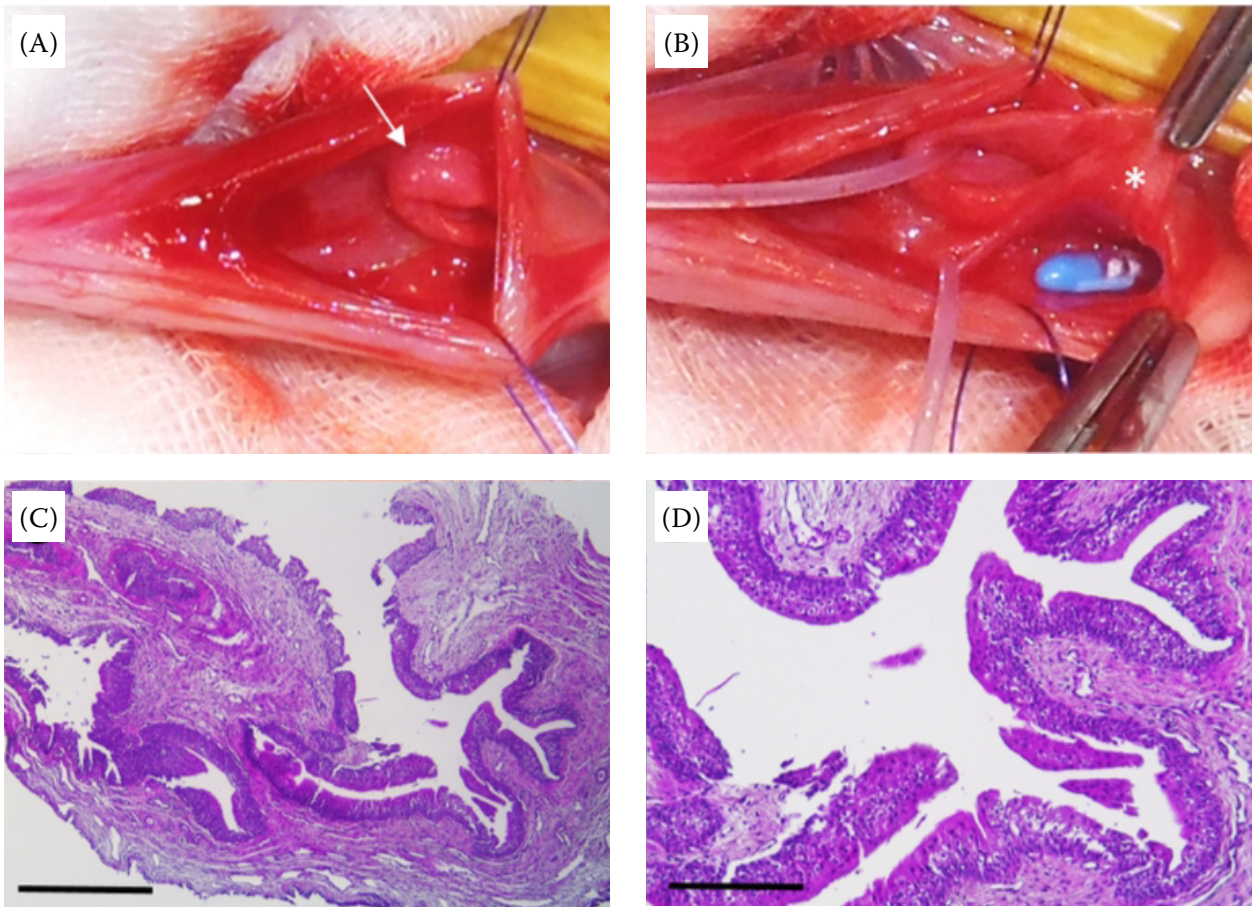

Figure 4. Intraoperative (A and B) and histopathological images (C and D). (A) A reddish, thickened cystic structure with smooth margins (arrow) is observed at the vesicoureteral junction (ventral view). (B) The placement of the tomcat catheters demonstrates the normal, symmetric positioning of the bilateral ureteral openings. The distal portion of the ureterocele shows elongation and appears prolapsed near the urethral opening (asterisk). (C and D) The histopathological assessment of the mass shows a normal transitional epithelium along the inner lining of the ureterocele. A mild submucosal infiltration of inflammatory cells is noted. No remarkable neoplastic changes are seen in the haematoxylin and eosin stained sections; bar = 500 μm in (C) and 200 μm in (D)

quired prolapse after a mid-urethral sling has been reported (Ramart 2017). In this case, since the dog exhibited clinical signs for the first time, the possibility of acquired factors could be considered. In addition, as observed on the histopathological examination, the submucosal inflammatory infiltration suggested an inflammatory response that could have induced the prolapse.

The imaging characteristics of ureteroceles are well-established in veterinary medicine, whereas little is known about those of prolapsed ureteroceles and their classification. The typical findings of ureteroceles are the presence of a mass and the thin-walled cystic dilation of the submucosal layer at the urinary bladder neck and communication between the ureter and the cystic structure (Secrest et al. 2011; Taori et al. 2011). Hydronephrosis and hydroureters may occur depending on the location, the degree of stenosis at the UVJ, and the presence of an infection (Xie et al. 2017). However, a prolapsed ureterocele could sometimes be misdiagnosed as a tumour because of its appearance, location, and urethral involvement. In this case, the ureterocele had an irregularly thickened wall with hyperechoic foci, and ultrasonographic features similar to those of a uroepithelial tumour.

A prolapsed ureterocele can elongate into the urethra and result in a urethral obstruction (Hill 2004; Sinha et al. 2014). Obstructive urinary retention is common in small animals and should be carefully evaluated because it increases the risk of infection and induces various complications. Although

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a prolapsed ureterocele is not thought to be a common cause of obstruction, we recommend that it should be considered as a cause in dogs presenting with a urethral obstruction.

Although ultrasonography is a common diagnostic tool for visualising urogenital tracts, the ultrasonographic assessment can be limited by bladder distention and the presence of a pelvic bladder (Mattoon and Nyland 2015). Therefore, a CT is the standard method for detecting urogenital abnormalities in dogs (Secrest et al. 2011), and it was useful in this case to detect the hydroureter and the UVJ lesion. Unlike the typical ultrasonographic appearance of a ureterocele, where a cystic mass protruding into the urinary bladder is seen near the UVJ, the ultrasonography in the present case revealed that the distal portion of the mass was invaginated into the proximal urethral lumen, making it difficult to evaluate the origin of the mass.

On the other hand, the CT-EU images in this study revealed that the cystic mass presenting as a pouch-like sac after the accumulation of the contrast medium in the prolapsed ureterocele was connected to the left ureter and extended into the proximal ureteral lumen, which could suggest that the distal portion of the ureterocele had prolapsed into the urethra. Although a CT-EU is widely used to detect various urogenital anomalies, such as ectopic ureters in dogs (Rozear and Tidwell 2003; Fox et al. 2016), there were obvious limits to visualising the distinction between the proximal urethra and the ureterocele, owing to the lower soft-tissue resolution, than could be obtained by the MRI, and the small size of the patient in this case.

Because of the recent improvement in the robust soft-tissue contrast and spatial resolution compared to previous years, an MRI has been widely used to evaluate urogenital tracts in humans (Bennett et al. 2009; Hiorns 2011; Chung et al. 2016). By contrast, an MRI has not been routinely performed for detecting urogenital tracts in veterinary medicine, but its use in non-neurological cases in veterinary practice has gradually increased in recent years (Manley et al. 2013; Lee et al. 2016). In the present case, as the MRI scan clearly showed the prolapsed ureterocele and depicted its relationship with the proximal urethra with an excellent soft-tissue contrast, an MRI could be a useful diagnostic tool for detecting a ureterocele.

In conclusion, we present a case of a prolapsed ureterocele as a rare complication in which the ureterocele prolapses into the proximal urethra, resulting in a urethral obstruction. The imaging findings of a prolapsed ureterocele differ from those observed in cases of a ureterocele and it could be challenging to differentiate them from other conditions, such as uroepithelial tumours. Despite the rarity of this condition, a prolapsed ureterocele should be included in the list of differential diagnoses of masses in the urinary bladder trigone region causing an outflow obstruction in dogs. Therefore, a CT-EU and MRI can be helpful in definitively diagnosing a prolapsed ureterocele.

Conflict of interest

The authors declare no conflict of interest.

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