

Gadolinium-enhanced excretory MR urography for upper tract urothelial carcinoma in high risk population

N. Takahashi¹, J. Glockner¹, R. P. Hartman¹, A. Kawashima¹, D. W. Stanley², A. Brau², and P. Beatty²

¹Radiology, Mayo Clinic, Rochester, MN, United States, ²GE Healthcare

Purpose: The purpose of this study is to retrospectively evaluate the utility of gadolinium-enhanced MR urography (MRU) for screening high risk population for developing upper tract urothelial carcinoma when CT urography (CTU) or excretory urography (ExU) is contraindicated.

Introduction: ExU or more recently CTU has been routinely used for screening patients with high risk for developing urothelial carcinoma. However, when the patient has contraindication to iodinated contrast media, often more invasive retrograde pyelography is required to image upper tract. MRU has been shown to be useful to detect upper urinary tract abnormality when patient has urinary obstruction. However, utility of MRU for screening high risk group patients for developing upper tract urothelial carcinoma has not been reported.

Material and Methods: 79 patients (mean age 69, male 59, female 20) underwent MR urography between 5/2005 and 10/2006. 67 patients underwent MR urography because of high risk for upper tract malignancy (hematuria, previous history of urothelial malignancy or current bladder malignancy, suspicious urine cytology) (Screening Group: SG). 61 of these had contraindication for CTU (renal insufficiency or history of allergy to iodinated contrast material). 12 other patients underwent MRU because of suspicious findings of upper tract tumor or hydronephrosis by non-contrast CT or US (Non Screening Group: NSG). MRU was performed on a 1.5T scanner (Signa, GE Healthcare, Milwaukee, WI) using an 8-channel torso phased array coil. The protocol included coronal breath-held T2-weighted single shot fast spin echo (SSFSE) and dynamic gadolinium-enhanced 3D T1 fat-suppressed -LAVA (Liver Acquisition with Volume Acceleration) in the corticomedullary, nephrographic and urographic phases. A prototype autocalibrated parallel imaging method [1] was implemented with LAVA to achieve 2x data acquisition acceleration with minimal motion or aliasing artifact. Intravenous furosemide was used to achieve distention of the urinary tract and dilution of the contrast. Two independent reviewers evaluated for presence or absence of mass in the upper urinary tract without knowledge of the final diagnosis. Histological or ureteroscopic diagnosis was used as a standard of reference for the presence of upper tract urothelial malignancy. Normal antegrade or retrograde pyelography or follow-up MRU was used as a reference for absence of disease.

Results: Follow-up was available in 42 patients; 32 in the SG and 10 in the NSG. Upper urinary tract malignancy was present in 14 patients; 6 patients in the SG and 8 patients in the NSG (2 malignancies in NSG was lymphoma and the remainder was urothelial carcinoma). None of the urothelial carcinoma in the SG was obstructive. In the SG, each reviewer correctly diagnosed 4/6 and 3/6 with malignancy (sensitivity 67%, 50%) and 22/26 and 24/26 without malignancy (specificity 85%, 92%). In the NSG, each reviewer correctly diagnosed 6/8 and 7/8 with malignancy (sensitivity 75%, 88%) and 1/2 and 2/2 without malignancy (specificity 50%, 100%). The overall accuracy for combined SG and NSG was 79% and 86% for each reviewer. Most urothelial tumors were best seen on LAVA images in urographic phase, but early phase images were helpful differentiating tumor from stone or clot. Typical MRU findings of the urothelial malignancy were an enhancing mass during the early phase of enhancement which appears as a filling defect during the urographic phase (Fig 1, Fig 2).

Conclusion: Gadolinium-enhanced excretory MRU can be used for screening high risk population for developing upper tract urothelial carcinoma when CT urography or excretory urography is contraindicated.

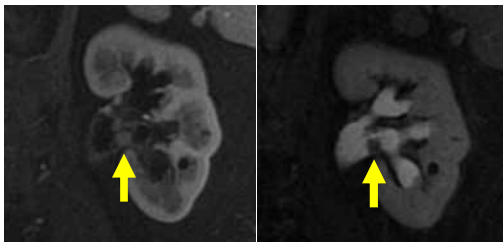


Fig 1a, 1b: 60 year-old male with a history of right nephroureterectomy and cystoprostatectomy for urothelial carcinomas in the right kidney and bladder underwent MRU for routine surveillance of the left upper tract. On dynamic gadolinium-enhanced LAVA images, there is an enhancing mass in the left renal pelvis in the corticomedullary phase (1a) which appears as a filling defect in the urographic phase (1b). The patient underwent endourologic resection of the tumor, which was proved to be non-invasive urothelial carcinoma.

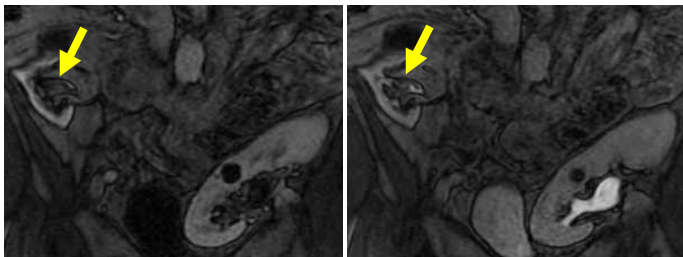


Fig 2a, 2b: 77 year-old female with renal transplants in bilateral iliac fossae underwent screening MRU because of abnormal urine cytology. On dynamic gadolinium-enhanced LAVA images, there is a small lesion with subtle enhancement in the renal pelvis of the right transplant kidney in the nephrographic phase (2a) which appears as a filling defect in the urographic phase (2b). The patient underwent nephrectomy and this was proved to be urothelial carcinoma. The transplant in the left iliac fossa was normal. Fat suppression could not be applied because of the left hip prosthesis.

Reference: 1. Brau ACS. 14th Proc ISMRM, 2006, #2462.