

Diffusion-weighted Imaging Using SS EPI of Abdominal Organs at 3T: Comparison with 1.5T

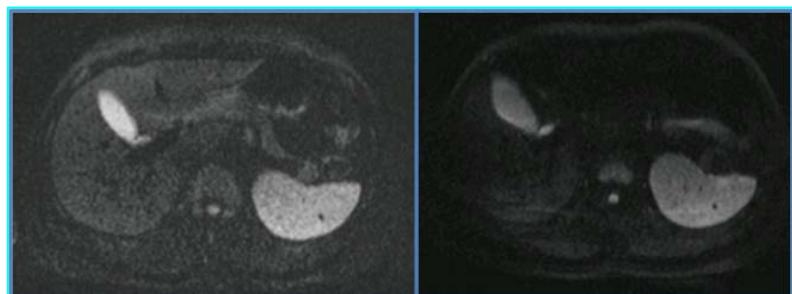
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Introduction: There is data to indicate that there is substantial variability in ADC values of the brain between 1.5T and 3T^{1,2}. To our knowledge, there is no currently published data comparing 1.5 to 3T SS EPI in the abdomen, particularly in terms of ADC reproducibility and image quality. In this study, we performed DWI of healthy volunteers at both 1.5T and 3T using low and high b-values to assess reproducibility of ADC values between the two field strengths.

Methods: In our preliminary analysis, we assessed 3 healthy volunteers with DWI of the abdomen using Siemens systems (Avanto 1.5T and Trio 3T). On each system, axial breath-hold SS EPI DWI sequences were performed with the same parameters on both systems: TR/TE 1900/76, GRAPPA 2, voxel size 0.9 x 0.9 x 7 mm. The sequence was obtained using b-values of 0-300-400 and 0-700-800 sec/mm² during separate acquisitions. A single observer measured ADC of the right posterior hepatic lobe, renal cortex, spleen, and pancreatic body by obtaining the average of 3 circular 100-pixel ROIs placed in homogeneous areas free of artifact. A separate observer rated image quality on the low-b and high-b value images on a 1-3 scale (3=highest image quality) for liver edge conspicuity, ghosting/distortion, overall image quality, and homogeneity of the corresponding ADC map (max. score 12). Mean ADC of each organ as well as image quality scores were compared between 1.5T and 3T. Coefficients of variation (CV) between field strengths for ADC of each organ were calculated.

Results: The liver demonstrated a trend toward lower ADC at 3T compared with 1.5T for both the low and high b-values that was not statistically significant (p=0.4-0.49). ADC values for kidney, pancreas, and spleen were similar (p=0.31-0.91). CV of ADC between 1.5T and 3T was moderate for all organs. Image quality scores were significantly higher at 1.5T than at 3T for both low and high b-value packages (p-values < 0.02). The lower ADC obtained at higher b value, observed in this study at both 1.5T and 3T (p-values < 0.01), has been previously documented^{3,4}.



Representative diffusion images from same volunteer at 1.5T (left) and 3T (right) using SS EPI with b=700.

Note increased ghosting and poorer conspicuity of liver edge on 3T image

		Liver	Kidney	Pancreas	Spleen	Image Quality (max 12)
Low b	1.5T	1.76	2.41	1.93	0.95	10.70
	3T	1.34	2.39	1.83	1.05	8.00
	CV	29%	33%	31%	33%	
High b	1.5T	1.20	2.09	1.39	0.91	10.70
	3T	1.03	2.07	1.45	0.86	7.30
	CV	34%	39%	37%	39%	

Mean ADC of abdominal organs with CV and image quality scores at 1.5T and 3T

Discussion: Our findings show moderate CV of ADC measurements of abdominal organs between 1.5T and 3T, although the differences were not statistically significant. An alteration in ADC at higher field strength has been observed in other studies, although the etiology is not entirely understood, possibly reflecting a combination of factors that are both physical (i.e., lower tissue T2 at 3T) and technical (i.e., increased field inhomogeneity and differences in gradient and receiver coil design) in nature^{1,2}. Variability of abdominal organ ADC between field strengths, if confirmed in additional patients, will

impact the application of quantitative ADC measurements in the characterization of focal lesions and diffuse processes, as well as in the evaluation of treatment response. We did note significantly higher subjective image quality of DWI at 1.5T than at 3T. Specifically, DWI at 3T showed increased degradation from distortion/ghosting artifact, which may reflect a combination of increased eddy currents and lower tissue T2 at higher field strength. Given our observed lower image quality at 3T and moderate reproducibility of ADC compared with 1.5T, we suggest that initial evaluation and continued follow-up of abdominal organs using SS EPI DWI may preferentially be performed at 1.5T, until these differences are better understood, and more optimized sequences are developed for high field.

References:

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3. Girometti, et al. JMRI 2008;28:411-9
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