Correlation of histological and IVIM-derived measures of vascularity in hypo- and hypervascularized pancreatic lesions

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Target audience: radiologists with an interest in oncology, oncologists, and physicists with an interest in advanced diffusion imaging

Purpose:
Non-invasive intra-voxel incoherent motion (IVIM) MRI aids diagnosing benign and malignant pancreatic lesions[1-3]. However, there is no data available on the correlation between histologically determined vascularization and IVIM parameters in pancreatic cancers. The aim of this study was to investigate the correlation between IVIM-derived parameters and histologically determined vascular density in hypo- and hypervascular solid pancreatic carcinomas.

Methods:
We included 36 patients with typically hypovascular pancreatic ductal adenocarcinoma (PACA) and 6 patients with typically hypervascular pancreatic neuroendocrine tumor (NET). Patients underwent DWI MR using the following parameters: EPI-DWI, TR/TE 2200/58ms, FOV 350 x 248mm, matrix = 130x92, 14 slices, 8 b-values (50-800 s/mm^2). IVIM-parameters were extracted from manually drawn VOIs using MITK Diffusion (www.mitk.org/DiffusionImaging). The resected tissue was evaluated histologically using microvessel density[4] (MVD). Pearson-correlation-coefficients reflecting the correlation of IVIM derived- and histological parameters were calculated.

Results:
Fig.1 shows a typical example of the IVIM and histological evaluation. The mean IVIM-derived parameters in PACA vs NETs were: 9.4 % ± 5.4 % vs 15.5 % ± 5.2 % (*f*) 1.2 ± 0.2 *10^{-3} vs. 1.03 ± 0.15 *10^{-3} mm^2/sec (D) and 41.3 ± 54.8 *10^{-3} vs. 53.8 ± 51.1 *10^{-3} mm^2/sec (D*). Fig. 2 shows a significantly lower *f* in PACA compared to NET (p<0.0001). Mean MVD was 36.8 ± 25.9/mm^2 in PACA and 80.0 ± 26.1/mm^2 in NETs. As can be taken from Fig. 3, *f* and MVD showed excellent correlation (r=0.85), D and D* did not correlate with the MVD (r=-0.18/-0.10).

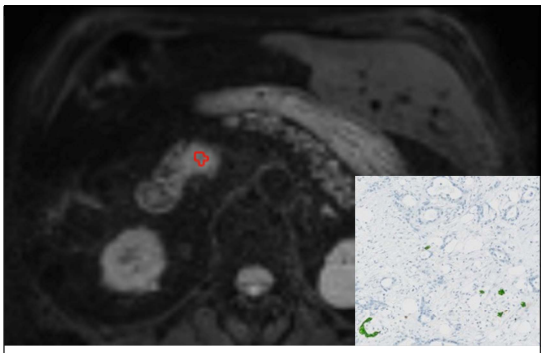

Fig.1: Diffusion-weighted image (b=200) of a hypovascular PACA in the pancreatic head. IVIM-derived f-value from the VOI: 1.4%. Inlay: corresponding histological specimen, the derived

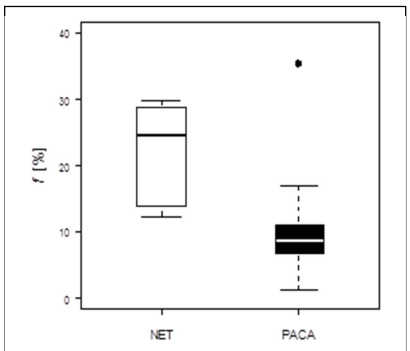

Fig. 2: Comparison of *f*-values for NETs and PACAs. Shown are median, upper and lower quartiles, whiskers and outliers.

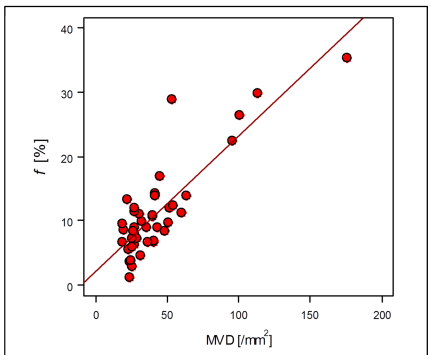

Fig. 3: Correlation of *f* and MVD. There is a clear spread in both parameters and a good correlation between them (r=0.85).

Discussion and Conclusion:
The IVIM-parameter *f* is supposed to reflect the vascular volume fraction. Additionally, angiogenesis is reflected by an increase in MVD and high MVD has been associated with poor prognosis in few reports dealing with pancreatic cancer[5-7]. In this first study investigating the histological correlation between *f* and MVD we could show a strong correlation between the IVIM-derived perfusion fraction *f* and the MVD in hypo- and hypervascular solid pancreatic tumors. Therefore, IVIM DWI imaging reflects MVD and may serve as noninvasive marker of tumor vascularity in pancreatic cancer.

Literature:
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