Radiologic Imaging in Nonalcoholic Fatty Liver Disease and Nonalcoholic Steatohepatitis

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KEYWORDS

• Steatosis • Nonalcoholic fatty liver disease • Nonalcoholic steatohepatitis
• Ultrasound • MRI • CT • Elastography • Imaging

KEY POINTS

- Imaging plays a role in the diagnosis and monitoring of patients with nonalcoholic fatty liver disease (NAFLD).
- MRI has the best sensitivity and specificity profile for diagnosing hepatic steatosis of any degree. MRI may be superior to biopsy in terms of estimating hepatic fat fraction and may be used to longitudinally follow patients with treatment.
- Image-based elastography is increasingly being used to evaluate for fibrosis in patients with NAFLD and may obviate biopsy.
- Up to 50% of patients with NAFLD with hepatocellular carcinoma have no morphologic evidence of cirrhosis, and special screening considerations may be needed in this population.

INTRODUCTION

Nonalcoholic fatty liver disease (NAFLD) encompasses a spectrum of liver pathologies defined by the presence of fat in the liver in the absence of alcohol consumption.[1] The disease spectrum ranges from simple steatosis to nonalcoholic steatohepatitis (NASH) to hepatic fibrosis and cirrhosis.[2,3] NAFLD is a frequently encountered entity in the Western world, with its prevalence estimated to be as high as 30%.[2,4]

Clinically, its recognition is vital, as the all-cause mortality rate of patients with NAFLD is at least 34% higher than that of the general population,[3] with the presence of NASH long considered to be a significant predictor of morbidity and mortality in

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patients with NAFLD.[5,6] However, more recent studies have suggested that among patients with NAFLD, it is not NASH but rather advanced fibrosis that independently predicts liver-related mortality.[1] In fact, a study by Soderberg and colleagues[6] of patients with NAFLD demonstrated no difference in mortality between those with biopsy-proven NASH and those without NASH. In contrast, a study by Younossi and colleagues[7] demonstrated high-grade liver fibrosis to be an independent risk factor for liver-related mortality with a hazard ratio of 5.7. In this study, the presence of NASH was only associated with mortality when fibrosis was included in the analysis. Therefore, it is the identification of fibrosis in a patient with NAFLD that indicates that patient's mortality risk. The degree of fibrosis in patients with NASH may progress, regress, or remain stable over time.[3]

Liver biopsy remains the gold standard for diagnosis of NAFLD and fibrosis and is the only way to diagnose NASH, which has no imaging findings.[1] However, biopsy has considerable disadvantages. It is invasive, costly, and carries the risk of potential complications, such as hemorrhage. Furthermore, it is subject to sampling variability and may not paint an accurate picture of the true disease severity.[8] Biopsy is, therefore, inappropriate to use as a screening test in at-risk patients or to evaluate the progression of disease in the many patients with NAFLD. Newer technologies, such as elastography, are increasingly being used to evaluate the degree of fibrosis.

Imaging plays a role in the diagnosis of NAFLD when patients are referred with abnormal liver chemistries, referred for the clinical suspicion of NAFLD (perhaps by having obesity, hyperlipidemia, or type 2 diabetes), or when abnormal findings are present at imaging performed for other reasons.[1,9] Imaging also plays a role in monitoring patients with known NAFLD. In the following article, the authors review the multimodality (ultrasound, computed tomography [CT], and magnetic resonance [MR]) imaging appearance of NAFLD and discuss the radiologic diagnostic criteria as well as the sensitivity and specificity of these imaging methods. The authors review the role of both ultrasound and MR elastography (MRE) for the diagnosis of fibrosis and for the longitudinal evaluation of patients following therapeutic intervention. Lastly, the authors briefly discuss the screening and diagnosis of hepatocellular carcinoma (HCC) in patients with NAFLD as there are special considerations in this population.

IMAGING DIAGNOSIS OF STEATOSIS

Ultrasonography

The intracellular fat vacuoles present in hepatic steatosis alter the properties of the liver such that its reflection of sound waves is increased relative to normal hepatic parenchyma.[2] This characteristic of intracellular hepatic fat produces an echogenic, or bright, liver on sonographic imaging. Most commonly, fat deposition is diffuse; therefore, the liver will appear homogeneously echogenic.[10] The right kidney, situated just inferior to the right hepatic lobe, may be used as an internal reference. The liver is typically evaluated on sagittal view with the kidney and liver at the same focal zone depth. In normal patients, the liver will be similar or slightly more echogenic than the renal cortex. A starker contrast between the echogenicity of the liver and the adjacent renal cortex is suggestive of hepatic steatosis. Additionally, the increased reflection of sound waves by the fat-infiltrated liver may result in a coarser hepatic echotexture than normal liver, decreased depth of penetration by the ultrasound beam, and loss of right hemidiaphragm and portal triad visualization, structures which are normally readily apparent at ultrasound.[2,9,10]

In clinical practice, ultrasound is used to provide a qualitative rather than a quantitative assessment of hepatic fat infiltration. Mild steatosis is defined as increased