MR Urography in Patients with Acute Flank Pain: Comparison of Gadolinium-Enhanced 3D FLASH after Low-Dose Diuretic with 2D Turbo Spin Echo Sequences

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Introduction:

Intravenous excretory urography (IVU) has been regarded as the imaging modality of choice for the detection of urinary tract disorders in patients with acute flank pain. Functional as well as anatomical details are provided by this imaging technique. The use of ionised radiation and contrast material (CM) are considered to be the major drawbacks of IVU. Recently, the use of magnetic resonance urography (MRU) using half-Fourier acquisition single-shot turbo spin-echo (HASTE) and rapid acquisition with relaxation enhancement (RARE) sequences has been described in patients with urinary tract disease. High resolution images can be achieved with breath-hold and rapid acquisition sequences. HASTE and RARE can demonstrate acute urinary obstruction and show perirenal high intensity signal. However, information about renal function is not achieved. Small stones are difficult to detect, and non-dilated urinary tract is not fully visualised. In this aspect Gadolinium-enhanced three-dimensional fast low-angle shot (3D FLASH) sequence provides an alternative rapid imaging technique for urinary tract evaluation.

The aim of this study was to compare the utility of combined thin slice HASTE and thick slab single-shot turbo spin echo (TSE) sequences with 3D FLASH MRU in the evaluation of patients with acute flank pain.

Patients and methods:

During the study period from April/99 to August/99, 29 consecutive patients with symptoms of acute flank pain underwent MRU followed immediately by IVU. Twenty-four men and 5 women (mean age 52 yr., range 29-74 yr.) were included. All patients had clinical symptoms of suspected renal colic for which IVU was programmed as an emergency examination. The study was approved by the Ethics committee of our hospital. Informed consent was obtained.

MR imaging was done using a 1.5 T scanner with phased array body coil. Breath-hold sequences were applied. Both T2-weighted (w) and 3D T1-w MRU were obtained in coronal orientation. T2-w MRU was performed with thin slice (fat suppressed HASTE, TR/TE/FA 11.90 ms/95 ms/150°, slice thickness 4-6 mm, FOV 360 mm, matrix 240x256, acquisition time 15 s) and thick slab (fat suppressed single-shot TSE, TR/TE/FA 2800 ms /1100 ms/150°, slab thickness 40 mm, FOV 300 mm matrix 240x256, acquisition time 7 s.) acquisitions. HASTE was also acquired in axial orientation (7-9 mm slice thickness) to cover the whole abdomen and retroperitoneal space. T1-w MRU was performed with Gd-enhanced 3D FLASH (TR/TE/FA 4.6 ms/1.8 ms/ 30°, effective slice thickness 1.75 mm, FOV 400 mm, 200x512 matrix, acquisition time 23 s) acquisition. 3D FLASH was occasionally acquired in sagital orientation on the affected side.

A low-dose diuretic injection (furosemide 0,1 mg/kg, with the total individual dose not exceeding 10 mg) was used to enhance excretion 30-60 s. before the administration of CM. 3D FLASH sequence was routinely repeated 5 and 15 min after the administration of gadopentatate dimeglumine (0,1 mmol/kg) and delayed follow-up was performed when necessary. The total examination time for all MRU-sequences was approximately 35 min if excretion was not delayed.

HASTE+TSE and 3D FLASH sequences were evaluated separately and independently by two experienced radiologists for the presence and cause of obstruction. MIP, MPR and source images were available on films for evaluation. The readers were aware of the side of the symptoms. No other clinical data or information from other studies were provided. IVU was used as reference. If the interpretation of IVU was questionable, the presence of ureteral stone was confirmed by computed tomography (n=2) or by the spontaneous passage of stone (n=1).

Results:

sensitivity and specificity of HASTE/TSE and 3D FLASH for both readers of the symptomatic side (n=29) are presented in Table 1. HASTE/TSE MRU was highly sensitive in the demonstration of obstruction, but failed to show the cause of obstruction in most of these cases. 3D FLASH proved to be 100% accurate (observer B) in the detection of ureteral stone. Interobserver agreement was calculated using statistic kappa and proved to be excellent for 3D FLASH (Table 1).

Conclusion:

Gadolinium-enhanced 3D FLASH MRU is a highly sensitive and specific imaging modality in investigating patients with acute flank pain, and could replace conventional excretory urography when the latter is contraindicated or undesirable. MRI also offers the possibility to screen the abdominal cavity and retroperitoneal space to rule out other pathological conditions. In our opinion the combined use of both HASTE and 3D FLASH sequences will ensure better confidence in the evaluation of acute suspected renal colic.

References:

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(3) A Rothpearl et al. Radiology 1995;194:125-130
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Table 1: Diagnostic accuracy and interobserver kappa (κ) values (95% CI) of MR-Urography in the assessment of obstruction and detection of ureteral stone. Comparison of HASTE/TSE and 3D FLASH MRU with reference to excretory urography.

	Sensitivity (%)		Specificity (%)		Overall accuracy (%)		Inter-observer κ (95% CI*)
Observer	A	B	A	B	A	B	
Assessment of Obstruction:							
HASTE+ TSE	100	100	90,9	100	96,6	100	0,93 (0,78-1,0)
3D FLASH	94,4	100	100	100	96,6	100	0,93 (0,79-1,0)
Detection of stone:							
HASTE+ TSE	38,9	44,4	100	100	62	65,5	0,19 (0- 0,58)
3D FLASH	94,4	100	100	100	96,6	100	0,93 (0,79-1,0)

*CI = Confidence interval

FIGURE. Right ureteral duplication and obstruction shown on MIP image from 3D FLASH MRU(A) and HASTE MIP image (B). Stone (arrow) is shown on 3D FLASH source image (C).