Reproducibility of ADC Measurements of Abdominal Organs at 1.5T and 3T

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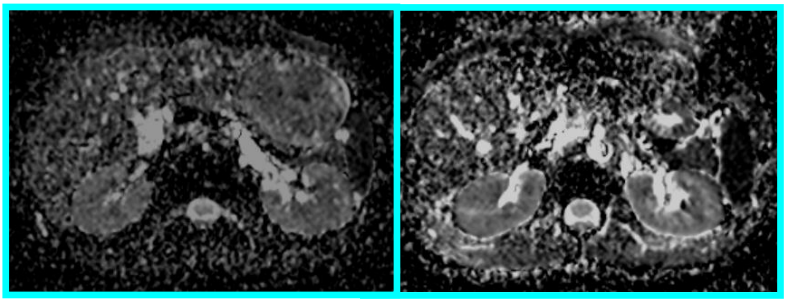
Introduction:

Diffusion-weighted imaging (DWI) with quantitative apparent diffusion coefficient (ADC) measurement is an increasingly applied technique for detection, characterization, and follow-up of liver and abdominal pathology[1,2]. Reproducibility of ADC measurements should be determined before assigning clinical significance to specific ADC values and for design of drug trials. DWI is often obtained with SS EPI sequence that is prone to eddy current artifacts with subsequent ghosting and image distortion that may lead to alterations in ADC measurements, worse at high field. In this prospective study, we assessed the reproducibility of ADC measurements of abdominal organs in healthy volunteers at 1.5T and 3T.

Methods:

3 healthy volunteers underwent DWI of the abdomen on Siemens Avanto 1.5T and Siemens Trio 3T systems. Each subject received two separate scans on each system (total of four scans per volunteer) under the same physiologic conditions. Each scan included a series of axial breath-hold SS EPI DWI sequences with various b-values; all performed using the same parameters: TR/TE 1900/76, GRAPPA 2, voxel size 0.9 x 0.9 x 7 mm. An acquisition from each scan obtained using b-values of 0, 300, and 400 sec/mm^2 was selected for analysis for this study. A single observer measured ADC values on all four scans for each subject by obtaining the average of 3 circular 100-pixel ROIs on the right posterior hepatic lobe, right and left renal cortex, spleen, and pancreatic body. Coefficient of variation (CV) between scans of ADC measurements for each organ was calculated at 1.5T and 3T, and was also compared between the initial scans obtained at 1.5T and 3T.

CV (%) of ADC Measurements Obtained from Repeat DWI			
	1.5T	**3T**	**p**
Liver	21.75	18.31	0.70
Kidney	7.42	4.17	0.43
Pancreas	3.71	6.49	0.71
Spleen	12.66	9.91	0.81



Representative ADC maps from the same volunteer obtained at 1.5T (left) and 3T (right) using DWI with b-values of 0-300-400. Note heterogeneity of liver parenchyma in both images.

Results:

We achieved good to excellent reproducibility of ADC measurement of the kidney, pancreas, and spleen when DWI was repeated at both 1.5T and 3T. However, reproducibility of ADC measurement for the liver was moderate at both field strengths. CV was overall similar for each organ between the two field strengths.

Discussion:

We did not observe a significant difference in CV of ADC measurements in abdominal organs between 1.5T and 3T, suggesting similar reliability of ADC measurements during repeat examinations at both field strengths. While there was overall excellent CV of ADC values in the abdomen, the liver demonstrated a more moderate variability in ADC. This finding has been described in prior studies[3,4] and may represent transient changes in portal venous flow that alter the contribution of hepatic sinusoidal perfusion to ADC measurements as well as a shorter liver T2 that increases noise contamination in the ADC measurement. While our preliminary data supports the emerging use of serial quantitative ADC measurements during follow-up MRI of the abdomen, some caution may be warranted when the liver is evaluated in this manner.

References:
1. Low RN, et al. JMRI 2007;25:848-858.
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3. Kwee TC, et al. JMRI 2008;28:1141-1148.
4. Hollingsworth KG, et al. NMR Biomed 2006;19:231-235.