MR-imaging characteristics and post-therapeutic morphologic changes in liver metastases from neuroendocrine tumors

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Introduction:

Liver metastases of neuroendocrine tumors (NET) show MRI-characteristics, which differ from most other liver metastases; i.e. they are hypervascular in the hepatic arterial dominant phase (1;2). The response of the metastases to treatment is not sufficiently reflected by the RECIST criteria. However, metastases of NET rather show characteristic changes to treatment, like central necrosis, hemorrhagic transformation and fluid-fluid levels, which are otherwise rare in hepatic metastases. The aim of the current study was to analyze, describe and quantify MR-morphologic characteristics and changes in liver metastases of NET at baseline and at different timepoints in treatment follow up. Additionally it shall be analyzed, how these MR-morphologic characteristics are reflected by tracer uptake in PET-CT and by changes in tumor perfusion.

Material and Methods:

Between 2004 and 2008, 83 MRI examinations of 41 patients (m/f = 28/13; aged (43 – 84 yrs) with proven hepatic metastases of NET were performed using a 1.5T MR-scanner. The standard imaging protocol included pre-contrast T2w SSFSE, T2w TSE, T1w 2D and 3D-GRE imaging followed by contrast enhanced imaging with liver-specific contrast agents. All examinations were analyzed by 2 board certified radiologists specified in liver imaging. The signal intensity (SI) characteristics of the liver lesions in T2w and T1w imaging, lesion homogeneity, presence of central necrosis, hemorrhagic transformation and FFL were evaluated in consensus at baseline and in the treatment follow-up. MRI-morphologic changes due to treatment were correlated in patients who had a PET-CT within three months around the MRI-examination. Additionally, in an ongoing study, perfusion of the liver was measured in 8 patients, using a TWIST sequence on a 3T MR-scanner (time resolution: 1.5sec).

Results:

MR-imaging morphologic examination revealed, that metastases became markedly hyperintense in T2w along with the treatment (baseline: 34%, under treatment: 50%; $p<0.05$). Also in T1w imaging SI increased under treatment (baseline: 15%, under treatment: 24%; $p<0.05$). Lesions became increasingly inhomogeneous under treatment from 54% to 71%. Central necrosis was progressive under treatment in 14% of all cases, and rising from 37% to 60%. Hemorrhagic transformation was present in 32% and FFL in 20% of the cases, both increasing under therapy. Necrotic transformation and FFL in metastases were reflected by photopenic regions in PET images (see figure 1). Preliminary results suggest that perfusion imaging correlates with the activity of metastases (see figure 2).

Figure 1: Exemplary case of liver metastases of NET before and after therapy in the arterial phase:
A: Liver metastases of NET before chemotherapy.
B: After chemotherapy three large liver metastases show central necrosis. The large metastasis in Segment VI/VII also shows central necrosis, but high signal intensity in the rim of the metastasis.
C: Corresponding PET image after therapy; metastases with central necrosis appear photopenic, while the large metastasis in segment VI/VII shows a tracer uptake in the rim of the metastasis, while the central necrosis is photopenic.
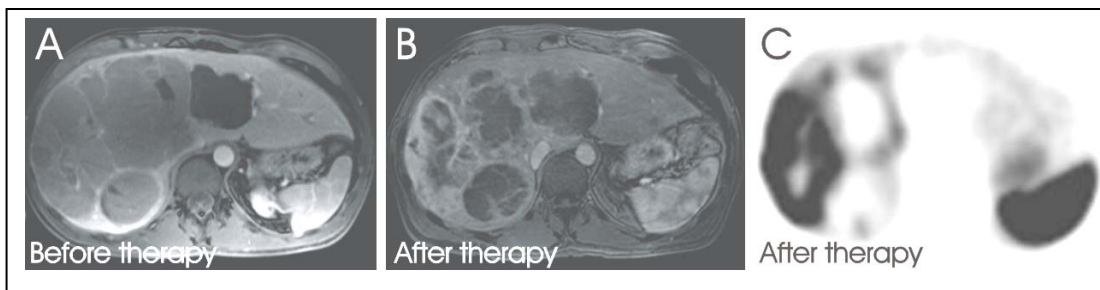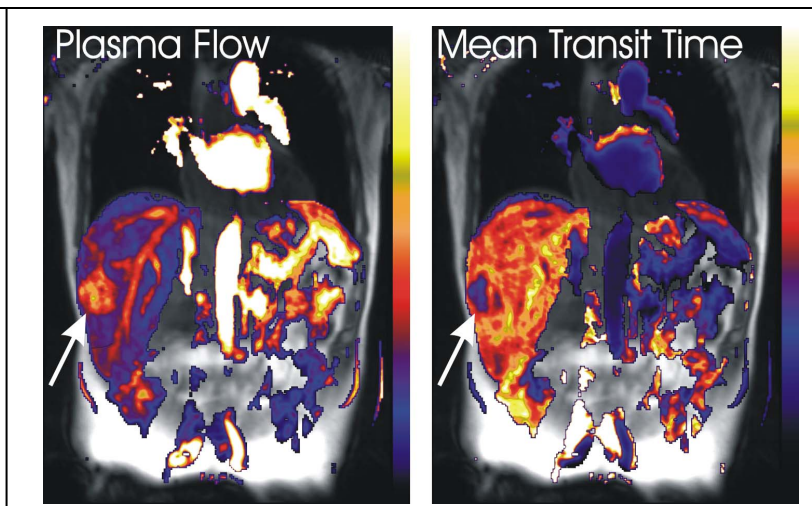

Figure 2: Perfusion images of a patient liver metastases of NET, using a TWIST sequence:
The white arrow indicates a metastasis in the right lobe, which is characterized by a higher plasma flow and a lower mean transit time than the surrounding liver tissue.

Conclusion:

Hepatic metastases from GEP-NET are characterized by high or very high SI in T2w pre-contrast imaging. The occurrence of FFL and hemorrhagic transformation may be considered as a characteristic morphologic signs of treatment effect in this entity. These morphologic changes during treatment are also reflected in PET imaging, where these lesions with morphologic changes become photopenic. Our preliminary results of perfusion imaging show, that plasma flow and mean transit time of TWIST sequence may be helpful for activity characterization of liver metastases of NET.

Reference List
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