Case – Utility of magnetic resonance urography in pediatric urinary incontinence: Radiological considerations

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Introduction

A study of children in the U.S. revealed that the incidence of enuresis at age 11 was approximately 7%.[1] Primary enuresis can be caused by various diseases, including developmental delay and congenital structural abnormalities. One congenital cause is the ectopic ureter, which is 2–12 times more common in females than males.[2] In females, the ureter abnormally inserting distal to the bladder neck causes continuous urinary incontinence. Insertion sites may include, but are not limited to: the urethra, vagina, uterus, or rectum.

The evaluation of urogenital conditions (including incontinence) in the pediatric population has traditionally included imaging techniques, such as ultrasonography (US), intravenous urography (IVU), voiding cystourethrography (VCUG), and radionuclide scintigraphy (DMSA).[3] The anatomical details provided by these techniques individually are insufficient for the formation of an accurate clinical diagnosis.[4] Magnetic resonance urography (MRU) provides more accurate anatomical and functional assessment of the urinary tract.[5] In the following case reports, we discuss the delayed diagnosis and treatment of both ectopic kidney and ureter in two young female patients.

Case report

Case 1

A 12-year-old female with history of right renal agenesis and primary mixed enuresis was referred to our clinic. She was seen previously by urology years before at another institution and had multiple investigations, including uroflowmetry, renal US, and VCUGs, all of which revealed a normal left and dysplastic right kidney. At time of re-presentation, the patient described round-the-clock low-volume incontinence that never resolved after toilet training. She is otherwise healthy, meeting all developmental milestones. Physical exam was unremarkable.

Case 2

A nine-year-old female with history of left renal agenesis and primary mixed enuresis was referred to pediatric urology clinic. At time of presentation, the patient described continuous low-volume urinary incontinence. She is otherwise healthy, meeting all developmental milestones. Physical exam was unremarkable. Magnetic resonance imaging of the spine and renal/bladder US revealed absent left kidney, normal right kidney.

After clinical evaluation, both patients underwent MRU for accurate exploration of urinary tract anatomy. T1- and T2-weighted images were obtained in the coronal, sagittal, and axial planes.

Results

Case 1

MRU revealed a right ectopic, renal remnant located in the right lower abdominal quadrant (5 cm in length) (Fig. 1A). A single ectopic ureter draining the right kidney inserted into the vagina (Fig. 1B). The left kidney (12 cm in length) had compensatory hypertrophy with normal function on MRU. The patient underwent a robotic right nephroureterectomy and was completely continent the next day.

Case 2

MRU revealed a left ectopic, renal remnant (2 cm in length) (Fig. 2A) located in the lower left abdominal quadrant near

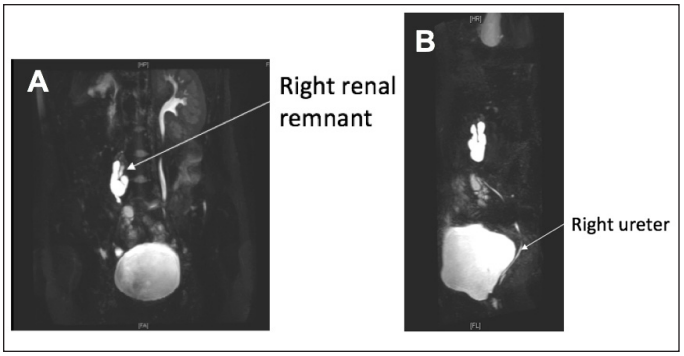

Fig. 1. (A) Magnetic resonance urography (MRU) in coronal plane revealing right renal remnant; ***(B)*** MRU in sagittal plane revealing right ectopic ureter inserting into vaginal wall.

the left internal iliac artery. A single ectopic ureter draining the renal remnant inserted into the vagina (Fig. 2B). The right kidney (13 cm in length) appeared normal on MRU. The patient underwent robotic left nephroureterectomy and achieved complete continence. Rapid frozen section confirmed renal tissue.

Discussion

Continuous day and nighttime wetting is a condition caused by a spectrum of abnormalities in the urogenital tract. The workup of patients presenting with enuresis involves careful history taking, physical examination, laboratory testing, and imaging. Currently, the radiographical evaluation of the urinary tract in enuresis can involve US, IVU, VCUG, and CT urography. Neurologic imaging (commonly MRI spine) is reserved in children with suspected and/or observed neurological abnormalities in the lower lumbosacral spine.[6]

Despite some limitations, the expanded use of MRU in urology and nephrology has gained acceptance as a valuable diagnostic tool.[7-10] Considerations when using MRU include the potential requirements for sedation and contrast medium. Intravenous contrast-enhanced T1-weighted images are usually applied in an integrative fashion to complement the non-enhanced T2-weighted sequences. However, recent studies suggest that non-contrast T2-weighted MRU alone is sufficient to diagnose an ectopic ureter and help direct clinical management.[11] The use of sedation is entirely dependent on child maturity and compliance. Generally, children under the age of seven are most likely to require sedation. With improvements in technology, the cost and examination time (currently about one hour) associated with MRU continue to decrease.

As exemplified in these cases, MRU provides advantages in the accurate identification of anatomical abnormalities in the urinary tract, particularly ectopic ureters. IVU is not used as often in present-day practice, as three-dimensional imaging modalities have improved. Although CT urography may provide comparable anatomical accuracy and resolution to MRU with a shorter scanning time, it guarantees radiation exposure, which is unfavourable in pediatric populations. MRU allows for three-dimensional, non-invasive, and radiation-free imaging of the urinary tract with high accuracy and resolution, highlighting why it should be the imaging modality of choice for pediatric anatomical urinary tract abnormalities.[7,11]

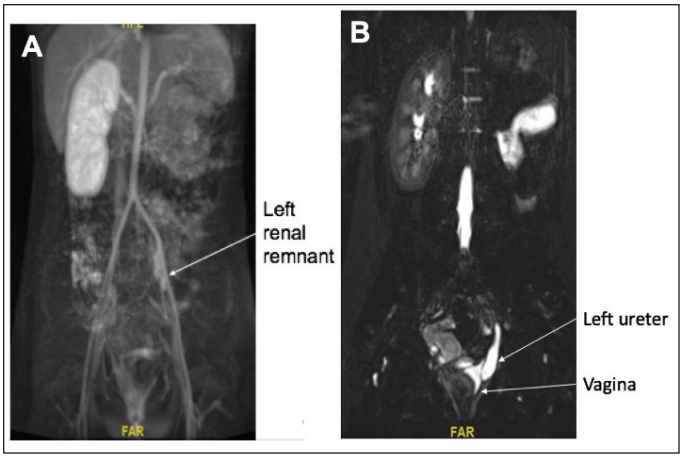

Fig. 2. (A) Magnetic resonance urography (MRU) in coronal plane revealing left renal remnant; ***(B)*** MRU in coronal plane revealing left ectopic ureter inserting into vaginal wall.

Conclusion

The presented cases confirm the utility of MRU in the evaluation and subsequent surgical management of ectopic kidneys and ureters in incontinent, toilet-trained girls. More specifically, when the ectopic ureter does not insert into the urinary tract, the abnormalities may not be detected if MRU is not used. With technological advancements and increased availability, we anticipate that MRU may become the primary imaging modality for the anatomical assessment of the urinary tract.

Competing interests: The authors report no competing personal or financial interests related to this work.

This paper has been peer-reviewed.

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