

## Free-breathing and high b-value diffusion-weighted MR images of malignant urinary tract obstruction

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**[Introduction]** 18F-FDG positron emission tomography (PET) is useful for malignant tumor detection, but has a limit in evaluating urinary tract neoplasms because of physiological radiotracer excretion. Various benign and malignant pathologies may cause urinary tract obstruction, and to differentiate benign obstruction from primary or secondary malignant tumor obstruction is important. In addition, malignant urinary epithelial tumors (transitional cell carcinoma) may occur as multiple lesions in the urinary tracts and preoperative detection of all tumors is helpful for adequate surgical planning. The purpose of this study is to evaluate malignant urinary tract obstruction by free-breathing and high b-value diffusion-weighted images (DWI) and corresponding isotropic ADC maps.

**[Materials and Methods]** Seven urothelial carcinomas (five ureteral cancers and two renal pelvic cancers) and four cases of ureteral obstruction due to secondary tumor involvement (two lymph node metastases from uterine cervical cancers, one vaginal cancer, and one ovarian cancer) with urinary obstruction were evaluated. Free-breathing DWI with high b-value ( $b=800 \text{ sec/mm}^2$ ) was performed in all subjects with a spin-echo, single-shot EPI sequence on a system with a 1.5-T superconducting unit (Signa Excite, General Electric, Milwaukee, WI) with 8ch body-array torso coils. The parallel image-encoding techniques (the array spatial sensitivity encoding techniques: ASSET, General Electric, Milwaukee, WI) were employed. Signal intensity on DWI (black and white inversion) was visually evaluated by two radiologists. The isotropic apparent diffusion coefficients (ADCs) of the pathologies were measured from ADC maps. Maximum intensity projection (MIP) of DWI (black and white inversion) was also reconstructed. Static-fluid MR Urography (MRU) based on heavily T2-weighted sequences, and/or coronal T2-weighted images with single shot fast spin-echo (SSFSE) sequence, or with fast imaging employing steady state acquisition (FIESTA) sequence were also obtained for the evaluation of urinary tract obstruction.

**[Results]** All seven urothelial carcinomas and three of four secondary tumors showed very high signal intensity on DWI. The ADC in seven urothelial carcinomas was  $1.13 \pm 0.18 \times 10^{-3} \text{ mm}^2/\text{sec}$ . The ADC in three high intense secondary tumors was  $0.93 \pm 0.09 \times 10^{-3} \text{ mm}^2/\text{sec}$ . One secondary tumor (ovarian mucinous cystadenocarcinoma) showed low intensity on DWI and very high intensity on T2-WI reflecting its cystic nature (ADC was  $3.08 \times 10^{-3} \text{ mm}^2/\text{sec}$ ). MIP of DWI can clearly demonstrate tumor extent, and MRU in combination with DWI provided the three-dimensional entire urinary tract imaging with the extension of tumors (Fig. 1).

**[Conclusion]** Free-breathing and high b-value DWI may be useful in both primary and secondary tumor detection in patients with urinary tract obstruction, and in differentiation from benign strictures. The combination of MIP of DWI and MRU is useful in tumor detection and in evaluation of tumor extent in the entire urinary tract. Because DWI and MRU can be obtained without the administration of contrast medium, these techniques are suitable for patients who cannot undergo drip infusion pyelography such as pregnant women, patients allergic to contrast agents, or patients with renal dysfunction.

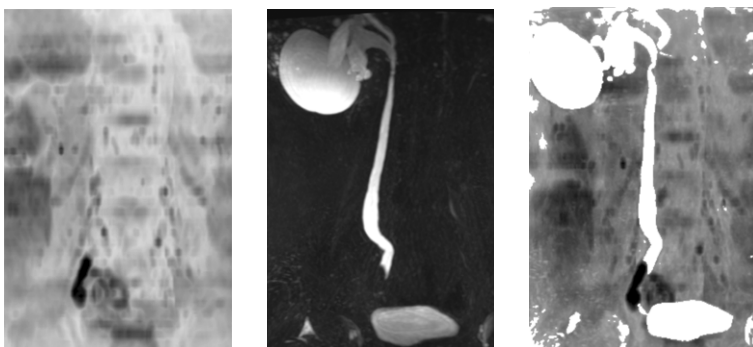


Fig. 1. MIP of DWI (left) , MRU (middle), and fusion image (right). The tumor extent in the entire urinary tract is well visualized.