

Value of diffusion weighted imaging (DWI) as an early imaging biomarker for prediction of therapy effect in patients with colorectal metastases following selective internal radiotherapy (SIRT)

M. Zeile¹, C. Wybranski¹, D. Loewenthal¹, M. Pech¹, F. Fischbach¹, R. Rühl¹, H. Amthauer¹, J. Ricke¹, and O. Dudeck¹

¹Clinic for Radiology and Nuclear Medicine, University Clinic Magdeburg, Magdeburg, 39120, Germany

Introduction

Intraarterial administration of ⁹⁰Y microspheres is a promising radiation therapy for palliation in patients with colorectal liver metastases [1]. Immediate and long-term follow-up are necessary for determination of treatment response. Morphologic criteria used to detect tumor response traditionally rely on changes in tumor size assessed by conventional cross-sectional imaging, which may not be conclusive until 3 months after therapy [2]. Clinical studies revealed the potential of diffusion weighted imaging (DWI) as a sensitive early biomarker for predicting tumor response to therapy [3,4].

Material and Methods

41 colorectal liver metastases in 18 patients, age 62.9 +/- 9.9 years, were included in this study. All patients underwent MRI with standard imaging protocol, including administration of Gd-EOB-DTPA as well as echoplanar (EPI) DWI sequences. Imaging was performed prior to therapy (baseline MRI), 1 to 3 days after SIRT (early MRI) as well as 6 weeks later (follow-up MRI). Tumor volume (TV) and intratumoral apparent diffusion coefficient (ADC) were measured independently by two experienced radiologists at all time points. All metastases were categorized in responding lesions (RL) or non-responding lesions (NRL) according to increase or decrease in tumor volume after 6 weeks. Statistical analysis was performed using Wilcoxon- and Mann-Whitney-test. Statistical significance was presumed for p<0.05.

Results

33 lesions were evaluated as RL (TV 6.7 to 457.6 ml, mean 56.1 ml), 8 lesions as NRL (TV 5.8 to 85.1 ml; mean 27.0 ml). On follow-up MRI, TV decreased by 31.3 +/- 21.3% in RL (p<0.0001), which was accompanied by a significant increase of ADC by 21.4 +/- 16.4% (from 1.75 to 2.08 x 10⁻³ mm²s⁻¹; p<0.0001). TV increased in NRL by 49 +/- 31.9% (p=0.012) while ADC decreased by 9.9 +/- 10.7% (from 1.41 to 1.25 x 10⁻³ mm²s⁻¹; p=0.036). On early MRI, no significant change in TV was found for RL and NRL (p=0.53). In contrast, RL showed a significant decrease of ADC of 10.7 +/- 8.4 % (from 1.75 to 1.57 x 10⁻³ mm²s⁻¹; p< 0.0001). In contrast, NRL displayed an increase of ADC of 9.6 ± 20.8% (from 1.42 to 1.52 x 10⁻³ mm²s⁻¹) which was not significant (p=0.40). In addition mean ADCs of RL and NRL were significantly different at this time point (p<0.0001).

Conclusion

DWI is capable of early prediction of therapy effects in patients with colorectal hepatic metastases after radioembolization prior to morphologic changes in sectional imaging.

References

1. Jakobs TF, Hoffmann RT, Poepperl G, Schmitz A, Lutz J, Tatsch K, Lubinsky A, Reiser MF, Helmberger T et al. Mid-term results in otherwise treatment refractory primary or secondary liver confined tumours treated with selective internal radiation therapy (SIRT) using (90)Yttrium resin-microspheres. *Eur. Radiol.* 2007; 5:1320-30
2. Jiao LR, Szyszko T, Habib NA et al. Clinical and imaging experience with yttrium-90 microspheres in the management of unresectable liver tumors. *Eur J Surg Oncol.* 2007; 5:597-602
3. Ross BD, Moffat BA, Lawrence TS, Mukherji SK, Gebarski SS, Quint DJ, Johnson TD, Junck L, Robertson PL, Muraszko KM, Dong Q, Meyer CR, Bland PH, McConville P, Geng H, Rehemtulla A, Chenevert TL. Evaluation of cancer therapy using diffusion magnetic resonance imaging. *Mol Cancer Ther.* 2003 Jun;2(6):581-7
4. Rhee TK, Naik NK, Omary RA, et al. Tumor response after yttrium-90 radioembolization for hepatocellular carcinoma: comparison of diffusion-weighted functional MR imaging with anatomic MR imaging. *J Vasc Interv. Radiol.* 2008; 8:1180-6

