Evaluation of MR diffusion-weighted imaging as a modality to study pancreatic carcinoma.

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Introduction

To date, response of inoperable pancreatic cancer to non-surgical treatment is assessed by measuring tumor volume, which changes only after some delay. The mean apparent diffusion coefficient (ADC) in brain tumors correlates with the tumor cellularity and could be a suitable surrogate marker to assess treatment response in pancreatic tumors earlier (1). Therefore, we sought to establish a diffusion-weighted imaging (DWI) technique for the reliable evaluation of the ADC in pancreatic tumors.

Materials and Methods

Seven patients (median age 62 years) with locally advanced pancreatic carcinoma were examined at 1.5 T (Avanto, Siemens, Erlangen, Germany). A single-shot echo planar imaging (EPI) sequence was used for DWI during free breathing applying a 1D-PACE gating technique with the following parameters: five b-values ranging from 0 – 800 mm²/sec, measured in x, y and z direction. TR=680 msec, TE=75 msec, α=90°, slice thickness=5 mm, NEX=3, matrix=104x192, FOV=244x450 mm. The precontrast scan included an axial T2 haste sequence in expiratory breath hold technique: TR=750 msec, TE=30 msec, α=180°, slice thickness=6 mm, NEX=1, matrix=192x256, FOV=275x400 mm.
The signal-to-noise-ratios (SNR) of tumor and of peritumor pancreas as well as the contrast-to-noise ratio (CNR) were measured. Thereby, the tumor and the adjacent pancreatic tissue were separated into four squares and Regions of Interest (ROIs) were drawn manually into each area using the scanner software (Syngo, Siemens, Erlangen, Germany). The ROI size varied from 27.5 to 81.4 mm^2. In order to obtain the ADC values of tumor and pancreas, ROIs were drawn manually covering the whole tumor in each slice and averaged. Additionally, the demarcation between tumor and pancreatic tissue in the diffusion-weighted (DW) images was compared to the T2-weighted (T2W) images. This was scored by two radiologists on a four-point rating scale.

Results

Three carcinomas were located in the pancreatic body and four in the head. On average, the maximal diameter on axial images was about 40 mm. In all cases tumor and adjacent pancreas were better delineated on T2W images than in the DW images (Table 1, Fig. 1 a and b). In both T2W and DW images, the tumors showed mixed hypo-, iso- and hyperintensity. In the DWI, the mean signal intensity of tumor was 165.99 ± 24.29 and of peritumor 175.92 ± 51.14. In the DW images the mean SNR in tumor was 5.90 ± 0.5 and in peritumor 6.14 ± 0.79. The mean CNR was 0.66 ± 0.57. In the tumor the average ADC value was 0.44 ± 0.15 x 10^{-3} mm²/sec, in the peritumor pancreas, 0.73 ± 0.32 x 10^{-3} mm²/sec, whereas the ADC values in peritumor showed a larger statistical spread (Fig.2).

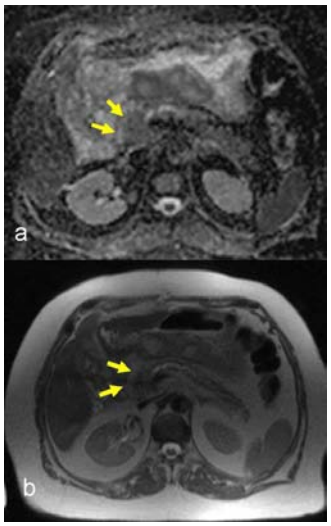

Fig. 1
Carcinoma of pancreas of head in **a** ADC map and **b** T2W.

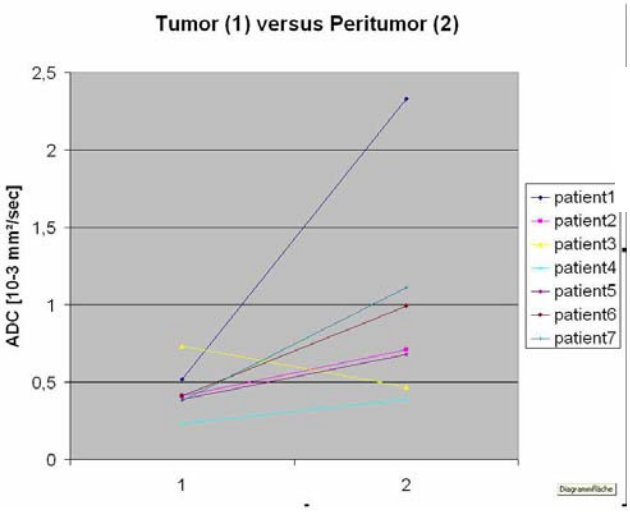

Fig. 2
The ADC values in tumor versus peritumor.

Table 1
Demarcation between tumor and pancreatic tissue in DW versus T2W images. Rating scale: ++ = very good, + = good, 0 = bad, - = no demarcation.

Tumor		Peritumor	
T2	ADC	T2	ADC
+	0	+	0
+	0	+	0
+	0	++	0
+	0	++	0
++	0	+	+
+	-	+	0
++	-	++	0

Discussion

Although tumor size was generally considerable, ADC-based delineation proved to be challenging, particularly, since the signal intensities of tumor and peritumoral tissue are similar. Both the subjective scores and the quantitative comparison of ADC values in tumor and pancreas indicate that using this technique will not improve the discrimination between tumor and pancreas. Nevertheless, the ADCs in malignant tumors have a relatively small variance and hold great promise as surrogate markers for assessing changes in the tissue's cellularity, as may occur as a response to treatment.

References

(1) Chenevert, TL et al. Diffusion magnetic resonance imaging: an early surrogate marker of therapeutic efficacy in brain tumors. J Natl Cancer Inst. 2000 Dec 20; 92(24):2029-36.