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MR UROGRAPHY IN THE DIAGNOSIS OF FUNCTIONAL AND ORGANIC DISORDERS OF THE UPPER URINARY TRACT

Abstract

Magnetic resonance urography (MRU) is an advanced, non-invasive imaging technique that provides comprehensive anatomical and functional assessment of the upper urinary tract without ionizing radiation. It combines high-resolution morphological imaging with functional evaluation of urinary excretion and renal drainage. MRU is particularly valuable in differentiating organic obstruction from functional urinary tract disorders, especially in pediatric patients, young adults, and patients requiring repeated follow-up. This article reviews the diagnostic capabilities of MR urography in the evaluation of functional and organic disorders of the upper urinary tract and highlights its clinical significance.

Keywords: MR urography; upper urinary tract; hydronephrosis; functional obstruction; organic obstruction; renal excretory function; dynamic contrast-enhanced MRI; urinary tract imaging; diuretic MR urography; noninvasive diagnostics.

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YUQORI SIYDIK YO‘LLARINING FUNKSIONAL VA ORGANIK BUZILISHLARINI TASHXISLASHDA MR-UROGRAFIYA

Abstrakt

Magnit-rezonans urografiya (MRU) - bu yuqori siydik yo‘llarini ionlashtiruvchi nurlanishsiz har tomonlama anatomik va funksional baholash imkonini beruvchi ilg‘or, invaziv bo‘lmagan tasvirlash usulidir. U yuqori aniqlikdagi morfologik tasvirni siydik ajralishi va buyrak drenajini funksional baholash bilan birlashtiradi. Organik obstruksiyani siydik yo‘llarining funksional buzilishlaridan, ayniqsa, pediatrik bemorlarda, yoshlarda va takroriy kuzatuvga muhtoj bo‘lgan bemorlarda farqlashda MRT alohida ahamiyatga ega. Ushbu maqolada yuqori siydik yo‘llarining funksional va organik buzilishlarini baholashda MR urografiyaning diagnostik imkoniyatlari ko‘rib chiqiladi va uning klinik ahamiyati yoritib beriladi.

Tayanch iboralar: MR urografiya; yuqori siydik yo‘llari; gidronefroz; funksional obstruksiya; organik obstruksiya; buyrakning ekskretor funksiyasi; dinamik kontrastli MRT; siydik yo‘llarini tasvirlash; diuretik MR urografiya; noinvaziv diagnostika.

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МР-УРОГРАФИЯ В ДИАГНОСТИКЕ ФУНКЦИОНАЛЬНЫХ И ОРГАНИЧЕСКИХ НАРУШЕНИЙ ВЕРХНИХ МОЧЕВЫВОДЯЩИХ ПУТЕЙ

Абстракт

Магнитно-резонансная урография (МРУ) — это передовая, неинвазивная техника визуализации, которая обеспечивает комплексную анатомо-функциональную оценку верхних мочевыводящих путей без ионизирующего излучения. Он сочетает в себе высокоразрешающую морфологическую визуализацию с функциональной оценкой мочевыделения и почечного дренажа. МРТ особенно ценна при дифференциации органической обструкции от функциональных нарушений мочевыводящих путей, особенно у педиатрических пациентов, молодых людей и пациентов, нуждающихся в повторном наблюдении. В данной статье рассматриваются диагностические возможности МР-урографии при оценке функциональных и органических нарушений верхних мочевыводящих путей и подчеркивается ее клиническое значение.

Ключевые слова: МР-урография; верхние мочевыводящие пути; гидронефроз; функциональная обструкция; органическая обструкция; выделительная функция почек; динамическая контрастная МРТ; визуализация мочевыводящих путей; диуретическая МР-урография; неинвазивная диагностика.

Introduction

Disorders of the upper urinary tract represent a common clinical problem in urology and nephrology, often manifesting as hydronephrosis, flank pain, recurrent urinary tract infections, or impaired renal function. Accurate differentiation between functional and organic causes of urinary tract dilatation is essential for appropriate management. Traditional imaging modalities, including ultrasound, intravenous urography, and computed tomography, primarily provide structural information and may be limited in functional assessment or associated with radiation exposure.

Figure 1. *Static MR urography of the upper urinary tract*

Magnetic resonance urography has emerged as a powerful imaging modality that overcomes many of these limitations. By integrating static fluid-sensitive sequences and contrast-enhanced dynamic imaging, MRU allows simultaneous visualization of urinary tract anatomy and renal excretory function. This dual capability makes MR urography particularly useful in complex diagnostic scenarios.

Materials and Methods

MR urography is typically performed using a combination of heavily T2-weighted sequences and T1-weighted contrast-enhanced dynamic sequences. Static MR urography relies on the high signal intensity of urine on T2-weighted images, enabling detailed visualization of dilated collecting systems and ureters without contrast administration. Functional MR urography involves intravenous gadolinium-based contrast agents with dynamic imaging to assess renal perfusion, filtration, and urinary drainage.

Table 1. *Diagnostic capabilities of MR urography in upper urinary tract disorders*

Disorder type	MR urography findings	Diagnostic value
Organic obstruction	Fixed narrowing, delayed excretion	High
Functional dilatation	Preserved enhancement, delayed drainage	High
Congenital anomalies	Detailed anatomical depiction	Very high
Postoperative changes	Assessment of patency and drainage	High

Quantitative parameters such as renal transit time, parenchymal enhancement curves, and excretory delay are evaluated. Diuretic-enhanced MR urography may be employed to distinguish true obstruction from functional dilatation. The results are correlated with clinical data and laboratory findings.

Results

MR urography demonstrates high diagnostic accuracy in identifying organic causes of upper urinary tract obstruction, including ureteropelvic junction obstruction, ureteral strictures, external compression, and congenital anomalies. Morphological sequences clearly depict the level and extent of obstruction, associated parenchymal thinning, and secondary changes.

Table 2. *Comparison of MR urography with other imaging modalities*

Modality	Anatomical detail	Functional assessment	Radiation
Ultrasound	Moderate	Limited	No
CT urography	High	Limited	Yes

MR urography	High	High	No

In functional disorders, MR urography reveals preserved renal parenchymal enhancement with delayed but progressive urinary excretion, suggesting non-obstructive dilatation. Dynamic contrast-enhanced sequences allow differentiation between obstructive and non-obstructive hydronephrosis by analyzing drainage patterns and renal transit times. MRU also provides valuable information in postoperative follow-up and in assessing response to therapeutic interventions.

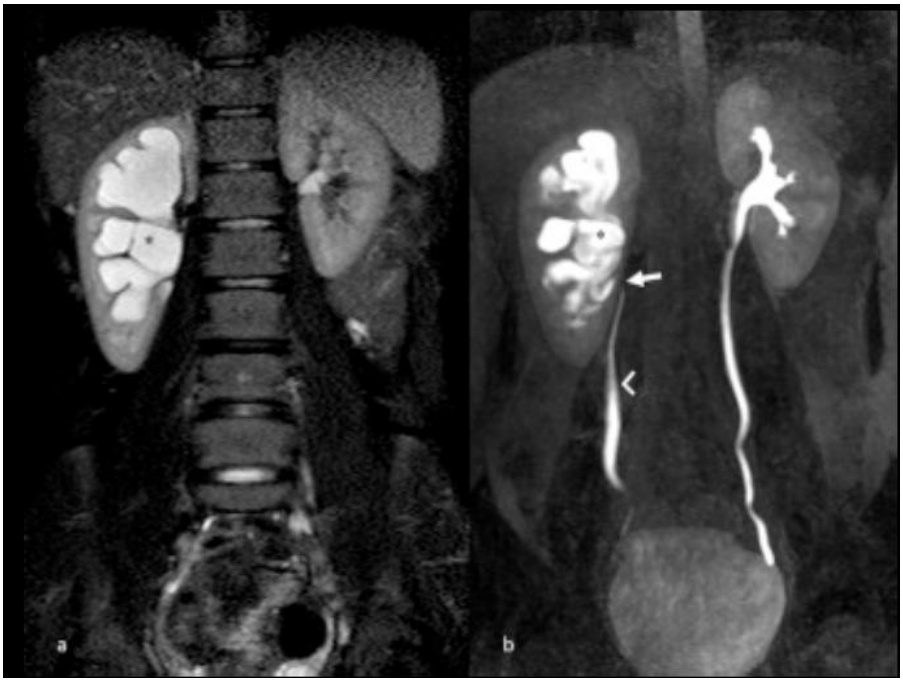
Figure 2. *Functional MR urography with contrast enhancement*

Discussion

The major advantage of MR urography lies in its ability to integrate anatomical and functional information in a single examination. Unlike CT urography, MRU avoids ionizing radiation, making it particularly suitable for children, pregnant women, and patients requiring serial imaging. Compared with ultrasound, MRU offers superior visualization of the entire ureter and more reliable functional assessment.

However, MR urography has limitations, including longer examination times, higher cost, and limited availability. Contraindications related to MRI and gadolinium contrast agents must also be considered. Despite these limitations, MRU plays an increasingly important role in the comprehensive evaluation of upper urinary tract disorders.

Figure 3. *Differentiation of functional and organic obstruction*



Conclusion

MR urography is a highly informative and safe imaging modality for the diagnosis of functional and organic disorders of the upper urinary tract. Its ability to simultaneously assess anatomy and renal function makes it a valuable tool in complex diagnostic situations and in treatment planning. Incorporation of MR urography into clinical practice enhances diagnostic accuracy and supports personalized patient management.

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