Characterization of head and neck tumors in a simultaneous whole-body MR/PET scanner using diffusion-weighted imaging and FDG-PET

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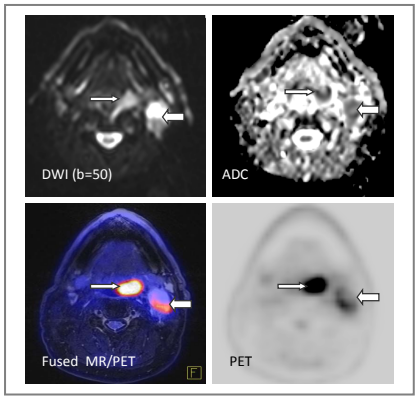
Purpose: To evaluate the use of diffusion-weighted imaging (DWI) in correlation with FDG-uptake in a simultaneous whole-body MR/PET scanner for the assessment of head and neck cancer.

Methods: Ten patients with histological proven head and neck cancer were included. All patients had no prior treatment. After a clinically indicated 18F-FDG-PET/CT performed for staging and therapy planning all patients underwent a simultaneous 3 T MR/PET scan (Biograph mMR, Siemens). In addition to standard anatomical MR sequences diffusion-weighted images in axial slice orientation were acquired using an EPI SPAIR sequence with b-values of 50 and 800 s/mm^2. Image quality of DWI was evaluated on a lesion basis both for the assessment of primary tumors and lymph node (LN) metastases on a four-point-scale (1 = excellent). Minimum and average apparent diffusion coefficients (ADCmin, ADCmean) as well as maximum and mean standardized uptake values (SUVmax, SUVmean) were assessed in a region of interest (ROI) analysis for primary tumors and LN metastases. SUVs of PET/CT and MR/PET were analyzed using Spearmans's rank correlation. Comparison between primary tumor and LN metastases regarding ADC and SUV was made using Wilcoxon rank sum test. The correlation between ADC values and SUVs was analyzed separately for primary tumors and LN metastases using Spearman's rank correlation.

Results: MR/PET was feasible in all patients. A typical image series is shown in Figure 1. Ten primary tumors and 19 LN metastases were found. Image quality of the diffusion-weighted images was rated 1.5 ± 0.7. SUVmax and SUVmean of primary tumors averaged at 16.9 ± 7.5 (range: 8.2 - 33.4) and 10.7 ± 4.7 (range: 6.3 - 21.8), respectively. SUVmax and SUVmean of the LN metastases were on average 8.4 ± 4.3 (range: 1.0 - 16.0) and 4.3 ± 1.9 (range: 0.9 - 9.7). ADCmin and ADCmean of primary tumors averaged at 0.66 ± 0.21 (range: 0.28 - 0.96) x 10-3 mm^2/s and 0.97 ± 0.22 (range: 0.53 - 1.28) x 10-3 mm^2/s. ADCmin and ADCmean of LN metastases were on average: 0.55 ± 0.30 (range: 0.10 - 1.11) x 10-3 mm^2/s and 1.09 ± 0.32 (range: 0.12 - 1.51) x 10-3 mm^2/s. There was significant correlation of SUV values measured in MR/PET and PET/CT (SUVmean: $\rho = 0.86$; SUVmax: $\rho = 0.85$; both $p < 0.0001$).
Primary tumors and LN metastases significantly differed in SUVmax and SUVmean ($p < 0.001$ and $p < 0.0001$, respectively) with higher values in the primary tumors. No significant difference was found between primary tumor and LN metastases regarding ADCmin or ADCmean. There was no significant correlation between ADC values and SUVs in the separate analysis of primary tumors and of LN metastases.



Conclusion: The acquisition of DWI in a simultaneous hybrid MR/PET scanner provides diagnostic image quality for the assessment of head and neck cancer. The absence of significant correlation between ADC and SUV suggests that DWI and FDG-PET might provide complementary information for the characterization of head and neck cancer.

Figure 1 MR/PET image series
64-year old male patient with orohparyngeal cancer (small arrow) and ispsilateral lymph node metastasis (large arrow).
Diffusion-weighted image, ADC map, PET and fused MR/PET (clockwise) acquired in a simultaneous whole-body MR/PET scanner.