

Diffusion-weighted MRI to detect pelvic lymph node metastases in patients with bladder or prostate cancer: comparison with histopathology as gold standard

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Introduction:

Correct staging of prostate and bladder cancer is a prerequisite for surgery and further treatment of the patient. Up to date the diagnosis of pelvic lymph node metastases is limited to size criteria only (by CT or MRI), however it has been shown that micrometastases are present in a substantial number of normal sized nodes in patients with prostate or bladder cancer (1). Diffusion-weighted MRI (DW-MRI) provides additional information on the internal structure of a normal sized node. Therefore, we hypothesize that DW-MRI might improve the staging of the involved cancer patients due to decreased ADC values in lymph node metastases compared to normal nodes (2).

Methods:

Forty patients (5 women, 35 men, median age: 65 years, range: 48-86) with bladder cancer (n=20), prostate cancer (n=14) or both (n=6) were examined on a 3T MR unit (Trio, Siemens Medical, Erlangen, Germany) using the Siemens body phased array coils in addition. For morphological evaluation a 3D T1-w and T2-w SPACE sequence (isotropic voxel size of 0.75 mm³ and 1.0 mm³ respectively) were performed. For structural analysis an axial echo-planar DW-MRI sequence was acquired with respiratory triggering (TR=4700msec; TE=59msec; 3b-factors 0, 500, 1000; matrix 128x128, FOV 330x330mm², slice thickness 4mm; gap 0mm; bandwidth 2300Hz/px, 6 acquisitions, TA 4:23min).

For image analysis DW-MRI was evaluated by two readers in consensus both qualitatively by visual analysis of the DW-MR image at a b-value of 1000sec/mm² (b1000 image) image and quantitatively by ADC-measurement and compared to histopathology on a patient level. Readers searched for hyperintense, round or oval structures on the b1000 images and correlated them with the morphological images in order to determine whether these structures corresponded to lymph nodes. The ADC values of the respective nodes were arbitrarily classified in three groups: malignant < 90, ambiguous 90-100, benign > 100x10⁻⁵mm²/sec. Template lymphadenectomy was performed in 36 patients, while 3 patients underwent biopsy and 1 patient had to be excluded due to bone metastases detected only on DW-MRI and confirmed thereafter by histology. This patient underwent chemotherapy instead of surgery.

Results:

Histopathology revealed 29 patients as negative and 10 as positive (Tab. 1). DW-MRI considering also the ADC-values (Tab. 2) correctly detected 23 patients as negative, whereas two were false-negative. Retrospective analysis showed a small metastasis on DW-MRI in one patient (Fig. 1), whereas the ADC value of the lymph node in the other patient was 102 x10⁻⁵mm²/sec. Eight of 10 positive patients were correctly classified as positive while six patients were false positive due to lipomatosis, follicular hyperplasia or sinus histiocytosis on histology. One patient correctly assigned as positive turned out to have a micrometastasis (1 x 1 mm) in a 4 x 6 mm sized node on the contra-lateral side.

Tab.: 1

		Histopathology	
		Positive	Negative
DW-MRI	Positive	8	6
	Negative	2	23

Tab. 2:

ADC-values* of the positive lymph nodes		
Prostate	Bladder	Both
53-89	64-102	60-90

* x10⁻⁵mm²/sec

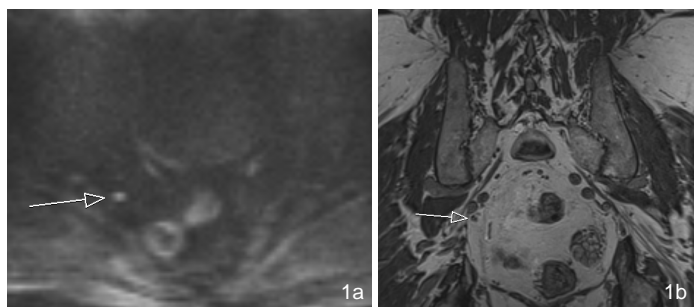


Figure 1. Preoperative axial DW-MR image at a b-value of 1000sec/mm² (a) of a 63-year old male patient with bladder cancer. Hyperintense round structure of 4 mm x 5 mm (arrow) corresponding to a normal sized right-sided iliac internal lymph node (arrow) on the coronal T2-w image (b). Histopathology showed a micrometastasis of 0,4 x 0,7 mm. This lymph node was missed on the first analysis of the DW-MR images, however it could be confirmed retrospectively with an ADC value of 82 x10⁻⁵mm²/sec.

Overall diagnostic accuracy of DW-MRI compared to histopathology yielded a sensitivity of 80%, a specificity of 79%, a positive-predictive value of 57% and a negative predictive value of 92%.

Discussion and conclusions:

DW-MRI together with conventional MRI for morphological analysis allows detection of metastases even in normal sized lymph nodes. Experience and meticulous analysis of the DW-MR images are important prerequisites for correct differentiation as our retrospective analysis of a small metastasis (Fig. 1) demonstrates. False-positive nodes cannot be excluded as also other benign pathologies such as follicular hyperplasia, sinus histiocytosis or lipomatosis may lead to restricted diffusion with consequent low ADC values. The proposed threshold values for malignancy have to be confirmed in larger scale studies.

References:

1. Fleischmann A. et al. J Clin Oncol 2005; 23:2358-2365.
2. Thoeny HC, De Keyzer F. Eur Radiol 2007 ; 17 :1385-1393.

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