Ultrasound of the Liver and Spleen

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KEYWORDS

• Ultrasound • Liver • Spleen

KEY POINTS

- Ultrasound is a quick, readily available, and informative first-line imaging modality for the liver and spleen.
- The liver and spleen are very amenable to ultrasound evaluation.
- Because many disease processes involving the liver and spleen can be evaluated on ultrasound, recognition of classic imaging appearances is important.
- Many diseases have varying appearances, and there may be significant overlap between benign and malignant disease.

INTRODUCTION

Ultrasound (US) imaging is a noninvasive, low-cost, and widely available modality for the evaluation of the liver and spleen. US can be performed at the bedside, allowing for rapid diagnosis and little in the way of patient preparation. Inherent in the technique is direct involvement of the patient, allowing the sonographer to interact with the patient, to ask clinically relevant questions, and to tailor the examination where possible.

LIVER

The liver lends itself to US evaluation given its location and homogeneous density, allowing for good sound transmission. However, because of the size and depth, the entire liver is often difficult to visualize. The body habitus of the patient also effects the depth of penetration with the US beam, further limiting visualization. Especially difficult areas to visualize include the subdiaphragmatic liver and the tip of the left hepatic lobe. Despite these challenges, US remains an important modality for the evaluation of the liver.

Patients should initially be placed in the left lateral decubitus position and a subcostal transducer approach should be applied. The right arm may be raised to open up and lift the rib spaces off the liver. A 3- to 5-MHz curved array transducer should be used for initial evaluation of the liver. A supine intercostal approach should also be taken to allow for complete visualization of the right hepatic lobe. Evaluation of the liver surface to assess for nodularity should be performed with a 5- to 12-MHz linear transducer. The surface is usually best evaluated in real-time because the liver surface moves with respiration. Care should be taken when evaluating surface nodularity as transducer angle and frequency can falsely create the appearance of a nodular surface.[1]

Anatomy

The liver is the largest organ in the abdomen, although the size may vary from patient to patient. The liver is located in the right upper quadrant but may extend far into the left upper quadrant and the right lower quadrant.[2] The size depends on patient sex, patient age, patient size, and alcohol consumption.[3–5] Liver size should be measured along the midclavicular line, although measuring liver size is not always standardized.[6] Most importantly, the measurement technique should be consistent

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among patients and prior US examinations. Although size can vary, a liver length greater than 15.5 cm should be considered enlarged and indicates hepatomegaly. Extension of the right hepatic lobe below the lower pole of the right kidney has also been suggested as a sign of hepatomegaly, although this may be unreliable in patients with a Riedel lobe.[7] Additional signs of hepatomegaly include a rounded appearance to the tip of the right hepatic lobe and extension of the left lobe over the spleen.

The liver may be divided into segments delineated by the hepatic veins (**Figs. 1** and **2**). The portal vein runs within each segment. Portal and hepatic veins can be distinguished by the presence of echogenic periportal tissue and the presence of the biliary duct and hepatic artery that course within the portal triad. The ligamentum teres appears as an echogenic band that divides the medial and lateral segments of the left hepatic lobe.

Normal liver parenchyma should be homogeneous in appearance, broken only by the presence of portal triads and the hepatic veins. Diffuse liver disease, discussed later, can alter the normal echogenicity of the liver. Normal liver echogenicity can be evaluated by comparing it with renal cortex, where the liver should normally be isoechoic to slightly more echogenic than the kidney.

Diffuse Liver Disease

Several disease processes may involve the entire liver, altering the texture and echogenicity of the hepatic parenchyma while preserving the normal anatomic relationships. These liver diseases are often hard to detect given their diffuse nature.

Fatty liver

Fatty infiltration of the liver is arguably the most common cause of diffuse liver disease. Fatty liver disease or hepatic steatosis results from the intracellular accumulation of triglycerides within hepatocytes. Classically, hepatic steatosis has been described as a result of alcohol consumption.[8] There is another cohort of patients who are non-alcohol drinkers who develop steatosis. A large number of patients have hepatic steatosis that is not clinically significant in most cases.[9,10] However, patients can progress from hepatic steatosis to steatohepatitis and potentially cirrhosis.[10]

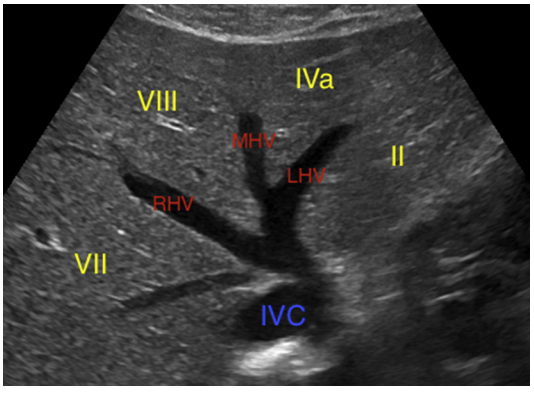

Fig. 1. Normal liver segments divided by the right hepatic vein (RHV), middle hepatic vein (MHV), and left hepatic vein (LHV), all draining into the inferior vena cava (IVC).

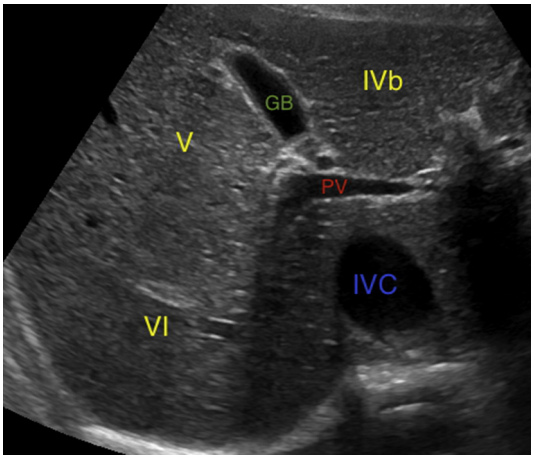

Fig. 2. Normal liver segments below the level of the portal vein (PV). Also seen is the gallbladder (GB) and the inferior vena cava (IVC).

US is a noninvasive tool for the evaluation of fatty liver disease. Hepatic steatosis appears as diffuse, increased liver parenchymal echogenicity, a "bright liver." Normally, the liver should be isoechoic to slightly more echogenic than the renal cortex (**Fig. 3**). A more echogenic liver suggests the diagnosis of fatty liver disease. Additional findings include blurring of the normal vascular margins with increased acoustic attenuation (diminished through transmission). Glycogenosis seen in type 1 glycogen storage disease results in diffuse glycogen deposition and may have an appearance indistinguishable from hepatic steatosis.[11] Fatty infiltration may be heterogeneous and areas of fatty sparing may be seen. Fatty sparing appears hypoechoic relative to the liver parenchyma and may appear masslike or flame-shaped and has tapered margins (**Fig. 4**). Common locations for fatty sparing include along the gallbladder fossa, porta hepatis, falciform ligament, dorsal left hepatic lobe, and caudate lobe.[7] Similarly, fatty infiltration may be focal, appearing as conspicuous echogenic areas within the liver parenchyma. A useful technique in differentiating focal fatty infiltration and focal sparing is visualization of non-displaced portal triads or hepatic veins coursing through the regions (**Fig. 5**).