Liver Fat Does Not Affect Liver Stiffness Measured with MR Elastography

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Background

MR elastography (MRE) has emerged as the most reliable non-invasive diagnostic technology for detecting and staging liver fibrosis [1-2]. Among the histologic processes associated with chronic liver disease (fibrosis, inflammation, steatosis, and cell injury), the presence and severity of fibrosis is by far the strongest predictor of subsequent morbidity and mortality [3].

MRE measures the stiffness of liver tissue, which increases progressively with the severity of liver fibrosis. Diagnostic interpretation of MRE results should consider the fact that other processes such as chronic inflammation and hepatic venous congestion can also cause increased liver stiffness. Fortunately, these effects are modest and multiple studies have demonstrated that MRE has a diagnostic performance that rivals liver biopsy for assessing liver fibrosis [3].

Abnormal accumulation of lipid droplets in hepatocytes is a hallmark of nonalcoholic fatty liver disease (NAFLD), which has become one of the most important causes of fibrosis and end stage liver disease, world-wide [4].

Subcutaneous fat is very soft to palpation. So, is it possible that the presence of liver fat might reduce liver stiffness and thereby impair the ability of MRE to detect co-existing fibrosis?

Evidence in the literature

Multiple published studies have reported that hepatic steatosis does not systematically affect MRE-measured liver stiffness in patients with chronic liver disease [5-8]. Liver stiffness was significantly correlated with inflammation grade and fibrosis stage, but not with relative fat fraction [6].

Liver stiffness assessed by MRE had high accuracy (AUROC = 0.93) for discriminating patients with NASH from simple steatosis [6].

Longitudinal studies have measured liver fat and liver stiffness in subjects over time. In a recent clinical trial, the effectiveness of a therapeutic agent designed to reduce liver fat was tested in subjects with NAFLD [8]. The results demonstrated a significant reduction in liver fat by more than 30% in treated subjects, as measured by proton density fat fraction MRI. However no significant change in liver stiffness was observed with MRE, supporting the principle that liver fat has little influence on liver tissue stiffness [8].

Alternate findings

There is evidence that ultrasound-based elastography measurements of liver stiffness are affected by liver fat [9-10]. This is likely an artifactual effect, arising from a physical phenomenon known as called dispersion [11].

In a small number of publications, a correlation between liver stiffness and steatosis was found. In a study of 327 patients with chronic hepatitis C, liver stiffness was correlated to viral activity and steatosis following a univariate analysis. However, fibrosis stage was also correlated to activity and steatosis. When
performing the multivariate analysis including fibrosis, activity, and steatosis, fibrosis was the only parameter that significantly correlated to liver stiffness [12].

One study concluded that “liver volume, fat fraction, and stiffness are inter-related and associated with multiple patient-specific factors” in a pediatric cohort of 202 patients [13]. The authors state “for every 1% increase in liver fat fraction, there was a 0.02 kPa decrease in liver stiffness.” If a patient experienced a 10% increase in liver fat fraction with baseline liver stiffness of 3.5 kPa, this would be a 0.2 kPa decrease in liver stiffness, or an overall percent decrease of 6%.

This falls well below the QIBA guideline of a 19% change or larger indicates a true change in stiffness has occurred with 95% confidence [14].

**Conclusion**

The preponderance of literature evidence supports a conclusion that MRE-based measurements of liver stiffness are not significantly affected by liver steatosis [5-8].

**References**


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