

Noninvasive Quantitative Biomarkers of Fatty Liver Disease with MRI

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Non-alcoholic fatty liver disease (NAFLD) is the most common cause of chronic liver disease in Western societies, and can progress to non-alcoholic steatohepatitis (NASH). The hallmark of NAFLD is hepatic steatosis, whereas NASH is marked by additional inflammation and fibrosis and can progress to cirrhosis and liver failure. MRI has a unique ability to quantify biomarkers of both fibrosis and steatosis safely and non-invasively and hence provide a potential alternative to biopsy. This work describes recent developments in quantitative MR imaging to allow for accurate fat quantification and Magnetic Resonance Elastography (MRE) in the quantification of hepatic shear stiffness as a surrogate biomarker of fibrosis. Iterative Decomposition of fat and water with Echo Asymmetry and Least-squares estimation (IDEAL) is shown to provide accurate fat quantification in phantoms, animal models, and patients, and the repeatability of this technique is investigated. Further, the repeatability of MRE in volunteers and patients is shown, as well as during a meal challenge in volunteers. These validations and analyses are necessary steps for continued development and translation of new biomarkers of liver disease into clinical practice, and as such, these MRI methods can assist in early detection and quantitative staging of NAFLD, therapy planning and monitoring, and potential identification of NAFLD versus NASH.