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Assessment of Hepatic Fibrosis with the Stiffness of Liver and the Dynamic of Blood in Liver HAO CHEN, Georgia State University, LIHONG YE, ZHENYAN LI, Shijiazhuang Fifth Hospital, YI JIANG, Georgia State University — Cirrhosis affects liver functions, and is a significant public health problem. Early stages of liver fibrosis are difficult to diagnose. The mechanism of fibrosis changing the mechanical properties of the liver tissue and altering the dynamic of blood flow is still unclear. In collaboration with clinicians specialized in hepatic fibrosis, we have developed a mechanical model to integrate our empirical understanding of fibrosis development and connect the fibrosis stage to mechanical properties of tissue and the consequential blood flow pattern changes. We modeled toxin distribution in the liver that leads to tissue damage and collagen deposition. We showed that the excessive collagen forms polygonal patterns, resembling those found in pathology images. Treating the collagen bundles as elastic spring networks, we also showed a nonlinear relationship between liver stiffness and fibrosis stage, which is consistent with experimental observations. We further modeled the stiffness affecting the mechanical properties of the portal veins, resulting in altered blood flow pattern. These results are supported by ultrasound Doppler measurements from hepatic fibrosis patients. These results promise a new noninvasive diagnostic tool for early fibrosis.

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