Hepatobiliary Scintigraphy: A Case-based Review

Julia Mario, MD • Eric Dietsche, MD • Jason Halpern, MD • Andrew Schneider, MD • Chris Sakellis, MD • Heather Jacene, MD • Hina Shah, MD

Author affiliations, funding, and conflicts of interest are listed at the end of this article.
See the slide presentation here.

Hepatobiliary scintigraphy, commonly referred to as a hepatic iminodiacetic acid (HIDA) scan, provides dynamic visualization of hepatobiliary physiology. The accompanying slide presentation provides a comprehensive review of the HIDA scan, including *(a)* the history and physiology of hepatobiliary scintigraphy agents; *(b)* clinical indications for hepatobiliary scintigraphy; *(c)* patient preparation, imaging techniques, and pharmacologic interventions; and *(d)* case examples with pearls, pitfalls, and named radiographic signs.

HIDA imaging agents are technetium 99m (^{99m}Tc)–labeled lidocaine analogs. Iminodiacetic acid is the carrier molecule that attaches ^{99m}Tc to lidocaine, while lidocaine is the biologically active agent. Like bilirubin, HIDA agents are taken up by hepatocytes and then excreted into bile canaliculi, with eventual flow down the extrahepatic bile ducts into the gallbladder and duodenum. However, unlike bilirubin, HIDA agents are not conjugated within the hepatocyte but rather are excreted unchanged.

HIDA imaging is a commonly used diagnostic tool and lends itself to evaluation of a wide range of hepatobiliary pathologic conditions. Acute cholecystitis is the most common indication. Other indications include chronic cholecystitis, biliary obstruction, biliary atresia versus neonatal hepatitis, bile leak, biliary stent function assessment, and liver transplant evaluation, among others. The slide presentation provides case examples of most of these entities with case-specific pearls and pitfalls, as well as a brief review of the disease processes depicted.

Proper patient preparation is essential for diagnostic accuracy. Understanding the clinical question is therefore critical for planning the study. For example, if the indication is acute cholecystitis, then the patient needs to have fasted for at least 4 hours, but not more than 24 hours, before imaging to prevent a false-positive result. This window of fasting ensures that the gallbladder has had sufficient time to relax after the most recent meal but also that it is not filled with concentrated bile, as would be expected after prolonged fasting. However, if the clinical indication is bile leak, then fasting is irrelevant. We provide a review of key questions to ask before performing cholescintigraphy.

The standard cholescintigraphy protocol is 60 minutes of dynamic imaging in the anterior view after intravenous administration of ^{99m}Tc-mebrofenin or ^{99m}Tc-disofenin. In patients with suspected acute cholecystitis with nonvisualization of the gallbladder at 60 minutes, either delayed imaging at 4 hours or augmentation with morphine and an additional 30 minutes of imaging is performed. When there is uncertainty about the anatomic location of the tracer, additional planar projections such as right lateral and left anterior oblique views, as well as SPECT/CT, may be performed. Additional pharmacologic interventions, including cholecystokinin for prolonged fasting or for calculating gallbladder ejection fraction and phenobarbital pretreatment for differentiating biliary atresia versus neonatal hepatitis, are reviewed.

Cholescintigraphy is superior to US for diagnosis of acute cholecystitis, with a sensitivity and specificity of 97% and 94%, respectively, compared with 77% and 83%, respectively, for US. The cystic duct sign (Fig 1) can be seen with acute cholecystitis. The rim sign (Fig 2) is a more ominous sign that is associated with later stages of acute cholecystitis, including gallbladder necrosis.

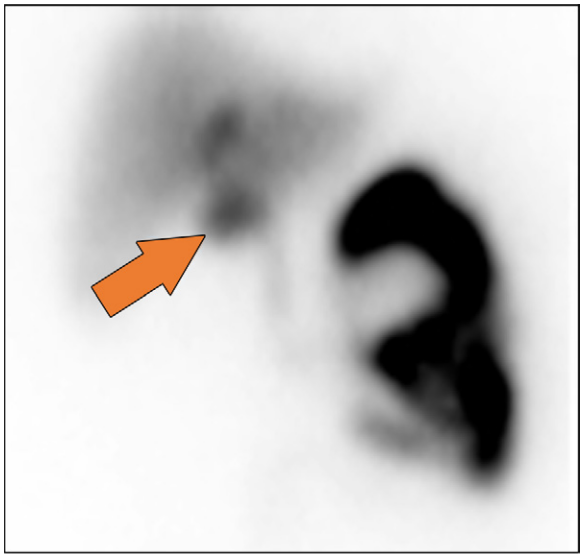

Figure 1. Acute cholecystitis with cystic duct sign in a 33-year-old woman. HIDA image in the anterior view after morphine administration shows nonvisualization of the gallbladder, with tracer activity in the expected location of the cystic duct (arrow) (confirmed at SPECT/CT, not shown).

Slide Presentation

RadioGraphics 2023; 43(9):e220104
https://doi.org/10.1148/rg.220104
Content Codes: GI, NM

Abbreviation: HIDA = hepatic iminodiacetic acid

TEACHING POINTS

- Hepatobiliary scintigraphy has a wide range of clinical applications, including chronic cholecystitis, biliary obstruction, and bile leak. The most common indication is acute cholecystitis, for which it is more sensitive and specific than US imaging.
- Understanding hepatobiliary and technetium 99m hepatic iminodiacetic acid (HIDA) radiotracer physiology is critical to appropriate patient preparation, protocoling, and interpretation of the HIDA scan.
- SPECT/CT combines the information gained from scintigraphy with cross-sectional anatomic information and therefore is an important tool for accurate interpretation of HIDA imaging when there is diagnostic uncertainty.

Author affiliations.—From the Department of Radiology, Brigham and Women's Hospital, Harvard Medical School, 75 Francis St, Boston, MA 02115-6195 (J.M., A.S.); Division of Nuclear Medicine, Department of Radiology, Brigham and Women's Hospital/Dana-Farber Cancer Institute, Harvard Medical School, Boston, Mass (E.D., C.S., H.J., H.S.); and Department of Radiology, Rhode Island Hospital, The Warren Alpert Medical School of Brown University, Providence, RI (J.H.). Recipient of a Certificate of Merit award for an education exhibit at the 2021 RSNA Annual Meeting. Received April 27, 2022; revision requested August 20 and received August 29; accepted September 9. **Address correspondence to** J.M. (email: *jmario@bwh.harvard.edu*).

Disclosures of conflicts of interest.—**H.J.** Consulting fees from Advanced Accelerator Applications, Blue Earth Diagnostics, and Spectrum Dynamics; royalties from Cambridge University Press. All other authors have disclosed no relevant relationships.

Suggested Readings

Krishnamurthy GT, Krishnamurthy S. Nuclear Hepatology: A Textbook of Hepatobiliary Diseases. Heidelberg, Germany: Springer, 2000.

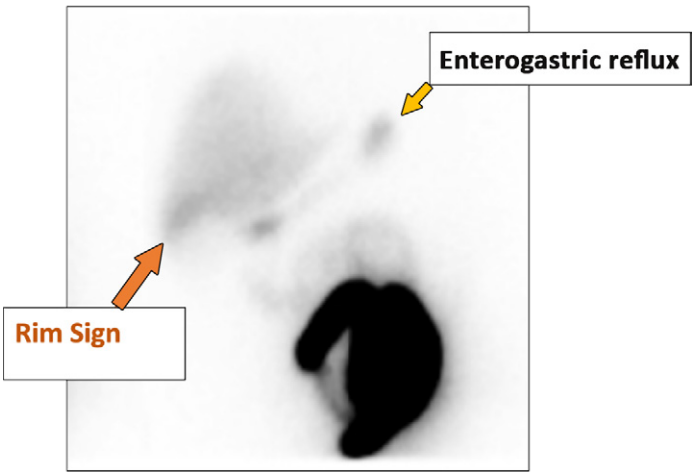

Figure 2. Acute cholecystitis with rim sign in a 59-year-old man. HIDA image in the anterior view shows tracer uptake in the region of the gallbladder (orange arrow). Enterogastric reflux is also depicted (yellow arrow). SPECT/CT (not shown) confirmed tracer activity surrounding the gallbladder. The patient underwent cholecystectomy and was found to have acute cholecystitis with areas of gallbladder necrosis and perforation.

O'Malley JP, Ziessman HA, Thrall JH. Hepatic, Biliary and Splenic Scintigraphy. In: Nuclear Medicine and Molecular Imaging: The Requisites. Amsterdam, the Netherlands: Elsevier, 2020.

Tulchinsky M, Ciak BW, Delbeke D, et al. SNM practice guideline for hepatobiliary scintigraphy 4.0. J Nucl Med Technol 2010;38(4):210–218 [Published correction appears in J Nucl Med Technol 2012;40(3):17A. Dosage error in article text.].

Ziessman HA. Hepatobiliary scintigraphy in 2014. J Nucl Med 2014;55(6):967–975.