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

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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 ($SUVmax_{metastasis}$ / $SUVmax_{NALT}$) values from PET-CT datasets were computed for all ROIs using an inhouse costumized software (PMI 0.4). Pearson's correlation coefficient was calculated for DCE-MRI parameters (r) and SUV_{max} 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 values 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 SUV_{max}.

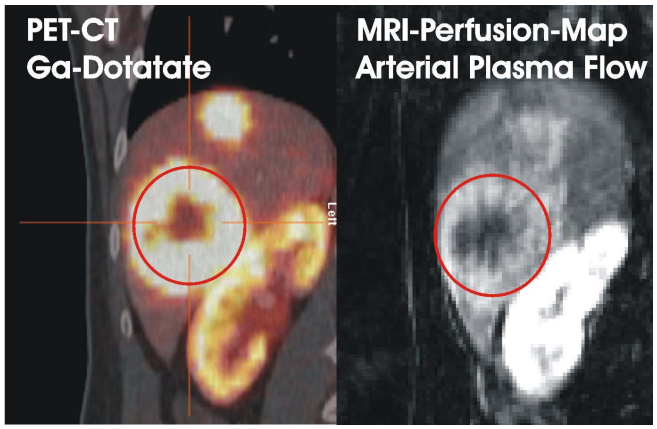

Figure 1: Exemplary case of liver metastases of NET before therapy: Left: Coronary PET-CT with the somatostatin-receptor specific PET-CT tracer Ga-Dotatate. Right: Parameter Map using dynamic-contrast enhanced MRI. This coronary view of the liver shows the arterial plasma flow for the large metastasis 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.

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

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