Impact of Low and High b-value MR Diffusion in HIV/HCV-Coinfected, HIV-Monoinfected and Uninfected Subjects

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Introduction

Conventionally, ADC in the liver is measured from one moderate b-value and b=0 (ADC^{conv}). Such a measure is likely a combination of a perfusion regime, low b-value ADC (ADC^{low}), and a tissue regime, high b-value ADC (ADC^{high}). The impact of these components may vary with disease. The purpose of this study was to compare and correlate ADC^{low}, ADC^{high}, and ADC^{conv} in subjects with: 1) HIV/hepatitis C virus (HCV) coinfection, 2) HIV monoinfection, and 3) neither infection.

Methods

Six HIV/HCV-coinfected subjects, 5 HIV-monoinfected subjects and 7 uninfected subjects were scanned on a GE 1.5T scanner with a singleshot EPI diffusion sequence with a modified lookup table of gradient directions to allow multiple b-value measurements in one acquisition. Images were acquired for b=0, 150, and 600 and 3 diffusion directions (TR/effective TE=1800/98 ms, FOV= 400mm, matrix=128×128, 2 NEX, 10mm slices, 9 slices) within one breathhold using an 8-channel body array. ADC^{low} was calculated from the b=0 & 150 images, ADC^{high} from the b=150 & 600, and ADC^{conv} from the b=0 & 600. Circular ROIs 1.5cm in diameter were placed in the right anterior and right posterior of the liver on 5 consecutive axial slices and means of the 10 ROIs calculated. Motion corrected, single voxel spectroscopy [1] was also obtained to confirm that significant steatosis (>5% lipids/water) effects did not confound the results of this study. T-tests were used to determine differences between groups and the different ADC techniques were linearly correlated.

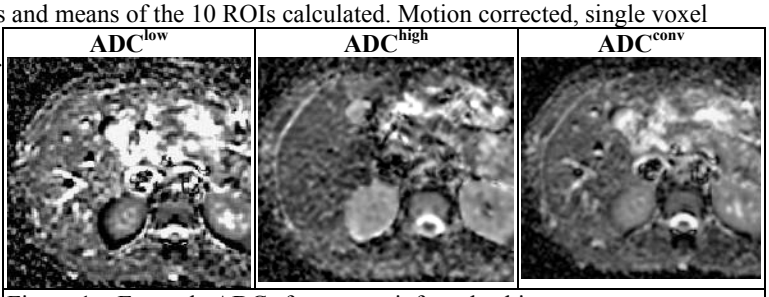

Figure 1 – Example ADCs from an uninfected subject.

Results

The 3 ADCs are shown in Fig 1 for an uninfected subject. Note the vessels are prominent in the ADC^{low}, essentially absent from the ADC^{high}, and apparent in ADC^{conv}. HIV/HCV subjects generally had lower values than HIV and uninfected subjects for all ADC measures. HIV-monoinfected subjects tended to have the highest ADCs (Figs 2 & 4, Table1), with a significant difference versus HIV/HCV coinfected subjects for ADC^{low} and ADC^{conv} ($p<0.05$, t-test without correction for multiple comparisons). One subject/group had significant liver MRS lipids/water (31±3%). These subjects had ADCs within the range of their respective group. ADC^{low} increased more rapidly than ADC^{high} as compared to ADC^{conv} (Fig 3). ADC^{low} & ADC^{high} did not correlate, implying they provide unique information.

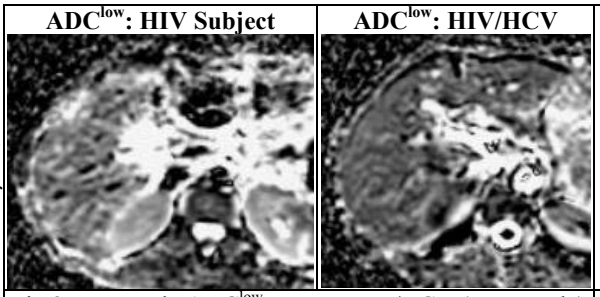

Fig 2 – Example ADC^{low}: HIV > HIV/HCV (same scale)

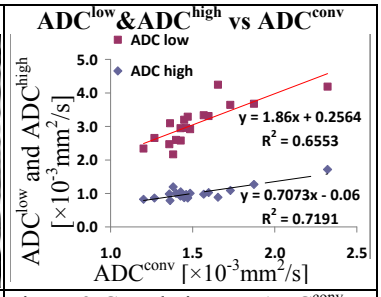

Figure 3-Correlations to ADC^{conv}.

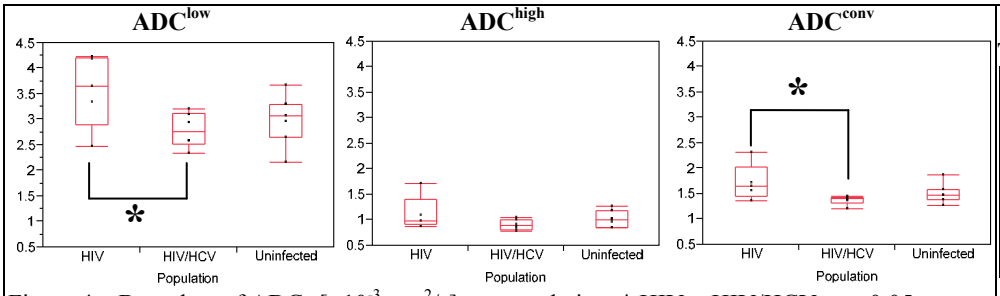

Figure 4 – Box plots of ADCs [$\times 10^{-3}$ mm^2/s] vs. population. * HIV > HIV/HCV, $p < 0.05$.

Table 1: ADCs by group [$\times 10^{-3} mm^2/s$]

	ADC^{low}	ADC^{high}	ADC^{conv}
HIV[n=5]	3.58± 0.72	1.13±0.33	1.73± 0.36
HIV/HCV [n=6]	2.79± 0.34*	0.91±0.10	1.38± 0.09*
Uninfected [n=7]	3.00± 0.49	1.03±0.16	1.50± 0.19

* $p<0.05$ vs. HIV, t-test

Discussion

The study demonstrated that separating the ADC^{low} and ADC^{high} components of ADC^{conv} may provide additional information for discrimination of liver disease. As expected, HIV/HCV subjects tended to have the lowest ADC values of all groups; these subjects frequently present with fibrosis, which has been associated with lower ADC values [2,3], and lower perfusion [4]. ADCs in HIV tended to be higher. The higher ADC^{low} in HIV monoinfection than HIV/HCV coinfection, and the possibly higher levels than those with neither infection, may reflect an inflammatory mediated increase in perfusion or development of abnormal vascularity and needs further investigation. HIV status may have important implications on the MR ADC assessment of fibrosis in those with and without HCV. Additionally, the decreased impact of vessels in the ADC^{high} images is promising for increasing the robustness of measurement in these images. Multiple b-value diffusion of the liver is feasible in a breathhold and promising for aiding discrimination of disease.

References [1] Noworolski. MRI. 2009. [2]Giormetti. JMRI. 2008. [3] Lewin. Hepatology. 2007. [4] Annet. Radiology. 2003.

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