Intravoxel Incoherent Motion MRI of the pancreatic adenocarcinomas: Characterization and Histopathological Correlations

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TARGET AUDIENCE: Researchers in the field of pancreatic MRI.

INTRODUCTION:

Recently, the role of ADC values in predicting adverse pathological features of pancreatic cancer has been reported.[1,2] However, both a significant association[1] and lack of association[2] between the ADC value and pathological grade of pancreatic cancer have been reported. These reports, however, used only two b values (0 and 500 s/mm^2) to measure ADC values. Ideally, multiple b values should be set up for exact measurement of ADC values. Thus, the purpose of the study was to identify prospectively potential associations between the DWI-derived IVIM parameters such as f (perfusion fraction), ADC_{fast} (pseudo-diffusion coefficient), ADC_{slow} (the tissue diffusivity) and these parameters with the commonly used DWI-derived ADCs of pancreatic adenocarcinoma and the tumor grade as well as other pathological features.

MATERIALS AND METHODS:

Fifty-one patients were included, 37 proved to have adenocarcinomas with moderate differentiation and 14 had adenocarcinomas with poor differentiation. The patients were studied using IVIM DWI with 9 b-values (0, 20, 50, 100, 200, 400, 600, 800 and 1000 s/mm^2). A respiratory-trigger was employed. The ADC was calculated for all b-values using linear regression yielding ADC_{total}. The ADC_b value of the monoexponential DWI, slow component of diffusion (ADC_{slow}), incoherent microcirculation (ADC_{fast}) and perfusion fraction (f) of the biexponential DWI were calculated for all of the lesions. These parameters were compared with histopathological findings including tumor grade of differentiation, T-stage, N-stage and tumor locations using Mann-Whitney U tests.

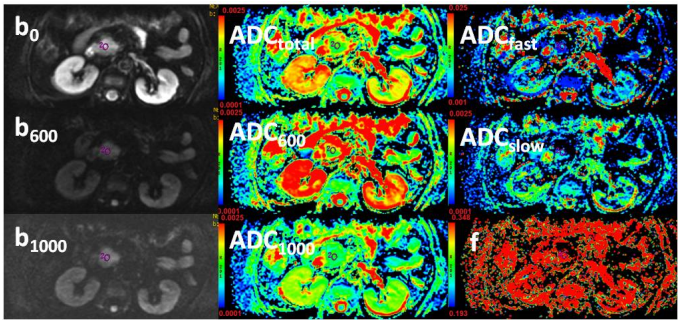

Fig 1. Various parameter maps of a case with pancreatic cancer on the head of pancreas. *f=0.572*

Table 1. Comparison of various quantitative parameters (×10^{-3} mm^2/s) obtained from multi-b-value DWI of pancreatic adenocarcinoma and various pathological features.

	Tumor grade			*Tumor location*			*Tumor stage*			metastatic perie-pancreatic lymph nodes		
	well/moderately differentiated	poorly differentiated	*P*	Head	Elsewhere in pancreas	*P*	T1/T2	T3/T4	*P*	Present	Absent	*P*
ADC_{20}	4.15±2.24	3.92±2.13	*0.849*	4.05±2.12	4.13±2.35	*0.901*	4.24±2.78	4.06±2.04	*0.846*	3.97±2.37	4.17±2.09	*0.419*
ADC_{50}	2.62±1.69	2.62±1.23	*0.665*	2.44±1.36	2.87±1.83	*0.358*	3.04±1.33	2.50±1.65	*0.098*	2.64±1.79	2.60±1.40	*0.897*
ADC_{100}	2.03±1.01	1.77±0.65	*0.499*	1.89±0.71	2.06±1.18	*0.954*	2.19±0.81	1.88±0.96	*0.107*	1.95±0.96	1.97±0.92	*0.775*
ADC_{200}	1.89±0.74	1.77±0.29	*0.460*	1.86±0.51	1.85±0.82	*0.599*	2.10±0.44	1.79±0.70	*0.060*	1.93±0.79	1.81±0.53	*0.827*
ADC_{400}	1.73±0.49	1.68±0.19	*0.768*	1.69±0.35	1.76±0.52	*0.811*	1.80±0.27	1.70±0.46	*0.496*	1.74±0.43	1.70±0.43	*0.732*
ADC_{600}	1.63±0.49	1.57±0.23	*0.941*	1.53±0.28	1.73±0.57	*0.320*	1.73±0.29	1.59±0.46	*0.226*	1.65±0.51	1.58±0.36	*0.662*
ADC_{800}	1.51±0.36	1.44±0.19	*0.486*	1.43±0.26	1.57±0.40	*0.235*	1.60±0.27	1.46±0.34	*0.256*	1.51±0.29	1.47±0.35	*0.917*
ADC_{1000}	1.22±0.31	1.14±0.17	*0.506*	1.16±0.23	1.25±0.32	*0.203*	1.21±0.17	1.20±0.30	*0.880*	1.18±0.29	1.21±0.27	*0.337*
ADC_{total}	1.38±0.29	1.35±0.16	*0.720*	1.34±0.22	1.43±0.31	*0.450*	1.47±0.20	1.36±0.27	*0.399*	1.37±0.19	1.38±0.30	*0.387*
ADC_{fast}	6.98±6.28	4.81±2.38	*0.326*	6.87±6.49	5.70±3.88	*0.612*	8.89±9.15	5.58±3.74	*0.154*	5.63±3.6	6.96±6.67	*0.634*
ADC_{slow}	0.86±0.32	0.81±0.33	*0.658*	0.80±0.31	0.91±0.33	*0.343*	0.86±0.37	0.84±0.31	*0.689*	0.80±0.36	0.88±0.29	*0.313*
f (%)	0.42±0.15	0.42±0.14	*0.941*	0.41±0.16	0.43±0.13	*0.653*	0.43±0.17	0.42±0.14	*0.854*	0.43±0.16	0.41±0.14	*0.562*

RESULTS:

The mean ADC in pancreatic adenocarcinomas with moderate differentiation was similar to those with poor differentiation at b-20, 50, 100, 200, 400, 600, 800 and 1000 s/mm^2 (P=0.326-0.941). There was no significant difference between groups for ADC_{total} (1.38±0.29 vs. 1.35±0.16 ×10^{-3} mm^2/s), ADC_{fast} (6.98±6.28 vs. 4.81±2.38 ×10^{-3} mm^2/s), ADC_{slow} (0.86±0.32 vs. 0.81±0.33 ×10^{-3} mm^2/s) and f (0.42±0.15 vs. 0.42±0.14). All of the multi-b-value DWI derived parameters were higher in tumors with stage T1/T2 versus stage T3/T4, and was no significantly different for the two groups (p = 0.060-0.880). In addition, all of the quantitative parameters were not significantly different between tumors located in the pancreatic head versus other pancreatic regions (p = 0.203-0.954) or between tumours with and without metastatic peri-pancreatic lymph nodes (p = 0.313-0.917) (Table 1, Fig. 1).

CONCLUSIONS:

In conclusion, it was found, in this focused DWI study, no associations between various quantitative parameters obtained from IVIM DWI of pancreatic adenocarcinoma and tumor grade. This finding suggests that the clinical use of ADC values to attempt to predict the prognosis of newly diagnosed pancreatic adenocarcinoma is not advisable.

REFERENCES:

1.Wang Y, Chen ZE, et al. J Magn Reson Imaging 33:136-142. 2. Rosenkrantz AB, Matza BW, et al. Clin Radiol 68:e191-197.