The Ins and Outs of Liver Imaging

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KEYWORDS

• Liver • Imaging • Elastography • Hemangioma • Focal nodular hyperplasia
• Hepatic adenoma • Hepatocellular carcinoma • Cholangiocarcinoma

KEY POINTS

- Dedicated contrast-enhanced liver magnetic resonance (MR) imaging or computed tomography (CT) can often definitively characterize many lesions as benign or malignant.
- Dedicated liver CT and MR imaging are accurate for the diagnosis of hemangioma due to its characteristic enhancement pattern. Other lesions such as focal nodular hyperplasia and hepatic adenoma can also be diagnosed based on imaging alone. MR imaging with a hepatobiliary contrast agent may prove helpful in some cases.
- Evolving MR techniques including diffusion-weighted imaging and MR elastography will have a greater role in evaluating the liver in the future.
- Optimal protocols are essential and preferences for certain examinations over others may be institutionally dependent, but it is important to work closely with radiologists to improve patient care.

LIVER IMAGING

The use of radiology in the evaluation of diffuse and focal liver disease has dramatically increased in recent years, in part because of advances in imaging technology. Imaging of the liver can be performed with a variety of modalities, and is used as both a screening and a diagnostic tool. In certain instances, imaging can help avoid the use of invasive procedures, making it a valuable clinical tool.

ULTRASONOGRAPHY

Ultrasonography is often the initial imaging study for the evaluation of suspected liver disease secondary to its low cost, ready availability, and lack of radiation exposure.

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Typical indications for the use of ultrasonography include detection and evaluation of hepatomegaly, elevated liver function tests, hepatic steatosis, cirrhosis, biliary obstruction, and hepatic lesions.[1–5] Drawbacks include difficulty with imaging the entire liver particularly near the diaphragm, interobserver variability, less accuracy in the detection of mild diffuse liver disease, limitations in patients with large body habitus or poor acoustic windows, and in the setting of fatty or fibrofatty infiltration of the liver secondary to decreased penetration of the sound beam.[1,3,5,6] It has lower sensitivity and specificity for liver masses, especially in the setting of cirrhosis.

Ultrasonography is particularly useful in evaluating the hepatic vasculature. The liver has a dual blood supply from the portal vein and hepatic artery. The portal vein supplies most of the blood supply to the liver. Normal physiologic portal venous flow is termed hepatopetal, or antegrade, with blood flowing through the portal vein from the central portion of the liver toward the periphery. The opposite process, termed hepatofugal, or retrograde, occurs when blood flows from the periphery of the liver centrally. Hepatofugal flow commonly occurs in the setting of liver disease, including cirrhosis with portal hypertension.[7] Direction of portal venous flow is readily detected on ultrasonography with color Doppler interrogation and waveform analysis.

COMPUTED TOMOGRAPHY

Computed tomography (CT) offers many advantages including its wide availability, moderate cost, speed, and its ability to detect and characterize diffuse liver disease and focal liver lesions. Depending on the clinical scenario and indication for the study, CT of the liver can be conducted using a variety of protocols, including unenhanced and single-phase, dual-phase, or triphasic contrast-enhanced CT examination.

Unenhanced CT of the liver can be used to evaluate diffuse or focal hepatic steatosis, hepatic deposition of iron, detection of calcifications in the setting of calcified metastases or postinflammatory processes, and in the evaluation of Lipiodol distribution after treatment with chemoembolization.[8,9]

Single-phase contrast-enhanced CT typically is performed when a specific hepatic disorder is not anticipated, or the entire abdomen and pelvis is imaged in the evaluation of systemic disorders such as metastatic disease. This study is generally performed during the portal venous phase of imaging because during this phase the liver demonstrates maximal enhancement, making it the most useful phase in which to detect hypovascular liver lesions such as those seen with a large number of metastases.[8,10]

Dual-phase contrast-enhanced CT can be performed in the evaluation for hypervascular metastases, such as breast, renal cell, or thyroid carcinomas, in addition to melanoma and endocrine tumors. In this setting, the scan is usually performed in the late hepatic arterial and portal venous phases. Another application of dual-phase CT would be in the setting of preoperative evaluation for partial liver resection, where detailed information regarding the vascular anatomy (assessed in the hepatic arterial phase) and imaging of the liver (assessed in the portal venous phase) is required.[8]

Triphasic contrast-enhanced CT is typically used in the setting of either known or suspected cirrhosis or hepatocellular carcinoma (HCC), and in the evaluation of focal liver lesions. In this protocol, an unenhanced phase is followed by hepatic arterial and portal venous phases.[8] The term triphasic has also been used to describe imaging in the arterial, venous, and delayed phases without unenhanced imaging. A hepatic arterial-phase sequence is performed in the setting of cirrhosis to best detect HCCs, which are supplied by the hepatic arterial system rather than the portal venous system. These lesions characteristically demonstrate hypervascular enhancement