

Role of Magnetic Resonance Urography Delayed Sequence in Assessment of Ureteric Spasm

Hesham E. EL Sheikh, Eman F. AbdelKalek, Israa A. Dahab

Department of radiology,
Benha faculty of medicine,
Benha University, Egypt.

Correspondence to: Israa
A. Dahab, Department of
radiology, Benha faculty of
medicine, Benha University,
Egypt.

Email:

israadahab2@gmail.com

Received: 8 October 2021

Accepted: 13 August 2022

Abstract:

Background: MRU is an excellent technique for the evaluation of the entire urinary tract. **The aim** of the study is to assess the capability of delayed sequence of MRU to distinguish between transient ureteric spasm that caused by ureteric peristalsis and ureteric stricture. **Patients and Methods:** The study carried on 30 referred patients for MRU examination (15 males and 15 females). Adding multiple delayed sequential T2 coronal as well as sagittal fat suppressed single shot fast spin echo images after 2 ,4 or more minutes for visualization of the entire ureter and distinguish between transient ureteric spasm and fixed pathological stricture. **Result :** As regard ureteric spasm that caused by normal peristaltic movements, 36,7% of the examined cases (11 patients) showed relieved spasm in the subsequent images repeated after 2 minutes ,while 43.3% (13 cases) showed relieved spasm in the images repeated after more than 2 minutes. As regard pathological spasm 20% of cases (6 patients) had fixed true strictures which were not relieved in the subsequent delayed images. **Conclusion:** T2-weighted MRU with multiple delayed sequence images is sufficient to identify all segments of the non-dilated ureter. It offers information on ureteral peristalsis and can distinguish between transient ureteric spasm due to peristalsis rather than the fixed

pathological stricture. By adding multiple T2 fat suppressed single shot fast spin echo sequences after 2 ,4 or more minutes, all ureteric segments were visualized and the entire ureteric course was evaluated .

Keywords: MRU, ureteric peristalsis, ureter.

Introduction:

MR urography (MRU) is a comprehensive imaging technique for the evaluation of the entire urothelial tract. Although CTU remains the modality of choice for evaluation of the upper urinary tract, MRU is preferred in number of clinical scenarios (1).

Common indications of MRU include but not limited to ,investigation of the cause of urinary obstruction, evaluation of urothelial neoplasm, and characterization of complex congenital anomalies of urinary tract (2).

MRU may be preferable to CTU for performing imaging examination for pediatric and younger patients, patients undergoing repeated assessment of the collecting system(because lack of ionizing radiation),patients with documented sever allergy to contrast agent, and patients with compromised renal function (3).

Urine is propelled through the urinary tract via peristaltic contraction, even with adequate hydration and distention of the collecting system, a peristaltic contraction at time of image acquisition may simulate a focal narrowing or stricture (4).

The temporal information required to distinguish between normal peristalsis and segment of true fixed narrowing can be obtained through sequential imaging of the ureters with Static –fluid MRI, which allow rapid acquisition (1-2 sec) which will show areas of intermittent distention and luminal collapse in the setting of normal peristalsis. Secondary signs of obstruction, such as

proximal dilatation of the ureter, may also be used to identify a true fixed stricture (5).

The aim of the study was to assess the capability of delayed sequence of MRU to distinguish between transient ureteric spasm caused by either ureteric peristalsis or ureteric stricture.

Material and method:

This cross-sectional study carried on referred patients for MRU examination, at Radiology department at Benha University Hospital, during the period from June 2020 to June 2021.

Thirty patients underwent clinical evaluation including history taking age, occupation, complain and previous examination.

Inclusion criteria: Patients with urinary problems underwent MRU with detection of ureteric narrowing that could be due to ureteric spasm.

Exclusion criteria: Patients with contraindications for MRU.

Patients with fixed ureteric stricture due to stones or other causes of obstructive uropathy.

Possible risk: No possible risk.

Ethical consideration: Approval from Research Ethics Committee (REC) was taken before starting field work

All the procedure of the study was approved by the Diagnostic Radiology Department. An informed permission was taken from the patients to contribute in the study after clarifying the aim of the study after which

they all agreed to participate without any obligation.

Statistical analysis: These data were tabulated and analyzed using the computer program SPSS (Statistical package for social science) version 26 to obtain:

Descriptive data

Descriptive statistics were calculated for the data in the form of frequency and distribution for qualitative data.

Analytical statistics

In the statistical comparison between the different groups, the significance of difference was tested using Inter-group comparison of categorical data which was performed by using fisher exact test (FET). P value <0.05 was considered statistically significant while >0.05 statistically insignificant P value <0.01 was considered highly significant in all analyses.

Result:

The study was done on 30 patients presented for MRU examination.

- **As regard ureteric spasm that was caused by normal peristaltic movements:**

36.7% of the examined cases (11 patients) showed relieved spasm in the subsequent images repeated after 2 minutes, while 43.3% (13 cases) showed relieved spasm in the images repeated after more than 2 minutes (**Table 1, Fig.1**).

- **Ureteric spasm results according to ureter size:**

There is statistically significant difference ($p<0.05$) according to ureter's size, 92.3% of the cases that showed temporary spasm had normal sized ureters, only one case with dilated ureter had temporary relieved spasm, other cases haven't (**Table 2, fig.2**).

- **Ureteric spasm results according to pathologic spasm:**

There is significant statistically difference between cases with pathological spasm and others of normal ureters of temporary spasm. As regard pathological spasm 20% of cases (6 patients) had fixed true strictures with pathological spasm which was not relieved in the subsequent delayed images unlike others that show temporary ureteric spasm due to normal peristalsis representing 80% ([24 cases](#)) of the examined patients (**Table 3, fig.3**).

Case 1:

Male patient 39 years old with recurrent pelvic pain, history of ueteric stones

MRU imaging findings:

- (A) Thick slab fat suppressed T2 weighted single shot fast spin echo MRU coronal image showed non visualized distal third of the left ureter (blue arrow) most probably due to obstructive ureteric stone.
- (B) Repeated image after 2 minutes showed patent distal ureter. A & B images also showed low signal area at the mid ureteric part of the right ureter (red arrow).
- (C) Normal opacified distal left and right ureter with no signal void stones. The temporary spasm is probably due to

ureteric peristalsis with no fixed stricture (. 4).

Case 2:

Female patient, 35 years old presented to MRU examination.

MRU imaging findings:

- (A) Thick slab fat suppressed T2 weighted fast spin echo coronal image showing proximal third of the left ureter (arrow) with potential spasm.
- (B) Repeated image after 2 minutes showing middle third of the left ureter (arrow).
- (C) Repeated image after 3 minutes showing middle and lower third of the same ureter (arrow). A & B were confidently diagnosed as areas of normal peristalsis (**Fig. 5**).

Case 3:

Male patient 25 years old, with recurrent flank pain presented to MRU examination.

MRU imaging findings:

- (A) Thick slab T2 single shot fast spin echo coronal image showing proximal part of the left ureter (arrow).
- (B) Repeated image after 1 minute showing opacified middle segment of the right ureter with potential spasm near the lower third (arrow).
- (C) Saggital image repeated after 2 minute showing normally opacified left ureter along its course, so the forementioned spasm was due to normal peristalsis (**Fig. 6**).

Table 1: Distribution of the studied group according to presence of ureteric spasm.

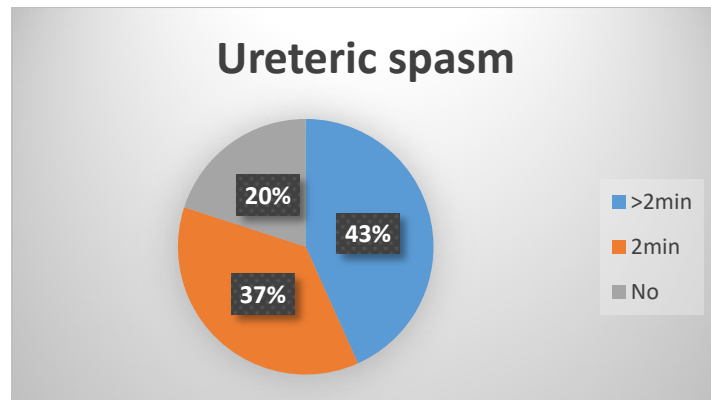
Ureteric spasm	No	%
>2min	13	43.3
2min	11	36.7
No	6	20.0
Total	20	100

Table 2

Ureter size	No spasm (6)		Spasm 2min (11)		Spasm >2min (13)		Statistical test	P value
	No	%	No	%	No	%		
Dilated	6	100	1	9.1	1	7.7	FET= 17.47	<0.001**
Normal	0	0.0	10	90.9	12	92.3		

Table 3.

Pathologic spasm	No spasm (6)		Spasm 2min (11)		Spasm >2min (13)		Statistical test	P value
	No	%	No	%	No	%		
Yes	6	100	0	0.0	0	0.0	FET= 23.23	
No	0	0.0	11	100	13	100		<0.001**



Figure

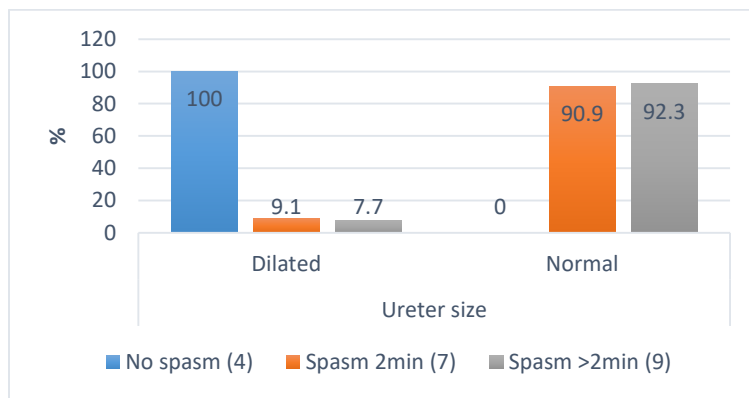


Figure 2

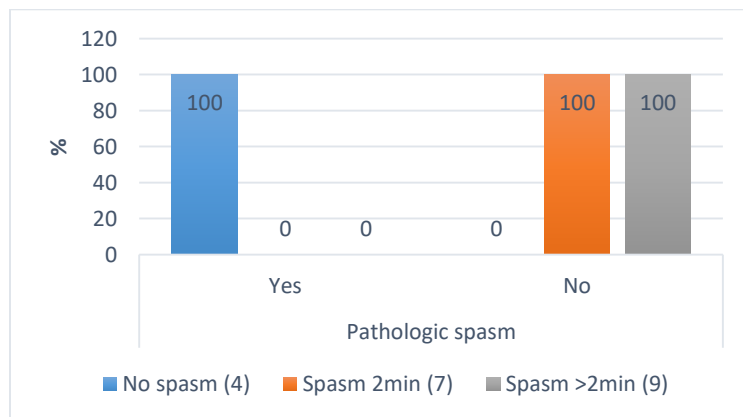


Figure 3

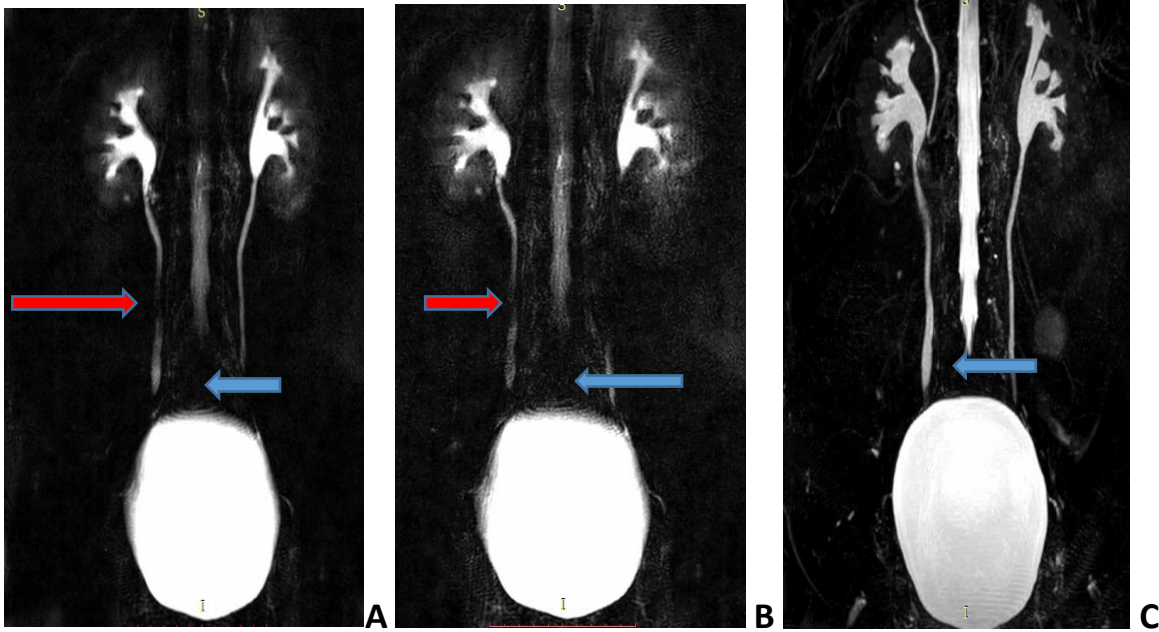


Figure 4

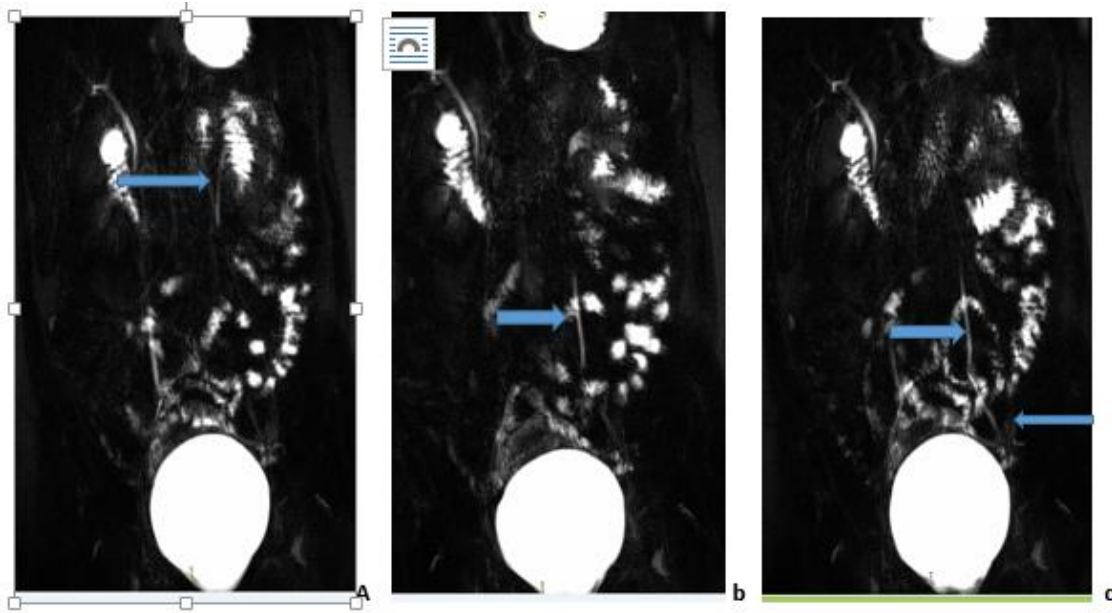


Figure 5

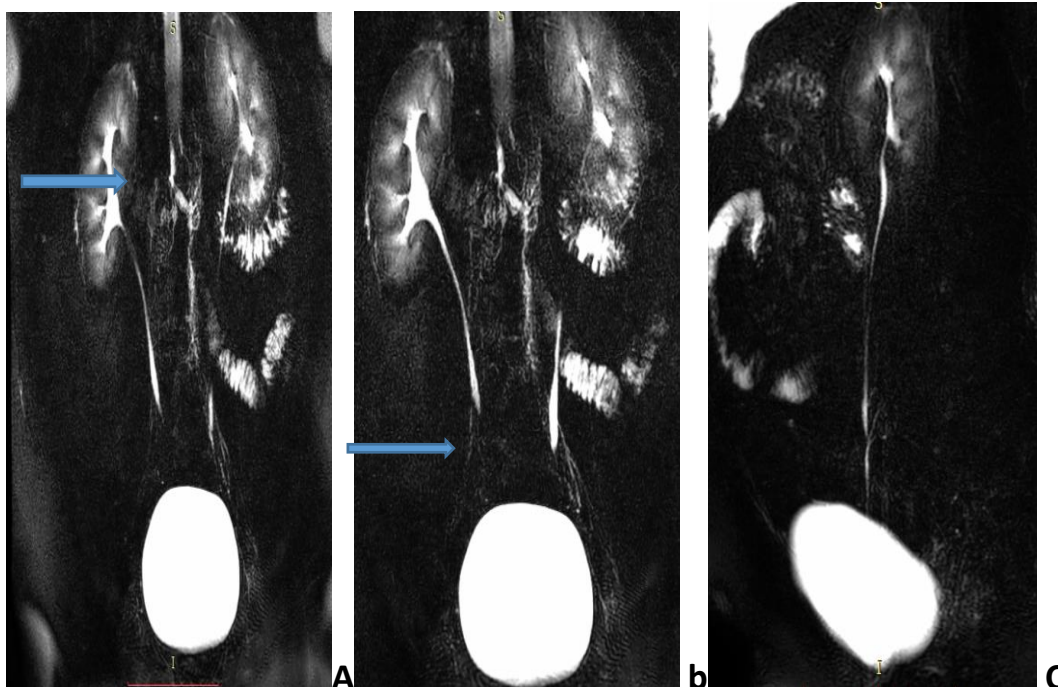


Figure 6

Discussion:

MRU permits an evaluation of the urinary tract without the exposure to ionizing radiation and iodinated contrast medium.

T2w-MRU was the first sequence to be proposed to study excretory urinary tract. Its initial relatively low resolution has been improved by the development of heavily T2-weighted turbo spin-echo sequences such as rapid acquisition with relaxation enhancement (RARE) utilizing multiple thin-slices with MIP or a thick-slice imaging technique and half-Fourier acquisition single-shot turbo spin-echo (HASTE) sequences (6).

In our study any area of potential stricture was assessed by adding multiple sequential single shot fast spin echo T2 images to

determine if its fixed true stricture was due to obstructive uropathy or temporary spasm due to peristaltic movement of the ureters. 80% of our cases showed temporary spasm relieve in the subsequent images ,only 20 % (6 cases) showed pathological fixed stricture in all subsequent images.

In previous studies (7,8), the most frequent cause of obstruction was the ureteric stricture.

In this work ,delayed sequences were added to MRU examination ,multiple single shot T2 fat suppressed fast spin echo coronal images were added after 2 minutes or 4 minutes or more to distinguish between transient ureteric spasm due to ureteric peristalsis and those with true fixed pathological strictures showing no relieve in

the subsequent images. Multiple images are taken for the whole ureteric segments until the entire normal non dilated ureter is completely opacified. This work included thirty patients, half of them were males and the other half were females, their ages ranged between 17&70 years (mean age, 42.5 years). 13 patients (43.3%) showed transient spasm that relieved in the sequential images taken after 2 minutes ,11 patients (36.7%) showed relieved spasm after more than 2 minutes with complete visualization of all ureteric segments. 6 patients (20%) showed true fixed strictures than was not relieved in the subsequent delayed images .

As regard to a previous study (9), in which they determined the feasibility of time-resolved dynamic contrast-enhanced magnetic resonance urography (MRU) for the evaluation of ureteral peristalsis using a data-sharing 3D gradient echo sequence with spiral k-space filling. A total of 16 ureters were examined. Image quality was good in four ureters, satisfactory in 11 ureters, and poor in one ureter. Mean peristaltic frequency was 3.5 waves per minute (range, 2.5–6.5 waves/minute) in normal ureters (n_11). Five ureters were considered abnormal (one urinary tract tuberculosis and four postsurgical ureters), and all had decreased or no peristalsis (0–1.5 waves per minute). MRU using a time-resolved, data-sharing 3D contrast-enhanced technique was able to demonstrate ureteral peristalsis and permits quantification of ureteral peristaltic frequency.

In our study, all patient examined by static MRU ,24 patients (90.09 %) showed normal

sized non dilated ureter which has transient spasm as confirmed in the delayed images,6 cases (9.1%) showed dilated ureter and only one showed transient spasm which was relieved in the subsequent images ,other cases of dilated ureter showed true fixed pathological stricture .

A previous study (10), found that 69% of ureters were better imaged with excretory MRU than static MRU. The majority (90%) of the ureters in this group were non-obstructed. Static MRU was equal to excretory in 40 % of dilated ureters and even better in 60% in visualizing dilated ureters or ureters draining malfunctioning kidneys.

Conclusion:

T2-weighted MRU with multiple delayed sequence images is sufficient to identify all segments of the non-dilated ureter. It offers information on ureteral peristalsis and can distinguish between transient ureteric spasm due to peristalsis rather than the fixed pathological stricture. By adding multiple T2 fat suppressed single shot fast spin echo sequences after 2 ,4 or more minutes, all ureteric segments could be visualized and the entire ureteric course could be evaluated

References:

1. Janisch F, Shariat SF, Baltzer P, Fajkovic H, Kimura S, Iwata T, et al. Diagnostic performance of multidetector computed tomographic (MDCTU) in upper tract urothelial carcinoma (UTUC): a systematic review and meta-analysis. *World J Urol.* 2020;38(5):1165–75.

2. Silverman SG, Leyendecker JR, Amis Jr ES. What is the current role of CT urography and MR urography in the evaluation of the urinary tract? *Radiology*. 2009;250(2):309–23.
3. Patel HC, Otero S, Moser JB, Hayward C, Rosen SD, Lyon AR, et al. A cross-sectional imaging study to identify organs at risk of thermal injury during renal artery sympathetic denervation. *Int J Cardiol*. 2015;197:235–40.
4. Chung AD, Schieda N, Shanbhogue AK, Dilauro M, Rosenkrantz AB, Siegelman ES. MRI evaluation of the urothelial tract: pitfalls and solutions. *Am J Roentgenol*. 2016;207(6):W108–16.
5. Zhu WJ, Ma MM, Zheng MM, Hao H, Yang KL, Zhou LQ, et al. Cine magnetic resonance urography for postoperative evaluation of reconstructive urinary tract after ileal ureter substitution: initial experience. *Clin Radiol*. 2020;75(6):480-e1.
6. Roy C, Ohana M, Host P, Alemann G, Labani A, Wattiez A, et al. MR urography (MRU) of non-dilated ureter with diuretic administration: Static fluid 2D FSE T2-weighted versus 3D gadolinium T1-weighted GE excretory MR. *Eur J Radiol open*. 2014;1:6–13.
7. Shokeir AA, El-Diasty T, Eassa W, Mosbah A, El-Ghar MA, Mansour O, et al. Diagnosis of ureteral obstruction in patients with compromised renal function: the role of noninvasive imaging modalities. *J Urol*. 2004;171(6 Part 1):2303–6.
8. El-Ghar A, Shokeir A, Rifaie H, El-Diasty T. Static T2w MRU in Noncalcular Urinary Obstruction: Comparison of Its Two Techniques. *ScientificWorldJournal*. 2008;8:454–62.
9. Kim JK, Cho KS. CT urography and virtual endoscopy: promising imaging modalities for urinary tract evaluation. *Br J Radiol*. 2003;76(903):199–209.
10. Borthne A, Nordshus T, Reisetter T, Geitung JT, Gjesdal KI, Babovic A, et al. MR urography: the future gold standard in paediatric urogenital imaging? *Pediatr Radiol*. 1999;29(9):694–701.

To cite this article: Hesham E. EL sheikh, Eman F. AbdelKalek, Israa A. Dahab. Role of Magnetic Resonance Urography Delayed Sequence in Assessment of Ureteric Spasm. *BMFJ* 2023;40 (Radiology):23-31.