

Assessment of nonalcoholic fatty liver disease using intravoxel incoherent motion (IVIM) diffusion-weighted MRI: an experimental study in a rabbit model fed with high-fat, high-cholesterol diet

Ijin Joo, Jeong Min Lee, Joon Koo Han, Byung Ihn Choi

Seoul National University Hospital, Korea.

jmlshy2000@gmail.com

PURPOSE: To evaluate the feasibility of intravoxel incoherent motion (IVIM) diffusion-weighted MRI parameters for the diagnosis of nonalcoholic fatty liver disease (NAFLD) and to determine optimal cutoff values of IVIM parameters for severity assessment of NAFLD using a rabbit model.

MATERIALS AND METHODS: Twenty-seven male New Zealand White rabbits of 8-week-old were used. After a different feeding schedule -a standard diet for 4 weeks ($n = 6$: control), a standard diet for 3 weeks followed by high-fat, high-cholesterol (HFHC) diet for 1 week ($n = 6$), a HFHC diet for 4 weeks ($n = 6$), and a HFHC diet for 7 weeks ($n = 9$), IVIM diffusion-weighted MRI were performed at 3T scanner using multiple b values. IVIM parameters including apparent diffusion coefficient (ADC), true diffusion coefficient (D), pseudo-diffusion coefficient (D^*), and perfusion fraction (f) of the liver parenchyma were measured. Based on histologic features using NAFLD activity score (NAS), each subject was categorized as one of the NAFLD severity groups: normal (NAS = 0), not-non-alcoholic steatohepatitis (not-NASH) (NAS = 1–2), borderline (NAS = 3–4), or NASH (NAS ≥ 5). IVIM parameters were compared among the NAFLD severity groups using Kruskal-Wallis test, and optimal cutoff values of IVIM parameters for severity assessment of NAFLD were determined by a receiver-operating characteristics (ROC) analysis

RESULTS: f values significantly decreased with severity of NAFLD, with median values of 22.2% in normal, 14.8% in not-NASH, 11.3% in borderline, and 9.5% in NASH ($p < 0.05$). ADC, D, and D^* did not show significant difference among the NAFLD severity groups. In terms of f values, the area under the ROC curves were 0.984 (normal vs. \geq not-NASH), 0.959 (\leq not-NASH vs. \geq borderline), and 0.903 (\leq borderline vs. NASH) with optimal cutoff values of 15.2%, 13.2%, and 11.0%, respectively.

CONCLUSION: f values extracted from IVIM MRI would help to differentiate normal liver from NAFLD and to determine the severity of NAFLD.