CASE REPORT

Blind-ending branch of a bifid ureter: multidetector CT imaging findings

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ABSTRACT. A bifid ureter with a blind-ending branch is a rare congenital anomaly. Although typically found incidentally, this anomaly can be symptomatic and radiologists should be aware of this important variant. To our knowledge, there has been no previous report of this anomaly as seen on multidetector CT urography. We present a patient with haematuria and review the clinical significance, radiological findings and embryological aetiology of this anomaly.

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Case report

A 65-year-old healthy female without any significant medical history had microscopic haematuria during a routine medical check-up. She denied gross haematuria, abdominal discomfort, flank pain or history of incontinence. Physical examination was unremarkable. Urinalysis demonstrated trace blood, but was otherwise negative. Urine cytology was negative. The remainder of her laboratory tests were normal. She was referred for a urology consultation and subsequently a CT urogram was ordered.

A multidetector row CT (MDCT) urogram was performed through her abdomen and pelvis to assess her kidneys and ureters (Discovery CT750 HD 64-slice scanner; General Electric Medical Systems, Milwaukee, WI). The MDCT urography protocol at our institution is similar to that documented in the literature [1]. Specifically, unenhanced CT images were acquired through the abdomen from the kidneys to the pelvic brim and did not demonstrate any renal stones. 125 ml of Optiray 350 (ioversol injection 74%, Tyco Health/Mallinckrodt Inc., St. Louis, MO) was injected intravenously at a rate of 3.5 ml s^{-1} and scanning was performed approximately 80 s after injection (corresponding to the "nephrographic" phase) from the diaphragm through the pelvis. The scan was then repeated at 10 min after injection (corresponding to the "excretory urogram" phase). "Nephrographic" phase imaging was unremarkable. However, on the 10 min delayed-phase images, a $4 \times 4 \times 16\text{-mm}$ teardrop-shaped collection of contrast was noted anteromedial to the right orthotopic ureter (Figure 1). The patient also underwent additional imaging 30 min after injection. Additional images demonstrated that the patient had a bifid right ureter with the blind-ending branch coursing anterior to and connecting with the orthotopic ureter at its mid portion (Figure 2).

Discussion

In 1904, Herbert [2] described the entity of the double blind-ending ureter. The incidence of this anomaly is unknown and, of the approximately 200 reported cases in the literature, most are seen in adult women. The prevailing theory is that the bifid ureter arises from abnormal embryogenesis [3].

At about day 28 of human gestation, the ureteral bud sprouts from the mesonephric duct and grows cranially towards the metanephric mesenchyme. Development occurs through reciprocal induction of these two structures. Normal differentiation of the ureteral bud produces the ureter, renal pelvis, major and minor calices, and collecting tubules. Normal differentiation of the metanephric mesenchyme produces the glomerulus, proximal tubule, loop of Henle and distal tubule [4]. Fission of the ureteral bud with failure of one of the branches to reach or stimulate the metanephric mesenchyme results in the blind-ending bifid ureter. If two ureteral buds arise from the mesonephric duct and each bud makes contact with the metanephric mesenchyme, the result will be complete duplication [3]. In most reported cases, the blind-ending bifid ureter arises from the distal or middle third of the orthotopic ureter [5].

Most blind-ending bifid ureters are not clinically significant. The two most common symptoms are recurrent urinary tract infection and poorly defined abdominal pain. Other symptoms include renal colic pains and haematuria. The cause of pain is an inflammatory process in the blind-ending ureteral branch, a concrement formed at the site of urinary retention or peristaltic disturbances caused by ureteroureteral reflux [6]. There has also been at least one case of transitional cell carcinoma arising from within this anomaly [7]. The study most frequently used to diagnose this anomaly is iv urography. However, other studies include voiding cystourethrography, photofluoroscopy and cinerentgenography, cystoscopy with retrograde pyelography, or CT [5, 8, 9].

To our knowledge, this is the first case of a blind-ending bifid ureter diagnosed on MDCT urography. On the 10 min delayed images, ureteroureteral reflux caused a

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Figure 1. (a) Axial contrast-enhanced CT image, (b) coronal 10 cm thick slab maximum intensity projection (MIP) and (c) frontal three-dimensional volume-rendered image at 10 min after injection of contrast demonstrates a teardrop-shaped collection of contrast (white arrows) anterior to the right proximal ureter.

Figure 2. (a) Coronal 10 cm thick slab maximum intensity projection (MIP) and (b) coned frontal three-dimensional volume-rendered image at 30 min after injection of contrast demonstrates the bifid right ureter with the blind-ending branch coursing anterior to and connecting with the orthotopic ureter at its mid portion.

small amount of contrast to be seen at the cephalad-most portion of the blind-ending bifid ureter. This is to be expected since it has been reported that ureteroureteral reflux occurs with asynchronous peristaltic waves. Specifically, antegrade peristalsis occurs in one branch and, when it reaches the bifurcation, it proceeds into the other branch as a retrograde wave. The two branches tend to alternate the direction of the peristaltic flow [5]. If the blind-ending branch does not fill with contrast, this is thought to be a result of oedema, extrinsic compression, fast emptying because of peristalsis, dyskinesia of the branches or inadequate radiological technique [5, 10].

Therapy for symptomatic patients includes antibiotic therapy, open surgical removal or laparoscopic retroperitoneal resection [5, 9]. With therapy, symptomatic patients generally demonstrate resolution of symptoms. For our patient subsequent cystoscopy was normal and she will return for routine follow-up in 1 year.

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