Upper Abdominal Ultrasound: What Every Resident Should Know

Liver Ultrasound — Session Lecture

ABSTRACT

Liver ultrasonography (US) is the primary imaging modality for hepatic evaluation in clinical practice, offering real-time, radiation-free assessment of parenchymal disease, focal lesions, vasculature, and biliary structures. Its diagnostic accuracy is critically operator-dependent, making technical competency and systematic interpretation fundamental skills for radiology trainees.

This lecture provides a practical, resident-oriented framework for liver US, with emphasis on transducer selection, machine parameter optimization, and a structured scanning protocol that ensures consistent, reproducible hepatic assessment. Common pathologic findings — including diffuse parenchymal disease, focal hepatic lesions, portal hypertension, and biliary dilation — are surveyed with a focus on key sonographic discriminators and evidence-based escalation criteria. Particular attention is given to artifact recognition and avoidance of reporting pitfalls that are frequently encountered during early training.

LEARNING OBJECTIVES

Upon completion of this lecture, participants will be able to:

- Select the appropriate transducer and optimize machine parameters (frequency, depth, gain, TGC, focal zone) for hepatic US examination
- Execute a systematic, reproducible scanning protocol to ensure complete evaluation of hepatic parenchyma, vasculature, and biliary structures
- Recognize key sonographic features of common hepatic pathology and formulate a structured differential diagnosis
- Identify and correctly interpret common ultrasound artifacts to avoid diagnostic errors
- Apply structured reporting principles and appropriate escalation criteria, including LI-RADS, for indeterminate hepatic observations

LECTURE SYLLABUS

1. Technical Essentials: Transducer Selection & Parameter Optimization

- Transducer types and clinical applications
  - Curvilinear (2–5 MHz): standard hepatic survey; broad field of view, optimal depth penetration
  - Linear (7–15 MHz): superficial structures, hepatic capsule, left lobe assessment
- Machine parameter optimization
  - Frequency: balance between spatial resolution and depth penetration
  - Depth: set to visualize the diaphragm with ≥ 1 cm below
  - Gain & TGC: adjust for uniform top-to-bottom parenchymal echogenicity; avoid over-gain
  - Focal zone: position at the depth of the region of interest
- Key technique tips: deep inspiration breath-hold; intercostal approach for right lobe access

2. Systematic Scanning Protocol

- Stepwise hepatic survey: subcostal longitudinal → subcostal transverse sweep → right intercostal oblique views
- Must-document checklist
  - Parenchymal echogenicity, echotexture, surface contour, and hepatic size (MCL; normal ≤ 15–16 cm)
  - Portal vein: diameter (normal ≤ 13 mm), flow direction
  - Hepatic veins: confluence with IVC, caliber, Doppler waveform (normal: triphasic)
  - CBD diameter (normal ≤ 6 mm; ≤ 7 mm post-cholecystectomy); IHBD dilation
  - Perihepatic free fluid; gallbladder (en passant)
- Patient positioning: supine for initial survey; left lateral decubitus for right lobe and subphrenic space
- Scanning principles: evaluate each region in ≥ 2 orthogonal planes; confirm findings before reporting

3. Hepatic Pathology: Key Sonographic Discriminators

- Diffuse parenchymal disease (overview)
  - Steatosis (Grades I–III): increased echogenicity vs. renal cortex; posterior beam attenuation in advanced disease
  - Cirrhosis: surface nodularity, coarse echotexture, caudate hypertrophy; associated portal hypertension signs
  - Acute hepatitis: diffuse hypoechogenicity, starry-sky pattern
- Focal hepatic lesions (overview)
  - Benign: simple cyst (anechoic + posterior enhancement), hemangioma (hyperechoic, homogeneous), FNH (central scar, spoke-wheel flow)
  - Malignant: HCC (variable echogenicity, portal vein thrombosis → LI-RADS CT/MRI), metastasis

4. Artifact Recognition & Diagnostic Pitfalls

- Key artifacts
  - Posterior acoustic enhancement: fluid-filled structure → confirms cystic lesion
  - Acoustic shadowing: calculi, calcified lesions, bowel gas → limits deep visualization; always document
  - Mirror artifact: strong reflector (diaphragm) duplicates hepatic lesion above → do not misinterpret as pleural lesion
  - Reverberation / comet-tail: intraluminal gas → do not mistake for solid lesion
- Common pitfalls to avoid
  - Diaphragmatic pseudolesion at hepatic dome: scan in orthogonal plane to resolve
  - Focal fat deposition/sparing: geographic, no mass effect, no flow distortion
  - Rib acoustic shadow mimicking calcification; gallbladder fossa fat mimicking hyperechoic lesion
  - Over-diagnosing IHBD dilation: confirm with Doppler (distinguish from portal vein)
  - Near-field artifact from suboptimal TGC: adjust before interpreting parenchymal echogenicity

5. Structured Reporting & Escalation Criteria

- Always document technical limitations (e.g., beam attenuation, limited acoustic window)
- Compare hepatic echogenicity to ipsilateral renal cortex and spleen as internal references
- LI-RADS ≥ 3 observation: recommend multiphase dynamic CT or gadoxetic acid-enhanced MRI
- Indications for escalation: indeterminate focal lesion > 1 cm; suspected HCC in cirrhotic liver; dilated bile duct without clear etiology; technically limited examination