Dynamic Contrast Enhanced MRI of the Liver for Therapy Monitoring of Hepatic Metastases from Neuroendocrine Tumors

W. H. Sommer1, S. Sourbron2, M. F. Reiser1, K. A. Herrmann1, and C. Zech1

1Department of Radiology, University Hospital Munich, Grosshadern Campus, Munich, Bavaria, Germany, 2University of Leeds, Leeds, United Kingdom

Introduction:
Liver metastases of neuroendocrine tumors (NET) are hypervascular in the arterial dominant phase (1;2). The response of the metastases to treatment is not sufficiently reflected by the RECIST criteria. Therefore, PET-CT is typically used for treatment follow-up, rather than MRI. The aim of the current study was to analyze perfusion parameters from dynamic contrast enhanced MRI (DCE-MRI) using a dual-inlet two-compartment uptake model for liver specific MRI contrast agent Gd-EOB-DTPA. These parameters should be correlated with specific uptake values (SUV) derived from PET-CT imaging with the somatostatin-receptor specific tracer Gallium-Dotatate.

Material and Methods:
Dynamic contrast enhanced-MRI data were acquired at 3T (Siemens Verio) in 18 patients with proven metastases of NET using the 3D gradient-echo sequence TWIST (48 coronal slices, 4mm thickness, 192x192 matrix, 2.1sec temporal resolution, 5min acquisition). All patients underwent MRI for clinical reasons. A standard dose of Gd-EOB-DTPA (flow: 2ml/min; 25µmol/kg BW; Primovist, Bayer) was used. These patients also underwent PET-CT with the somatostatin-receptor specific PET-tracer Ga-Dotatate within 1 week after MRI. By visual coregistration ROIs were placed in all hepatic metastases (>3cm) which were visible both on PET-CT and MRI images. Additionally one ROIs was placed in non-metastatic normal appearing liver tissue (NALT) both in DCE-MRI and PET-CT datasets. DCE-MRI parameters (arterial and venous plasma flow, extracellular mean transit time, extracellular volume and intracellular uptake rate of Gd-EOB-DTPA) and corrected SUVmax (SUVmaxmetastasis / SUVmaxNALT) values from PET-CT datasets were computed for all ROIs using an inhouse customimized software (PMI 0.4). Pearson’s correlation coefficient was calculated for DCE-MRI parameters (r) and SUVmax values.

Results:
A total of 62 ROIs was placed in hepatic metastases of NET. Mean diameter of ROIs was 3.8cm. Arterial plasma flow showed highest correlation value with Ga-Dotatate uptake (r=0.74; p<0.0001; 95%CI: 0.57 to 0.88) followed by extracellular volume (r=0.42; p=0.020; 95%CI: 0.09 to 0.68) (see figure 1). Venous plasma flow (r=−0.15; p=0.42; 95%CI: -0.49 to 0.22), extracellular mean transit time (r=−0.33; p=0.08; 95%CI: -0.62 to 0.04) and intracellular uptake rate of Gd-EOB-DTPA (r=−0.20; p=0.29; 95%CI: -0.53 to 0.17) were not significantly correlated to SUVmax.

Conclusion:
MRI-perfusion parameters from the dual-inlet two-compartment uptake model provide functional information for liver metastases of neuroendocrine tumors. Especially arterial plasma flow shows a high correlation with SUV-values derived from the somatostatin-receptor specific PET tracer Ga-Dotatate. For patients with hypervascularized liver metastases, DCE-MRI provides additional functional information which might be relevant for therapy monitoring.

Reference List
3. S. Sourbron, W. Sommer, C. Zech, M. Reiser, K. Herrmann (2009); Tracer-kinetic analysis of Gd-EOB-DTPA in the liver with a dual-inlet two-compartment uptake model; ISMRM

Figure 1: Exemplary case of liver metastases of NET before therapy: Left: Coronary PET-CT with the somatostatin-receptor specific PET-CT tracer Ga-Dotatate. Right: Parameter Map using dynamic-contrast enhanced MRI. This coronary view of the liver shows the arterial plasma flow for the large metastasis in segment V/VIII of the right liver lobe and the good correlation between SUV-values and the arterial plasma flow both in the hypervascularized rim and the necrotic center of the metastasis.