Obstructed left retrocaval ureter in a dog

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SUMMARY
Retrocaval ureters form due to a congenital malformation of the caudal vena cava. This anomaly has been reported in cats and is usually incidental. Retrocaval ureters are rare in dogs, but have been associated with ureteral obstruction. When presented with a dog with hydrourerter and hydronephrosis, an obstructed retrocaval ureter should be considered as a rare differential. This case report describes a left retrocaval ureter causing ureterohydronephrosis diagnosed by CT.

BACKGROUND
Retrocaval ureters, also named circumcaval ureters, have been described as a rare cause of intramural hydroureter and hydronephrosis in human beings.1–3 They develop due to an embryonic malformation of the caudal vena cava (CVC) tissue.4 A dorsally and medially displaced ureter results from persistence of the right posterior cardinal vein during development. The ventrally located CVC can cause compression and narrowing of the ureter leading to ureteral wall hypertrophy and sclerosis.5 Retrocaval ureters are largely an incidental finding in human beings and in affected patients, it is almost exclusively seen affecting the right ureter, with male patients over-represented.4 6–8

Feline retrocaval ureters have been well described in the literature. They most commonly occur on the right-hand side and predominately in male cats.9–11 In dogs, retrocaval ureters have been described affecting the left and right ureter. Right retrocaval ureters have been described as a rare incidental finding, causing no clinical significance.12 Two reports exist of left canine retrocaval ureters causing ureterohydronephrosis.13 14

CASE PRESENTATION
An eight-year-old male entire cocker spaniel presented to his referring veterinary surgeon for a six-week history of shifting pelvic limb lameness, left then right. Lumbar pain was suspected and the dog was referred to a neurology specialist. At the neurology specialist, neurological examination was normal. MRI was performed which revealed no spinal cord, neural or vertebral abnormalities. However, assessment of the abdominal cavity included in the MRI study revealed a caudal abdominal aortic thrombus (AT) (figure 1) and left hydroureter (figure 2). The dog was referred to the cardiology service of the authors’ institution.

On presentation, clinical examination revealed paraparesis with absent femoral pulses bilaterally. Neurological examination was otherwise normal. Pain was present on extension of both pelvic limbs. Otherwise, physical examination was unremarkable.

INVESTIGATIONS
Routine haematology was unremarkable. Urine protein to creatinine ratio (UPC) was 12.6 (abnormal >1.0). Thoracic radiography and echocardiographic examination were unremarkable. Left renomegaly was present on abdominal radiography. On abdominal ultrasonography (figure 3), the left kidney was hyperchoic with a moderate loss of corticomedullary definition. Marked left renal pelvic dilatation of up to 1.4 cm and dilatation of the left cranial abdominal ureter were present (1.5 cm at its greatest diameter) with no obstruction visible in the sections examined. A reduction, when compared with the MRI images, in the length of the AT was noted, with minimal Colour Doppler flow around it. Residual thrombi were present in both iliac arteries (left more than right).

Initially, the dog began opioid pain relief which was deescalated over a three-day period. He continued on clopidogrel (Plavix; Sanofi-Aventis) 2 mg/kg, orally, one time a day, benazepril (Benfotiam) 2 mg/kg, orally, twice a day and aspirin (Aspirin; Aspar Pharmaceuticals), 0.5 mg/kg, orally, one time a day. Two days postadmission femoral pulses became palpable bilaterally. Five days postadmission, the dog was discharged with the diagnosis of a suspected protein losing nephropathy. The dog continued on the prescribed oral medications and a renal diet (Hills k/d; Science Plan Pet Food).

Seven days postdischarge the dog re-presented for investigation of a 3–4 cm area of dorsal tail tip ischaemic necrosis. On re-evaluation, the UPC had improved but was still markedly abnormal at 9.52. Repeat abdominal ultrasound revealed worsening of the hydronephrosis and hydroureter. Renal pelvic dilatation was 1.9 cm, compared with 1.5 cm previously. A reduction in the length of the AT was noted. The dog began pentoxifylline (Trental; Sanofi-Aventis) 15 mg/kg, orally, every 12 hours.

Ten months later, the dog presented for re-evaluation. The dog had lost 2.1 kg in weight, had a poor hair coat, had developed a pot-bellied abdomen and was polydipsic. UPC was again re-evaluated and was 13. Adrenocorticotropic hormone stimulation test was positive for a diagnosis of hyperadrenocorticism.

A full body CT scan with intravenous contrast medium application (Niopam 340, 700 mg iodine/kg) was performed under sedation, using a 64-slice helical CT unit (Siemens SOMATOM Definition AS, Siemens AG, Munich, Germany). A
Figure 1  T2-weighted sagittal MRI image showing a hyperintense area in the caudal abdominal aorta extending into both external iliac arteries, suspected aortic thrombus (arrows).

Figure 2  T2-weighted sagittal MRI image showing a dilated left ureter (arrows) at the level of the fifth lumbar vertebra.

hypophyseal macroadenoma (1.1×1×0.8 cm, height × length × width) (figure 4), hepatomegaly, calcinosis cutis and muscula-laris and bilateral adrenal hyperplasia were identified, consistent with hypophyseal dependent hyperadrenocorticism. A marked chronic left hydronephrosis and left cranial abdominal hydro-ureter were identified secondary to an obstructed left retrocaval ureter (figure 5). The left renal pelvis was 3 cm in diameter and filled with hypoattenuating fluid. The prerenal CVC had a levo-position. The left cranial abdominal ureter had a torturous course and was markedly distended (1.8 cm at maximal diameter). The left ureter extended dorsal to the prerenal CVC at the level of the fifth lumbar vertebra. At this level, the left ureter ran medially, resulting in a ‘fish hook’ appearance. The left ureter continued ventrally, its diameter tapered and the caudal pelvic portion of the ureter was collapsed. The collapsed ureter continued between the levopositioned CVC and dextropositioned aorta, passing the left surface of the colon and inserting into the urinary bladder at a normotopic location. The right ureter had a normal course and insertion into the urinary bladder. The AT noted previously had resolved. Secondary dystrophic mineralisation was present in the aorta, right internal and both external iliac arteries and within the tail vasculature. Hansen-type-1 mineralised intervertebral disc extrusions were present at L6-L7 and L7-S1 causing moderate spinal cord and cauda equina compression. Prolonged parenchymal and excretory renal phases were evident bilaterally. At 60 minutes postcontrast administration, corticomedullary enhancement was still present in the left kidney.

OUTCOME AND FOLLOW-UP
Treating the hyperadrenocorticism was decided against due to owner factors and the risk of potentiating neurological signs due to the size of the hypophyseal macroadenoma. Surgical manage-ment of the hydroureter and hydronephrosis was not an option in this case due to the dog’s comorbidities. Clopidogrel, pentoxifylline, enalapril (Enacard: Boehringer-Ingelheim) and the renal diet were continued. One month later, the dog was euthanased at his referring veterinarian.

DISCUSSION
Retrocaval ureters have been described in human beings as a rare cause of hydroureter.1–3 Approximately 20 per cent of clinical retrocaval ureters in human beings have been shown to be associated with other congenital abnormalities such as hypospadias, supernumerary lumbar vertebrae or cryptorchidism.15 16  The use of helical CT has been described as the preferred imaging modality of choice for diagnosing retrocaval ureters in human beings.17

In one study of 306 cats, 35 per cent of cats presented with a retrocaval ureter, with 22 per cent of those having a double CVC.9 Retrocaval ureters have been described more commonly occurring in right ureters, with male cats being over-represented.9 10 18 The presence of a retrocaval ureter predisposes cats to developing a ureteral stricture according to one publication,19 although this has not been confirmed in another study.18 Strictures associated with a retrocaval ureter are often found in the right abdominal ureter, in close proximity (<3 cm) from the ureteropelvic junction. Concurrent nephrolithiasis is present in 64 per cent of cats with an obstructive retrocaval ureter.10 Treatment of feline obstructive retrocaval ureters involves the use of a subcutaneous ureteral bypass device or a double pig tail ureteral stent. These devices have been shown to have similar outcomes in cats with ureteral obstruction caused by a retrocaval ureter and in those cats with a ureteral obstruction due to other causes.19

Retrocaval ureters are rare in dogs. They have been described as a cause of hydronephrosis and hydroureter.13 14 Two case reports exist which describe clinically significant left retrocaval ureters occurring in female Bernese mountain dogs, four months and eight years of age, respectively. One case report14 described the presence of a left retrocaval ureter diagnosed during surgical
treatment of a congenital portosystemic shunt. The dog developed hydrourerter and hydronephrosis seven months later. Shifting pelvic limb lameness was also noted in this case; however, it was attributed to hypertrophic osteodystrophy. Another case report\(^1\) described a left retrocaval ureter diagnosed by MRI. The case discussed here contributes to the current literature as it describes a clinically significant left retrocaval ureter causing ureterohydronephrosis, diagnosed by CT.

Contrast-enhanced CT imaging is the preferred method for diagnosing retrocaval ureters.\(^2\) CT allows more direct visualisation of the vasculature and its association with the upper urinary tract compared with radiography and ultrasound.\(^1\)\(^3\)\(^4\) The criteria to diagnose a retrocaval ureter on CT are visualisation of a ureter running medial at the fourth or fifth lumbar vertebra, passing dorsal to the CVC. In cats, a ‘reverse J’ or ‘fish hook’ shape of the ureter has been associated with a diagnosis of a retrocaval ureter.\(^5\) Due to the small diameter of the feline ureter (0.3–0.4 mm) and the torturous course of retrocaval ureters, the caudal third of the ureter may not be visualised ultrasonographically.\(^1\) However, when a cranial abdominal ureteral obstruction is identified, the possibility of a retrocaval ureter should be considered.

In the case discussed here, the AT initially diagnosed is likely due to the dog’s comorbidities contributing to a hypercoagulable state including hyperadrenocorticism and protein losing nephropathy. Duplication of the CVC in human beings has been associated with retrocaval ureters.\(^2\)\(^1\) These patients have also been shown to be at an increased risk of developing deep vein thrombosis.\(^2\)\(^3\) This is thought to be due to reduced blood pressure reducing venous return from the lower extremities. In a retrospective study of canine CVC duplication, in which 20 per cent of cases had unilateral or bilateral retrocaval ureters, no thrombosis or venous stasis was reported.\(^1\)

In conclusion, retrocaval ureters are rare in dogs. Obstructed retrocaval ureters can cause hydronephrosis and hydrourerter. When presented with a left sided hydronephrosis and hydrourerter in a dog, a retrocaval ureter should be considered a differential diagnosis. A vascular and excretory urographic CT examination allows for comprehensive evaluation of the complex vascular anomalies and associated secondary ureteral pathology.

**Figure 3** Abdominal ultrasonographic examination revealing: (A) left hydronephrosis, (B) left cranial abdominal ureteral dilatation (callipers) and (C) lack of intravascular Doppler signal consistent with a caudal abdominal aortic thrombus extending into both external iliac arteries.

**Figure 4** Transverse CT image showing a contrast enhancing hypophyseal macroadenoma (arrows).

**Figure 5** Transverse abdominal contrast-enhanced CT images revealing the tortuous course of the left ureter (arrows). (A) Left hydronephrosis and a marked dilatation of the left cranial abdominal ureter. (B) The dilated ureter runs dorsal to the levopositioned CVC at the level of the fifth lumbar vertebra. (C) The ureter runs medial and then ventral towards the gap between the levopositioned CVC and abdominal aorta, tapering in size. (D) The ureter continues ventrally completely compressed between both vessels and inserts into the urinary bladder at a normotopic location.
Retrocaval ureters are rare in dogs. They can affect the left or right ureter. Retrocaval ureters can result in ureterohydronephrosis.

Excretory contrast CT imaging is the preferred method of diagnosing retrocaval ureters in animals.

The diagnostic criteria for a retrocaval ureter is a ureter running dorsal and then medial at the level of the fourth or fifth lumbar vertebra, resulting in a ‘fish hook’ or ‘J’ image appearance.

When presented with a dog with left hydroureter and hydronephrosis, a retrocaval ureter should be considered a differential.

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