INTRAVOXEL INCOHERENT MOTION DIFFUSION-WEIGHTED IMAGING AND TEXTURE HETEROGENEITY FOR STAGING OF HEPATIC FIBROSIS IN CHILDREN

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Purpose: To assess the performance of intravoxel incoherent motion (IVIM) diffusion-weighted imaging (DWI) and corresponding texture heterogeneity in liver fibrotic staging in children.

Methods: Sixty-five children with pathologically confirmed hepatic fibrosis were enrolled in this study. Hepatic fibrosis was staged according to the METAVIR scoring system (F0-F4). MRI was performed on a 3.0T MRI system (SIGNA HDxt; GE Healthcare, Milwaukee, WI, USA). IVIM-DWI was acquired by spin echo-echo planar imaging with DW gradients in three orthogonal directions. Eleven b-values were adopted:0, 10, 20, 30, 50, 80, 100, 200, 400, 800, 1000 s/mm^2. Three diffusivity values maps (ADC_{fast}, ADC_{slow} and f) were generated thereafter. These three indices and their coefficient of variations (CVs, =Standard deviation/Mean×100%) were measured by positioning 4 separate circular regions of interest (ROIs) with fixed-size on the parameteric maps. Measurements from four ROIs were averaged as the final results. Nonparametric tests (Kruskal-Wallis H test and Spearman rank correlation) and receiver operating characteristic curve (ROC) analysis were performed. A *P* value<0.05 was considered to indicate statistical significance.

Results: Spearman`s rank correlation demonstrated ADC_{fast} was inversely correlated with fibrosis stage (r=-0.77, P<0.001). CV of ADC_{fast} (**Fig.1**) and CV of ADC_{slow} were positively correlated with fibrosis stage (r=0.81, r=0.70, respectively; both P<0.001). The areas under the ROC of ADC_{fast}, CV of ADC_{fast} and CV of ADC_{slow} in discriminating between (F0+F1+F2) and (F3+F4) were 0.768, 0.897 and 0.724 respectively (**Fig.2**).

Discussion: IVIM DWI could extract perfusion-related diffusivity and pure molecular diffusivity simultaneously, the former was reported to be negatively correlated with the staging of hepatic fibrosis [1]. We confirmed such finding in the present study, and furthermore, demonstrated good correlation between the staging of hepatic fibrosis and heterogeneity of both perfusion-related and pure molecular diffusivity. Statistically the CV reflects the variance among individuals within a sample, in this context it mirrors the heterogeneity of diffusivity among the pixels within the ROI positioned in the liver parenchyma. The uneven distribution of fibrotic tissues may contribute to such heterogeneity. The positive correlation between fibrotic staging and the heterogeneity of ADC_{fast} and ADC_{slow} suggest that the uneven distribution of fibrotic tissue aggravated with the progress of hepatic fibrosis. Of the ADC_{fast}, the CV of ADC_{fast} and CV of ADC_{slow}, the CV of ADC_{fast} demonstrated the largest area under the ROC suggesting the best diagnostic efficiency in discrimination of (F0+F1+F2) and (F3+F4).

Conclusions: ADC_{fast}, the heterogeneity of ADC_{fast} and ADC_{slow} correlate well with fibrosis stage of the liver in children, among which the heterogeneity (CV) of ADC_{fast} is of highest diagnostic efficiency for staging.

References 1.Tang A, Tan J, Sun M, et al. Radiology.2013; 267(2):422-431.

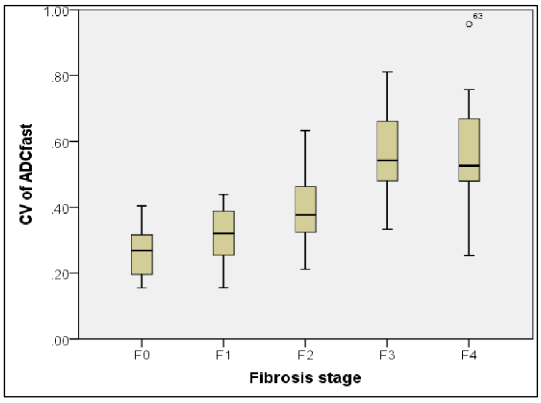

Figure 1 There was a strong correlation between CV of ADC_{fast} and fibrosis stage (r=0.81, P < 0.001).

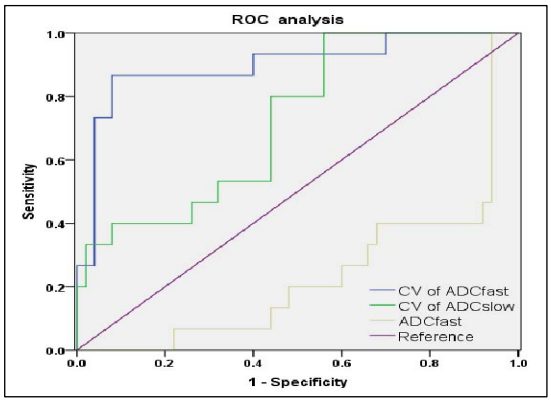

Figure 2 Graph shows results of ROC analysis using ADC_{fast}, CV of ADC_{fast} and ADC_{slow} for differentiation of METAVIR groups F0-1-2 versus F3-4.