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Case report

MR urography findings of a duplicated ectopic ureter in an adult man

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Abstract. In this report we present the imaging findings in an adult male with a duplicated ectopic ureter which inserted into the prostatic urethra. The appearances at excretory urography, US, CT, and MR urography are described together with the potential pitfalls of the imaging techniques. Both US and MR urography accurately image the collecting system from the kidney to the point of distal ureteral insertion, and in our patient, MR urography provided similar information to US.

Key words: Ectopic ureter – Duplicated ureter – US – CT – MR imaging

Introduction

The diagnosis of duplication of the renal collecting system with an ectopic ureter is usually straightforward. Traditionally, intravenous urography (IVU), voiding cystourethrography, retrograde pyelography, and cystoscopy have been used to ascertain the presence and the anatomy of the duplex collecting system [1]. More recently, US has become an accepted method of establishing the presence of a duplex kidney, and CT is also used as a complementary technique for evaluating a duplicated system [2, 3, 4].

Developments in MR imaging of static fluid has led to the emergence of MR urography as a potential imaging technique of the urinary system without the hazards of intravenous iodinated contrast material and ionizing radiation. Magnetic resonance urography has been shown to be highly sensitive in the diagnosis of urinary obstruction, defining the severity of dilatation, the site, and in the majority of patients, the cause of obstruction [5].

In this report we present an adult male patient with a duplicated ectopic ureter which inserted into the prostatic urethra. Imaging findings at excretory urography, US, CT, and MR urography, which, to our knowledge, has not been previously described, are illustrated and discussed, along with the potential pitfalls of the imaging techniques.

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Case report

A 33-year-old man presented with a history of recurrent hematuria, hemospermia, right flank pain, and urinary infection in the previous. Intravenous urography revealed that the right kidney was displaced inferiorly and the contrast-medium-filled collecting system had a so-called drooping lily appearance (Fig. 1). Contrast-enhanced CT (Siemens Somatom plus DRH, Siemens, Erlangen, Germany) showed a dilated right upper-pole moiety with marked parenchymal loss (Fig. 2 a). The dilated, tortuous right upper moiety ureter extended below bladder extravesically, but the exact point of insertion could not be detected (Fig. 2 b, c). Transabdominal US (Siemens Sonoline SI 400, Siemens, Erlangen, Germany with 3.5-MHz convex transducer) showed insertion of the ectopic ureter into the prostatic urethra at the level of verumontanum (Fig. 3). Magnetic resonance imaging was performed using a Siemens Magnetom Impact scanner (1 T; Siemens, Erlangen, Germany). Immediately before the examination, the patient received an antispasmodic agent (Buscopan, GmbH, Germany) parenterally to suppress intestinal motility. The MR urography was made without IV injection of contrast material. T2-weighted turbo spin-echo (SE) fat-saturation sagittal and coronal images (TR/TE = 7000/119 ms, field of view = 350 × 350 mm, 4-mm slice thickness, 256 × 256 matrix) of the abdomen were obtained. Magnetic resonance urography showed the whole collecting system from the kidney to the point of distal ureteral insertion into the prostate in one sequence (Fig. 4). Retrograde urethro-cystography did not demonstrate vesicoureteral reflux.

A right heminephrectomy with hemiureterectomy was performed. Histopathologic examination revealed

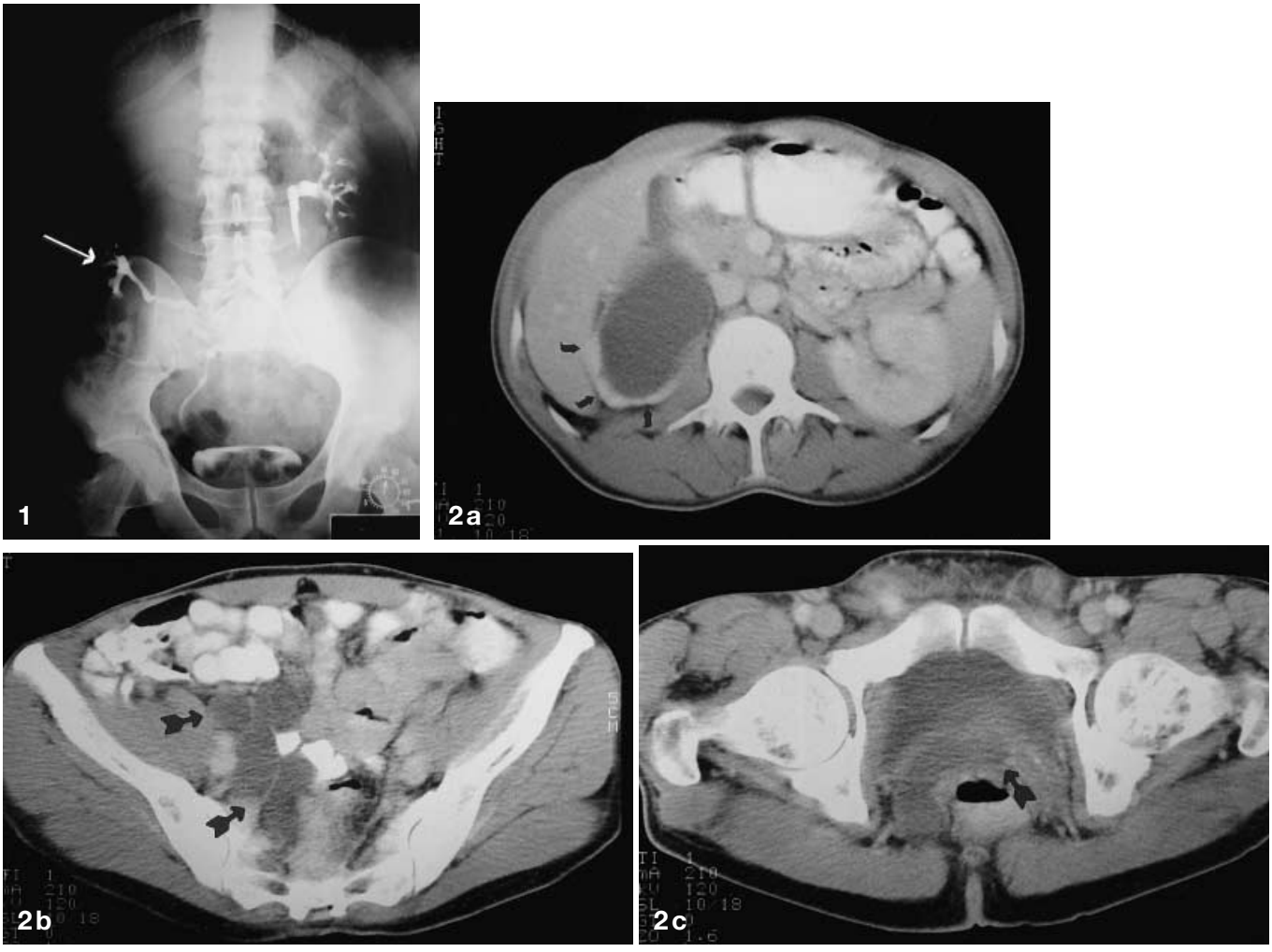

Fig. 1. The intravenous urogram demonstrates a "drooping lily" appearance of the right lower pole *(arrow)*. The left kidney is normal

Fig. 2. **a** Axial CT scan with IV contrast reveals the right upper-pole obstructed moiety with marked parenchymal loss *(arrows)*. **b** A CT image of pelvic level shows the dilated, tortuous left upper moiety ureter *(arrows)*. **c** A CT image obtained at a lower level demonstrates the dilated ureter extending below bladder *(arrow)*. However, exact insertion site of ectopic ureter cannot be determined because of low soft tissue contrast resolution

chronic pyelonephritic changes and partial dysplasia in the resected kidney. Hemorrhagic, ulcerated chronic ureteritis was also detected in the resected ureter.

Discussion

Duplication of the ureters is the most common anomaly of the urinary tract. Duplications may be either complete or incomplete. Complete duplication may be asymptomatic or recognized when complications develop as a result of reflux into the lower-pole ureter, obstruction of the upper pole with an ectopic ureterocele or a narrowed distal ureter with an ectopic orifice, or, in females, dribbling of urine because of infrasphincteric insertion of the upper-pole ureter [6].

Ectopic ureters are rare anomalies, with an incidence between 1 in 2000 and 1 in 4000 found in autopsies in children. Detection in adulthood is far less common. Their incidence is at least four times higher in females than in males, and approximately 80 % of patients are associated with duplex kidneys [7]. The most common site of insertion of an ectopic ureter is proximal urethra [8].

The imaging diagnosis of an abnormal duplex collecting system is usually straightforward and depends on demonstrating whether the upper-pole moiety is obstructed and, if so, whether the associated renal parenchyma is worthy of salvage. If an ectopic ureterocele is present, whether it inserts intravesically or extravesically must be evaluated. In adults, obstruction of the upper pole is not always related to ectopy and further evaluation of the retroperitoneum for obstruction is necessary.

Multiple imaging techniques were required in our patient to answer the foregoing questions. The IVU, demonstrating a "drooping lily" appearance of the lower pole, suggested the presence of an obstructed upper-pole moiety (Fig. 1) [1]. However, an extremely ectopic ureteral orifice, as in our patient, usually indicates a dysplastic, poorly functioning segment. This may hamper

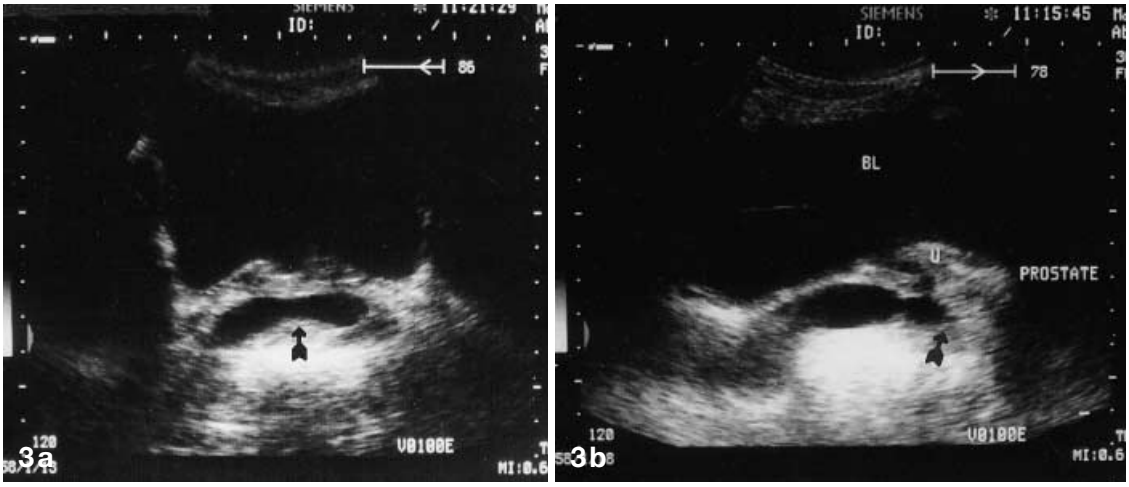

Fig. 3. **a** Transverse transabdominal sonogram shows the dilated, extravesical ectopic ureter *(arrow)*. **b** Sagittal transabdominal sonogram demonstrates insertion of the ectopic ureter into the prostatic urethra at the level of verumontanum *(arrow)*

Fig. 4. **a** T2-weighted coronal MR urography image (TR/TE: 7000/119 ms) shows markedly dilated upper pole moiety resembles a cystic mass *(arrow)*. **b** T2-weighted coronal MR urography image (TR/TE: 7000/119 ms) obtained at a more posterior level demonstrates hydronephrotic upper segment connected to a dilated ureter. **c** T2-weighted right parasagittal MR urography image (TR/TE: 7000/119 ms) reveals insertion of the ectopic obstructed ureter into the prostate *(arrow)*

detection of the segment by IVU despite delayed films. In contrast, US is able to image the non-functioning upper-pole system directly. When an obstructed upper-pole collecting system is extremely dilated, as in our patient, US shows an anechoic cystic mass in the upper pole. This appearance should be differentiated from renal cysts and caliceal diverticula. Ultrasound may allow differentiation between a cyst and the obstructed segment. A renal cyst is usually spherical, whereas the duplicated segment extends into the upper ureter on oblique scans. If the proximal ureter is not dilated, the differentiation can be very difficult. A large caliceal diverticulum cannot be differentiated from a dilated collecting system without excretory urography [6].

Ectopic ureters are usually dilated and can be traced to their ectopic insertion by US (Fig. 3). However, US is rarely able to demonstrate the dilated ureter in its entirety because of overlying gas in bowel. The tortuous route of a dilated ureter may also confuse the sonographer. Transrectal or transvaginal US may help to demonstrate the ectopic ureteral orifice [9].

Computed tomography can image the upper-pole moiety independently of function since it demonstrates the obstructed upper pole system as a hydronephrotic sac. Residual tissue in the upper pole is easily assessed,

much as it would be with US (Fig. 2 a) [4]. Contiguous caudal cuts can be used to assess the intravesical or extravesical position of the distal obstructed ureter (Fig. 2 b). However, CT cannot always show the exact location of the ectopic ureter orifice, as in our patient, because of low contrast resolution for deep pelvic structures and because imaging in the axial plane cannot accurately depict the cranio-caudally oriented insertion (Fig. 2 c).

Magnetic resonance imaging has multiplanar capability and provides high-resolution images of deep pelvic structures. Magnetic resonance urography also has the potential for the morphological and functional evaluation of the urinary system, without the hazards of intravenous iodinated contrast material. Ureteral strictures, congenital ureteroceles, and extrinsic compression or local invasion from retroperitoneal and pelvic malignancy are readily demonstrated by MR urography [5].

The concept of MR urography is not new. The rapid acquisition with relaxation enhancement (RARE) method described by Henning et al. [10] and Henning and Friedberg [11] can be used to perform a fast, heavily T2-weighted sequence ideally suited for visualization of obstructed urinary tract. However, contrast-enhanced excretory MR urography performed after injection of a diuretic offers a rapid approach for visualization of the morphology of the nondilated urinary tract. This MR urographic technique with high-resolution 3D-gradient-echo sequences is a promising and accurate alternative to conventional excretory urography for imaging the fine anatomic and functional detail of both kidneys and urinary tract [12, 13]. Three-dimensional contrast-enhanced MR urography in this particular patient was not considered necessary because the hydronephrotic upper segment connected to the dilated ureter which inserted into the prostatic urethra had been accurately demonstrated by MR urography without IV contrast material (Fig. 4).

The IVP, US, and MR urography techniques cannot distinguish between vesicoureteric reflux and obstructive megaureter; therefore, retrograde urethro-cystography or isotope nephrography must be combined with US or MR urography. In this patient retrograde urethro-cystography did not demonstrate vesicoureteral reflux.

We conclude that it is often necessary to use several imaging methods to evaluate an obstructed duplex system. Ultrasound is an excellent screening procedure that is low in cost, noninvasive, and widely available. Computed tomography with low contrast resolution for deep pelvic structures has limited usefulness for the demonstration of the insertion of an ectopic ureter. Magnetic resonance urography can accurately image the collecting system from the kidney to the point of distal ureteral insertion noninvasively. However, MR urography cannot be considered as the standard method for the evaluation of a duplicated renal system. Magnetic resonance urography should be reserved for selected patients without definitive sonographic results. Furthermore, voiding cystourethrography or isotope nephrography must be combined with US or MR urography to distinguish between vesicoureteric reflux and obstructive megaureter.

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