Intravoxel incoherent motion imaging of the liver: Which affects more on apparent diffusion coefficient changes of cirrhosis and liver lesions, D or D*?

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Purpose: To compare the diffusivity parameters between normal liver and cirrhotic liver and between malignant and benign focal liver lesions using intravoxel incoherent motion (IVIM) model.

Materials and Methods: This study included 84 patients who had focal liver lesions in the liver. 15 patients had normal liver and 9 patients had cirrhosis. The final diagnoses of the focal liver lesions were as follows: hepatocellular carcinoma (n = 45), cholangiocarcinoma (n = 6), metastatic liver tumor (n = 3), cyst (n = 18), hemangioma (n = 4), focal nodular hyperplasia (n = 1), abscess (n = 1), other benign lesions (n = 6).

IVIM diffusion-weighted imaging was performed using 12 b values: 0, 10, 20, 30, 40, 50, 80, 100, 200, 400, 800, and 1000 s/mm^2. To calculate IVIM parameters, 3 each regions of interest (ROIs) were placed in the liver parenchyma and in the focal liver lesion. D* ($\times 10^{-3}$ mm^2/s), D ($\times 10^{-3}$ mm^2/s), and perfusion fraction (f; %) were calculated. Diffusivity parameters of normal liver and cirrhotic liver were compared using the Wilcoxon test. Those of malignant and benign focal liver lesions also were compared. Diagnostic performance for distinguishing cirrhosis from normal liver and malignant from benign hepatic lesions, were also analyzed.

Results: The D* of the cirrhotic liver; 80.4 [51.5–109.3] (mean [95% confidence interval]) was significantly less than that of the normal liver; 100.3 [91.0–109.7] ($p = 0.0157$), while there was no significant difference of the D between the cirrhotic liver; 1.01 [0.89–1.12] and the normal liver; 1.10, [0.97–1.23] ($p = 0.3873$).

The D* and the D of the malignant lesions (D*; 62.7 [59.2–66.2] and D; 1.15, [1.09–1.20]) were significantly less than those of benign lesions (87.6 [74.4–100.7] and 2.46 [2.30–2.60]; $p = 0.0008$ and < 0.0001). Area under ROC curves for predicting malignant lesions were 0.72 [0.57–0.83] in D* and 0.98 [0.93–1.00] in D.

Conclusion: The D* (microcirculation or perfusion) played a more important role than the D (pure molecular diffusion) in differentiating cirrhotic from normal livers. The D* was suppressed in the malignant lesions, as well as that of the D. The D was more reliable parameter for distinguishing between malignant and benign focal liver lesions.