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 (ADCconv). Such a measure is likely a combination of a perfusion regime, low b-value ADC (ADChigh), and a tissue regime, high b-value ADC (ADClow). The impact of these components may vary with disease. The purpose of this study was to compare and correlate ADClow, ADChigh, and ADCconv 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. ADClow was calculated from the b=0 & 150 images, ADChigh from the b=150 & 600, and ADCconv 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.

Results
The 3 ADCs are shown in Fig 1 for an uninfected subject. Note the vessels are prominent in the ADClow, essentially absent from the ADChigh, and apparent in ADCconv. 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 ADClow and ADCconv (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. ADClow increased more rapidly than ADChigh as compared to ADCconv (Fig 3). ADClow & ADChigh did not correlate, implying they provide unique information.

Discussion
The study demonstrated that separating the ADClow and ADChigh components of ADCconv 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 ADClow 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 ADChigh 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

Acknowledgments
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Table 1: ADCs by group [×10-3 mm2/s]

<table>
<thead>
<tr>
<th>Group</th>
<th>ADClow</th>
<th>ADChigh</th>
<th>ADCconv</th>
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<tr>
<td>HIV [n=5]</td>
<td>3.58±0.72</td>
<td>1.13±0.33</td>
<td>1.73±0.36</td>
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<tr>
<td>HIV/HCV [n=6]</td>
<td>2.79±0.34*</td>
<td>0.91±0.10</td>
<td>1.38±0.09*</td>
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<tr>
<td>Uninfected [n=7]</td>
<td>3.00±0.49</td>
<td>1.03±0.16</td>
<td>1.50±0.19*</td>
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*p<0.05 vs. HIV, t-test

Figure 1 – Example ADCs from an uninfected subject.

Figure 2 – Example ADClow: HIV > HIV/HCV (same scale)

Figure 3 – Correlations to ADCconv.

Figure 4 – Box plots of ADCs [×10-3 mm2/s] vs. population. * HIV > HIV/HCV, p < 0.05.