

Histopathological correlation of IVIM-derived true diffusion constant in patients with pancreatic carcinoma and chronic pancreatitis

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Introduction:

Fibrosis is the most characteristic histopathological feature of pancreatic carcinoma and chronic pancreatitis (1). Both diseases display an increased fibrosis compared to healthy pancreatic tissue and, during radio-chemotherapy, fibrosis increases. Previous studies showed the ability to distinguish pancreatic carcinoma and chronic pancreatitis using the diffusion-weighted imaging (DWI) derived apparent diffusion constant (ADC) (2) and more recent studies using IVIM-derived parameters indicate that differences in ADC depends on the lower perfusion fraction f in pancreatic cancer (3). The true diffusion constant D , reflecting the tissue microstructure did not show any group differences. The aim of this study was to compare differences in D with the histopathological grade of fibrosis in pancreatic diseases regardless of the underlying disease.

Material and methods:

We included 15 patients with histopathological proven pancreatic carcinoma and 9 patients with histopathological proven chronic pancreatitis. DWI-MRI was performed; (parameters: EPI-DWI, TR/TE 1300/60 ms, FOV 350 x 273 mm, resolution 3,5 x 3,5 x 5 mm, 14 slices, ($b = 25, 50, 75, 100, 200, 300, 400, 600, 800$ s/mm²) before surgery. We calculated the ADC and the IVIM-derived parameters D and f in a polygonal region of interest within the tumours and the foci of chronic pancreatitis. The resected tissue was retrospectively evaluated by a histopathologist with regard to the grade of fibrosis (0=absent, 1=dense tumor glands or single cells, back on back with scanty fibres/ periductal and interlobular fibrosis, 2(moderate)= tumor glands or single cells more disperse, separated by moderate fibres no back on back/ periductal, inter und intralobular fibrosis, 3(severe)=diffuse fibrosis, tumor glands and single cell drifted apart/diffuse fibrosis). Since grade 0 and 1 did not occur, the differences ADC-, D - and f -values between grade 2 and 3 were compared using a two-tailed t-test.

Results:

14 patients were found to have a moderate fibrosis (grade 2) (8 patients with pancreatic carcinoma and 6 patients with chronic pancreatitis), 10 patients had a severe fibrosis (grade 3) (7 patients with pancreatic carcinoma and 3 patients with chronic pancreatitis). The statistical analysis showed a significant difference between the D -values for moderate and severe fibrosis ($p = 0.027$) with mean D -value of $1.02 \cdot 10^{-3} \pm 0.48 \cdot 10^{-3}$ s²/mm for moderate fibrosis and mean D of $1.22 \cdot 10^{-3} \pm 0.76 \cdot 10^{-3}$ mm²/sec in the group with severe fibrosis (see fig. 1). There were no significant differences for the f - and ADC-values between moderate and severe fibrosis ($10.3\% \pm 1.5\%$ vs. $11.4\% \pm 2.1\%$ ($p = 0.68$); $1.19 \cdot 10^{-3} \pm 0.45 \cdot 10^{-3}$ s²/mm vs. $1.25 \cdot 10^{-3} \pm 0.47 \cdot 10^{-3}$ s²/mm ($p = 0.36$) respectively).

Discussion and Conclusion:

In contrast to a previous study with 10 patients with pancreatic cancer (3 with loose fibrosis and 7 with dense fibrosis) that reported a difference between the two groups(1), this finding could not be replicated. We did find significant differences for the IVIM-derived true diffusion constant D between moderate and severe fibrosis. A potential explanation is that the ADC is strongly biased by perfusion effects. Since fibrosis seems to increase in pancreatic carcinomas during radio-chemotherapy the ability to assess the grade of fibrosis could be a helpful parameter to evaluate the tumor response. Therefore D could serve as a parameter to monitor tumor response in pancreatic carcinoma.

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2. Lee SS, Byun JH, Park BJ, et al. Quantitative analysis of diffusion-weighted magnetic resonance imaging of the pancreas: Usefulness in characterizing solid pancreatic masses. J Magn Reson Imaging 2008; 28:928-936.
3. Lemke A, Laun FB, Klauß M, et al. Differentiation of pancreas carcinoma from healthy pancreatic tissue using multiple b-values: comparison of apparent diffusion coefficient and intravoxel incoherent motion derived parameters. Invest Radiol 2009; 44:769-775.

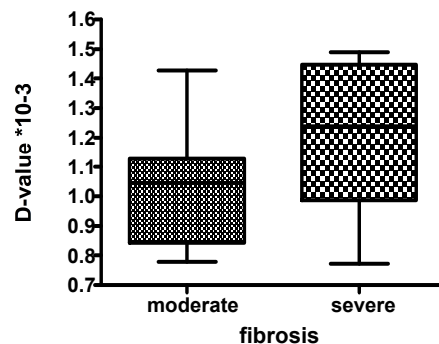


Figure 1: Significantly increase in D from moderate to severe fibrosis. The solid line indicates the median, the box indicates the 25- and 75-percentile and the outer limit indicates the outlier