The Role of Ultrasonography in the Evaluation of Diffuse Liver Disease

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KEYWORDS

• Ultrasound • Sonography • Diffuse • Liver disease • Hepatic disease

KEY POINTS

- Coarsening and heterogeneity of hepatic echotexture, altered echogenicity, and surface nodularity are key ultrasonography (US) findings that suggest diffuse liver disease.
- Identification of vascular displacement, altered flow, or thrombosis during color and Doppler US interrogation are critical ancillary features that support a diagnosis of diffuse liver disease by US.
- Even in the absence of a specific diagnosis, US findings interpreted in the proper clinical context often facilitate the next step in the patient's evaluation.

INTRODUCTION

Ultrasonography (US) is frequently the initial modality for evaluating patients with hepatic dysfunction or suspected diffuse disease. Availability, low cost, and lack of ionizing radiation contribute to its popularity. Rapid acquisition of structural and physiologic data has made US an indispensable tool in assessing diffuse liver disease.

Gray-scale findings that suggest diffuse liver disease include surface nodularity, heterogeneous echotexture, and altered parenchymal echogenicity. Doppler US findings of vessel distortion, thrombosis, neovascularity, the arterial buffer response, and variceal formation are important ancillary findings. In addition, assessment of the biliary system and perihepatic spaces are helpful in detecting diffuse hepatic abnormality.

Ultrasound elastography has evolved over the past 30 years as a noninvasive method of assessing liver fibrosis.[1] Although elastography platforms differ by method of excitation and measurement, they all have shown utility for evaluation of numerous diffuse liver diseases. Newly developed applications, such as real-time tissue elastography, virtual touch quantification, and color map integration are promising developments that are anticipated to enable elastography to play a prognostic role in diffuse liver disease.[2] Similarly, it is possible that perfusion data afforded by dynamic contrast-enhanced US will be an additional area of growth once microbubble contrast agents gain approval in the United States.

Despite its popularity, the utility of US may be limited by a relatively small field of view, operator dependence, and artifacts. Several diffuse hepatic processes are not detectable during initial US examinations early in the course of the disease. Furthermore, the abnormalities that are eventually detected by US may be nonspecific, requiring further evaluation with contrast-enhanced

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computed tomography (CT), magnetic resonance (MR) imaging, or biopsy.

NORMAL ANATOMY AND IMAGING TECHNIQUE

Hepatic Parenchyma

Hepatic US is performed with standard curvilinear and high-resolution linear probes. The curvilinear probe (2–6 MHz) allows acoustic penetration of deeper parenchyma while a high-resolution probe (7–12 MHz) may be used to depict greater surface detail. Optimization of the gain, time-gain compensation, and tissue harmonics by an experienced sonologist, and second-look sonography by informed radiologists are requisites for achieving diagnostic examinations.

Normal liver parenchyma has a homogeneous echotexture (**Fig. 1**); the assessment is subjective but the liver should not appear granular or coarsened if speckle reduction and compound imaging parameters are optimized. Hepatic echogenicity is subjectively compared with that of adjacent solid viscera such as the kidneys and spleen; normal hepatic echogenicity is marginally higher than that of the kidney but less than that of the spleen. The spleen provides a more reliable comparison because numerous intrinsic kidney diseases can alter their echogenicity. Normal relative hepatic echogenicity is summarized in **Box 1**.

Box 1
Normal relative hepatic echogenicity

- Liver > kidneys
- Liver < spleen
- Liver < portal tracts
- Liver < diaphragm muscle

Hepatic Vasculature

Normal hepatic vessels have smooth walls and anechoic lumens. Intrahepatic arteries are difficult to resolve on gray scale alone, but parallel the portal veins. Normal spectral Doppler interrogation shows a low-resistance waveform with continuously hepatopetal diastolic flow. Normal portal veins have thin echogenic walls and monophasic waveforms with mild respiratory variation. Alterations of portal mural echogenicity should be considered abnormal. Normal hepatic veins and the inferior vena cava (IVC) lack discernible walls. The normal hepatic venous waveform is triphasic, owing to 2 hepatofugal peaks and 1 hepatopetal peak reflecting primarily right atrial pressure.

Miscellaneous

The normal common bile duct measures up to 6 mm in normal individuals, but radiology dogma suggest that the diameter of the duct can increase with age.[3] The central intrahepatic ducts should normally measure 3 mm or less. The diameter of the common bile duct may vary following cholecystectomy.

The normal perihepatic spaces should contain a variable amount of homogeneous fat; any ascites, fluid collection, or soft-tissue lesion should be considered abnormal.

Imaging Protocol

Scanning typically commences with the use of a curved linear-array probe at 3 to 6 MHz. With the patient in a supine position, the left hepatic lobe is insonated via a subcostal approach; an intercostal window in the left lateral decubitus position is usually required for evaluation of the right lobe. Repositioning and breathing instructions may be used for problematic anatomic regions such as the subcostal surface, the tip of the lateral segment, and the subdiaphragmatic regions.

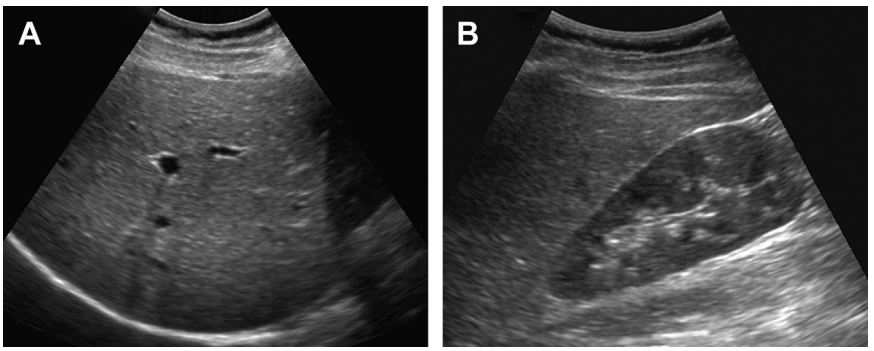

Fig. 1. Normal liver ultrasonogram. (*A*) Transverse ultrasonography (US) shows homogeneous echotexture. (*B*) Sagittal image demonstrates that the liver echogenicity is slightly higher than that of the right kidney.