

## Chapter 2: The Liver

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DUNSTAN ABRAHAM

### Normal Sonographic Anatomy

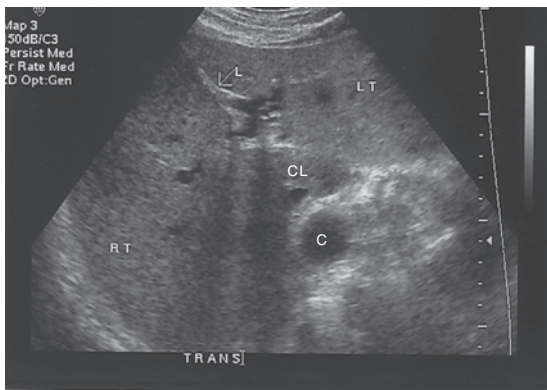
- Homogeneous, echogenic texture (Figure 2-1)
- Measures approximately 15 cm in length and 10–12.5 cm anterior to posterior; measurement taken at mid clavicular in longitudinal section
- Divisions—right, left, and caudate lobes (Figure 2-2)
- Main lobar fissure
  - Echogenic line extending to gallbladder fossa (Figure 2-3)
  - Separates right and the left lobes
- Falciform ligament (contains ligamentum teres)
  - Round, hyperechoic area in left lobe (Figure 2-3)
  - Divides left lobe into medial and lateral segments
- Fissure for ligamentum venosum
  - Echogenic line anterior to caudate lobe (Figure 2-4)
  - Separates caudate from left lobe

### *Hepatic Vessels*

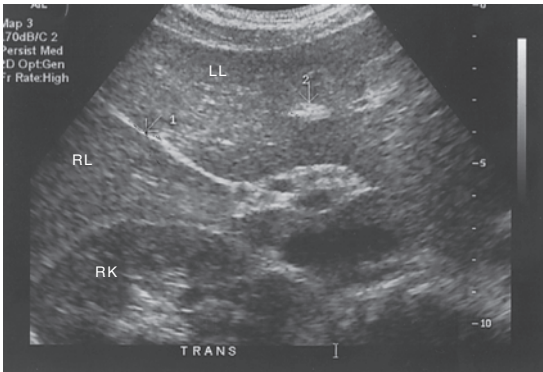
- Portal veins
  - Main portal vein enters liver at hilum (Figure 2-5).
  - Divides into right and left branches
  - Right branch divides into anterior and posterior branches.
  - Left branch divides into medial and lateral branches (Figure 2-6).
  - Walls are thick and echogenic.
- Hepatic veins
  - Right, middle, and left branches drain into inferior vena cava (Figure 2-7).
  - Walls are thin compared with thick-walled portal vein (Figure 2-8).



**Figure 2-1 Normal Liver.** A longitudinal sonogram demonstrates a homogeneous liver with midlevel echoes. Anechoic structures (white arrows) represent normal vessels. The diaphragm (black arrow) is seen superiorly.

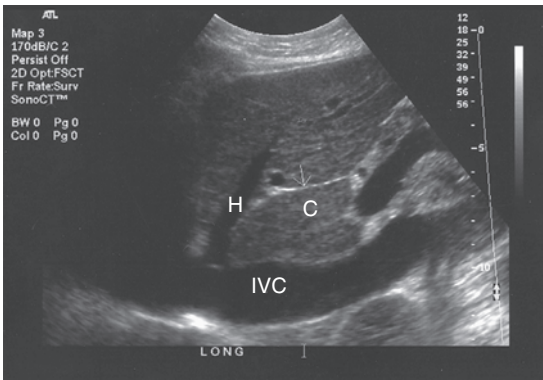


**Figure 2-2 Lobes of the liver.** Transverse view shows right (RT), left (LT), and caudate (CL) lobes of the liver. The inferior vena cava (C) is seen posterior to the caudate lobe (CL). L—main lobar fissure.



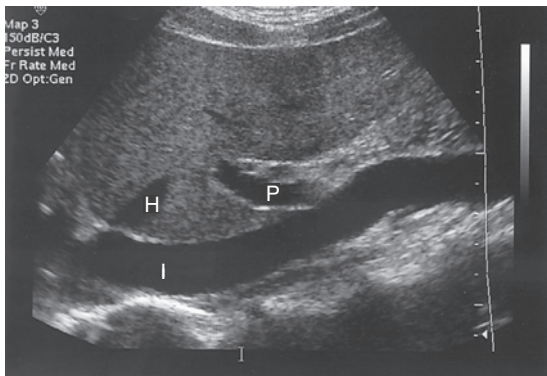
**Figure 2-3 Main lobar fissure and falciform ligament.**

A transverse sonogram shows main lobar fissure (1) separating the right lobe (RL) from the left lobe (LL). The falciform ligament (2) is seen within the left lobe. The right kidney (RK) is seen posterior to the right lobe.

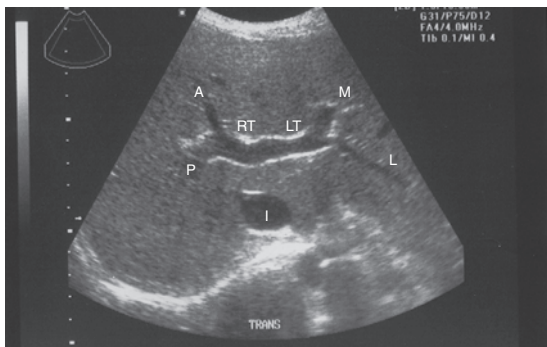


**Figure 2-4 Fissure for ligamentum venosum.**

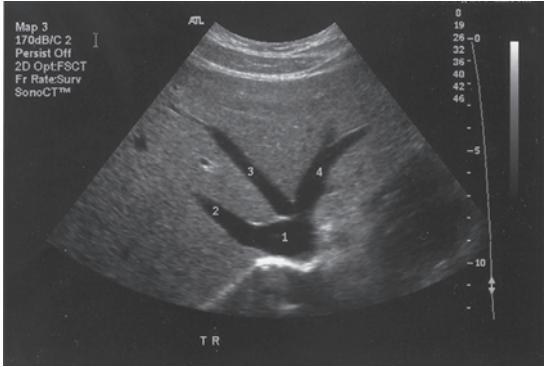
A longitudinal scan shows fissure for ligamentum venosum (arrow) anterior to the caudate lobe (C). The left hepatic vein (H) is seen joining the inferior vena cava (IVC).



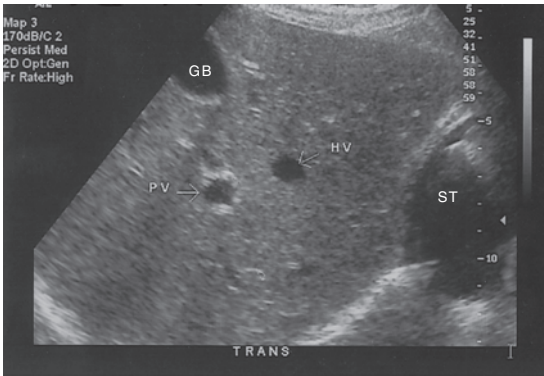
**Figure 2-5 Main portal vein.** A longitudinal sonogram shows main portal vein (P) as it enters hilum of the liver. The inferior vena cava (I) and hepatic vein (H) are also demonstrated.



**Figure 2-6 Branches of the portal vein.** A transverse image showing the right branch of the portal vein (RT) dividing into anterior (A) and posterior (P) segments. The left branch (LT) divides into medial (M) and lateral (L) segments. The inferior vena cava (I) is seen posteriorly. Note the echogenic borders of the portal vein.



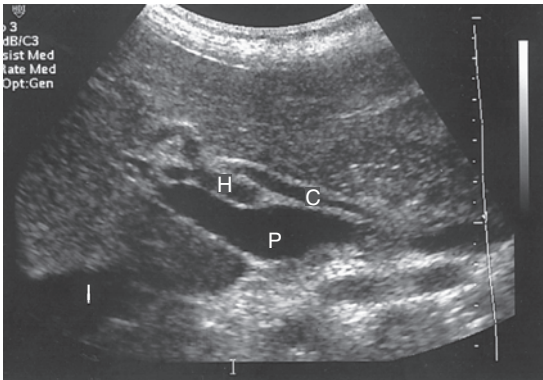
**Figure 2-7 Hepatic veins.** A transverse sonogram showing right (2), middle (3), and left (4) hepatic veins draining into the inferior vena cava (1).



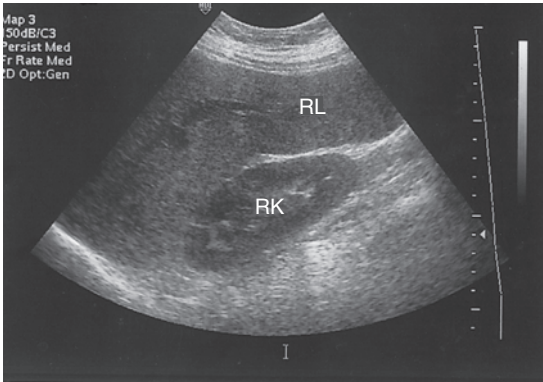
**Figure 2-8 Portal and hepatic veins.** A transverse sonogram showing a section of portal vein (PV) with its hyperechoic borders adjacent to a section of hepatic vein (HV), which has thin border (not hyperechoic). The gallbladder (GB) and fluid-filled stomach (ST) are also identified.

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- Hepatic artery
  - Generally seen between the common bile duct and the portal vein as small, rounded, anechoic structure
  - Linear and anechoic when demonstrated in oblique long axis view (Figure 2-9)
- Intrahepatic bile ducts
  - Are anechoic and seen anterior to portal vein
  - Measure less than 2 mm in anterior to posterior dimensions
- Diaphragm seen as curvilinear hyperechoic structure abutting liver superiorly
- Reidel's lobe
  - Downward projection of right lobe (Figure 2-10)
  - May give false appearance of hepatomegaly



**Figure 2-9 Hepatic artery.** A longitudinal oblique view demonstrates the hepatic artery (H) between the main portal vein (P) and common bile duct (C) as it enters the liver. I—inferior vena cava.



**Figure 2-10 Reidel's lobe.** A longitudinal image shows a Reidel's lobe (RL) projecting from the right lobe of the liver. The right kidney (RK) is seen posteriorly.

## Liver Pathology

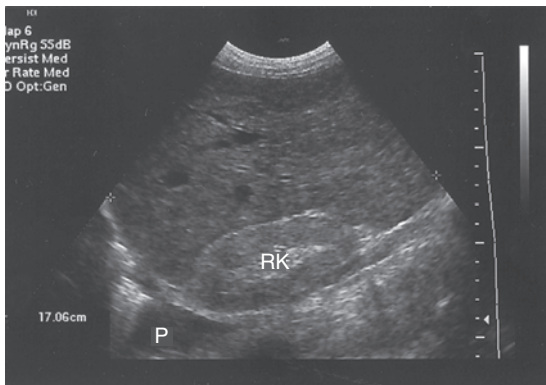
### *Diffuse Diseases*

#### *Hepatomegaly*

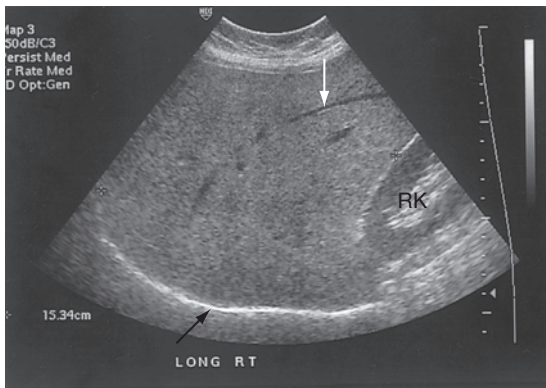
- Liver measures more than 15 cm in length (Figure 2-11)
- Commonly seen with infiltrative diseases and masses in the liver

#### *Fatty Liver*

- Mild (early stage)
  - Minimal increase in liver echogenicity
  - Intrahepatic vessels and diaphragm well visualized (Figure 2-12A)
- Moderate (mid stage)
  - Moderate increase in liver echogenicity
  - Intrahepatic vessels and diaphragm suboptimally visualized



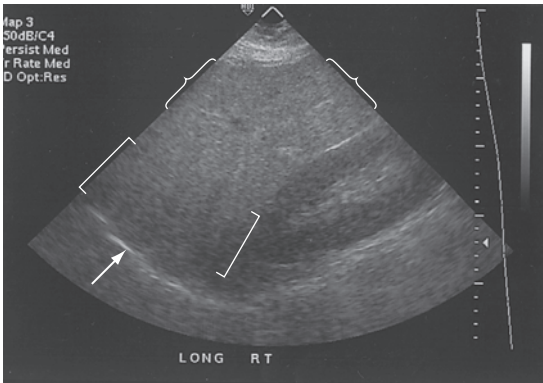
**Figure 2-11 Hepatomegaly.** Liver measurement in a longitudinal section shows enlargement of the organ (RK—right kidney, P—pleural effusion).



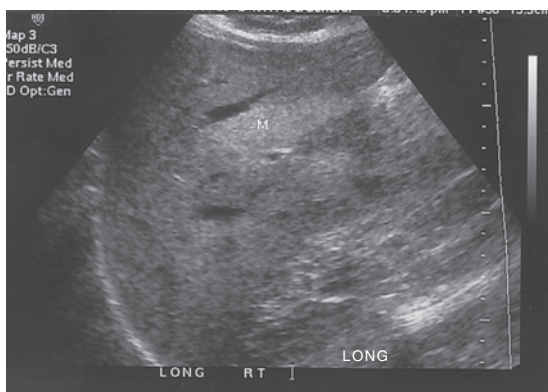
**Figure 2-12A Mild fatty infiltration of the liver.** A longitudinal image showing generalized increased echogenicity of the liver. Note that the diaphragm (black arrow) and section of an intrahepatic vessel (white arrow) are well visualized. Right kidney (RK) is posterior to the liver.



- Severe (late stage)
  - Significant increase in liver echogenicity
  - Poor visualization of posterior aspect of liver
  - Poor or nonvisualization of intrahepatic vessels and diaphragm (Figure 2-12B)
- Focal fat infiltration
  - Hyperechoic area within an otherwise normal liver; commonly seen in right lobe and may resolve over time (Figure 2-13)
- Focal fat sparing
  - Area of normal liver within fatty liver; commonly seen anterior to portal vein and gallbladder (Figure 2-14)
- Focal fat infiltration and sparing may mimic liver tumor



**Figure 2-12B Severe fatty infiltration of the liver.** A longitudinal image showing increased echogenicity of the liver in the anterior segment { }. The posterior segment [ ] is hypoechoic because of poor penetration of the beam. The diaphragm (arrow) is poorly demonstrated and the intrahepatic vessels are not seen.



**Figure 2-13 Focal fatty infiltration.** A longitudinal image showing hyperechoic area (M) consistent with focal fatty infiltration.



**Figure 2-14 Focal fatty sparing.** The longitudinal image demonstrates normal liver (M) surrounded by liver with increased echogenicity caused by fatty infiltration.

*Cirrhosis*

- Early stage
  - Liver echogenicity increased
- Late stage
  - Irregular surface (nodules), enlarged caudate lobe, and small right lobe (Figure 2-15A,B)
- Associated findings may include dilated portal vein, portal vein flow away from liver (hepatofugal), recanalized umbilical vein, splenomegaly, and ascites.
- Ascites seen as anechoic area or areas around abdominal organs and in flanks and pelvis (see Chapter 12)

*Cystic Masses*

*Epithelial Cyst*

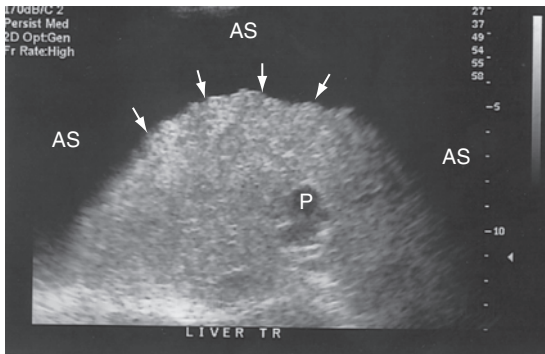
- Single or multiple, anechoic, well-defined cystic mass(es) with good posterior enhancement (Figure 2-16)
- Cyst may become complex with internal echoes caused by hemorrhage or infection (Figure 2-17).
- Complex cyst may mimic tumor.

*Polycystic Liver Disease*

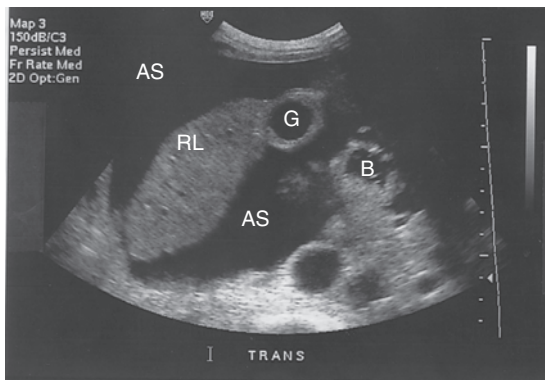
- Multiple anechoic masses with posterior enhancement (Figure 2-18)
- May have low level echoes (debris)
- May have echogenic wall calcification
- Associated with polycystic kidney disease (see Chapter 6)

*Inflammatory Diseases (Abscesses)*

- Common types include echinococcal, pyogenic, and amebic.
- Abscesses may be intrahepatic, subhepatic, and subphrenic (subdiaphragmatic).
- Variable sonographic appearances as described later here

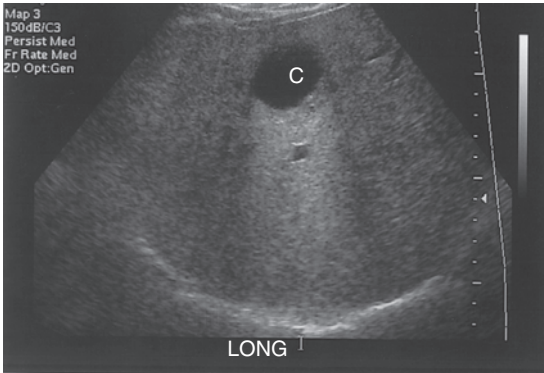


(A)

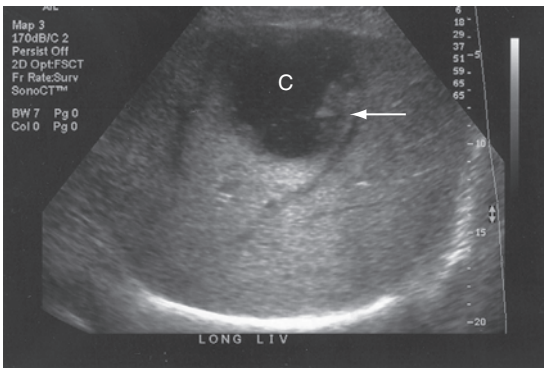


(B)

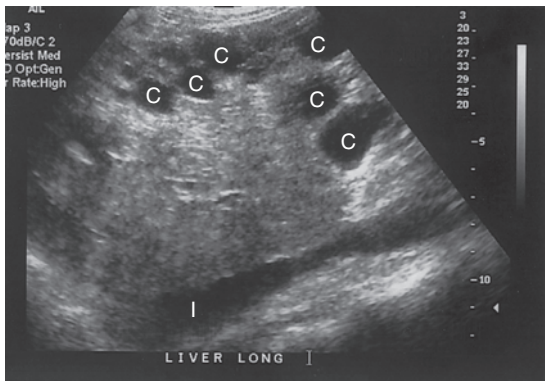
**Figure 2-15A & B Late stage cirrhosis.** Transverse views of the liver demonstrate surface nodularity in (A) (white arrows) and a small right lobe (RL) in image (B). Ascites (AS) is seen surrounding the liver: P—portal vein, G—gallbladder, B—bowel.



**Figure 2-16 Epithelial cyst.** Longitudinal image shows a simple hepatic cyst (C), which is anechoic with smooth borders, and acoustic enhancement posteriorly.



**Figure 2-17 Complex hepatic cyst.** Longitudinal view show hepatic cyst (C) with medium-level echoes (white arrow).



**Figure 2-18 Polycystic liver disease.** Longitudinal sonogram showing multiple liver cysts (C) in a patient with advanced polycystic kidney disease. I—inferior vena cava.

#### *Echinococcal Cysts*

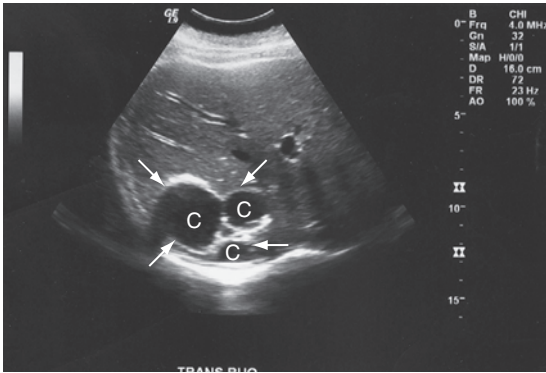
- Varies from simple cysts (completely anechoic) to complex mass (cyst with internal echoes)
- Posterior enhancement
- Echogenic thin linear septations and wall calcifications may be seen
- Large cyst (mother cyst) with smaller cysts within (daughter cysts) is specific for echinococcosis (Figure 2-19).

#### *Pyogenic Abscess*

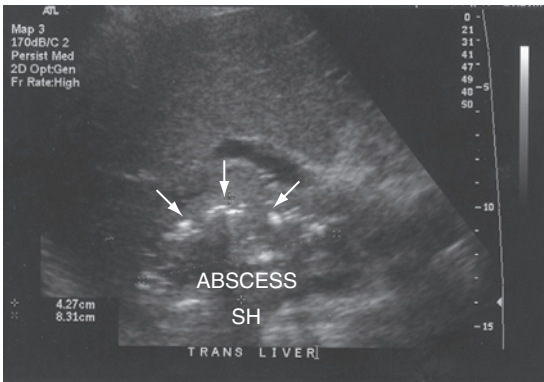
- Round or ovoid mass
- Irregular walls
- Anechoic to hyperechoic
- Enhancement in most cases
- Echogenic area with shadowing represents air from gas-producing organisms (Figure 2-20)

#### *Amebic Abscess*

- More common in right lobe
- Round or oval shape mass



**Figure 2-19 Echinococcal cyst.** The transverse sonogram of the liver demonstrates a mother cyst (between arrows) containing several daughter cysts (C).



**Figure 2-20 Pyogenic abscess.** Transverse image of the right lobe of liver showing a pyogenic abscess. Note the presence of multiple echogenic foci (arrows) with shadowing (SH) posteriorly. These represent gas bubbles within the abscess.

- Low-level internal echoes (Figure 2-21A,B)
- Distal acoustic enhancement

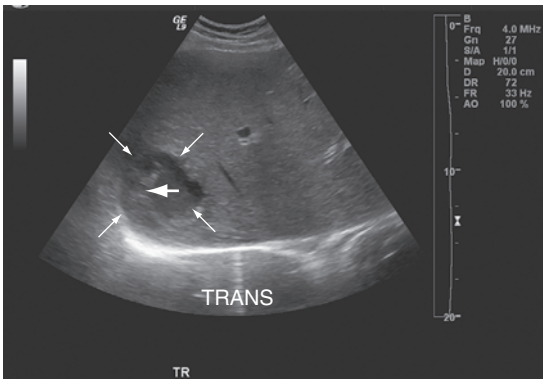
### ***Benign Liver Tumors***

#### *Cavernous Hemangioma*

- Commonly seen in posterior aspect right lobe
- Round, hyperechoic solid mass (Figure 2-22)
- Well-defined borders
- Normally less than 3 cm in size but may be larger
- Can mimic liver tumor

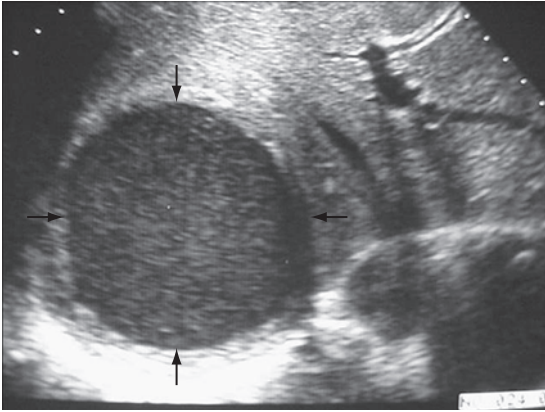
#### *Focal Nodular Hyperplasia*

- Commonly isoechoic to liver texture but may be hyperechoic to hypoechoic (Figure 2-23)
- May have a central fibrous scar that may be hypoechoic or hyperechoic and linear
- Increased vascularity within central scar
- May mimic hepatoma or adenoma (see later here)

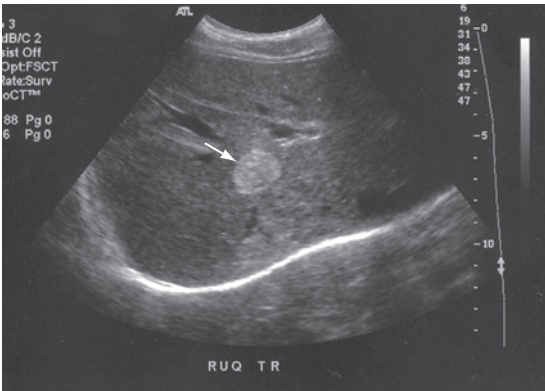


**Figure 2-21A Amebic abscess.** (A) A transverse sonogram showing an amebic abscess (between white arrows) in the right lobe of liver. Note the presence of diffuse low-level echoes and a thick septation (small white arrow).

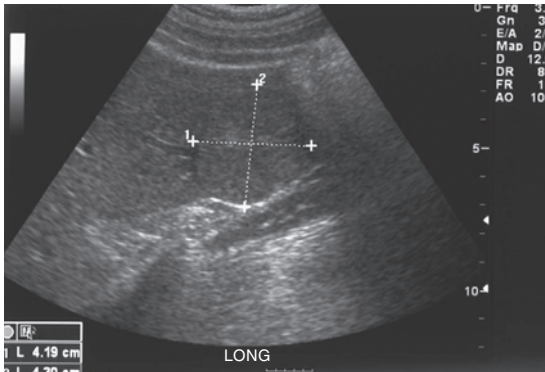




**Figure 2-21B** (B) The transverse view shows a large, well-defined cystic mass with low-level echoes and moderate posterior enhancement (between arrows).



**Figure 2-22 Cavernous hemangioma.** The transverse view demonstrates a small, rounded hyperechoic mass (arrow) consistent with a hemangioma.



**Figure 2-23 Focal nodular hyperplasia.** Longitudinal section of liver with a rounded mass (between calipers), which is isoechoic to the adjacent liver texture. This represents focal nodular hyperplasia.

#### *Liver Cell Adenoma*

- Hypoechoic, hyperechoic, isoechoic, or complex mass
- Fluid component and intraperitoneal blood seen with hemorrhage
- May mimic focal nodular hyperplasia

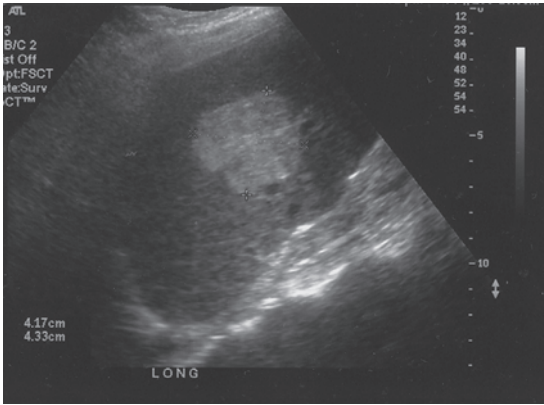
#### *Lipoma and Angiomyolipoma*

- Well-defined echogenic masses (Figure 2-24)
- May mimic hemangiomas, liver metastasis, or focal fat infiltration

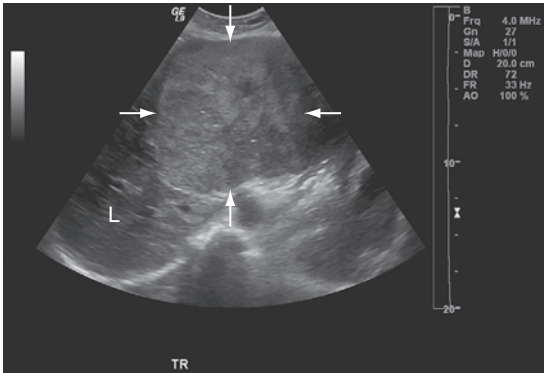
#### *Malignant Hepatic Neoplasms*

##### *Hepatoma (Hepatocellular Carcinoma) and Metastasis*

- Hepatomas and metastasis may have a similar appearance.
- Single or multiple masses
- Hypoechoic, isoechoic, or hyperechoic to liver texture (Figure 2-25)



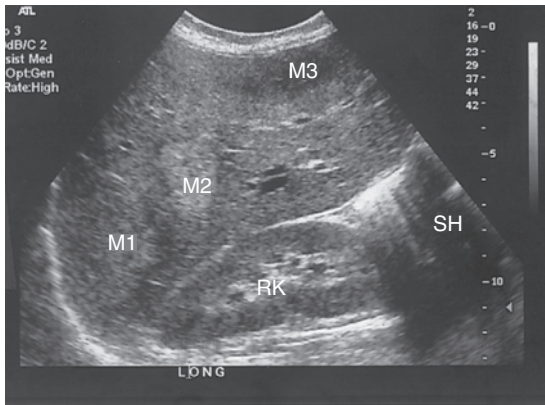
**Figure 2-24 Lipoma.** Longitudinal image shows lipoma as an echogenic liver mass (between calipers).



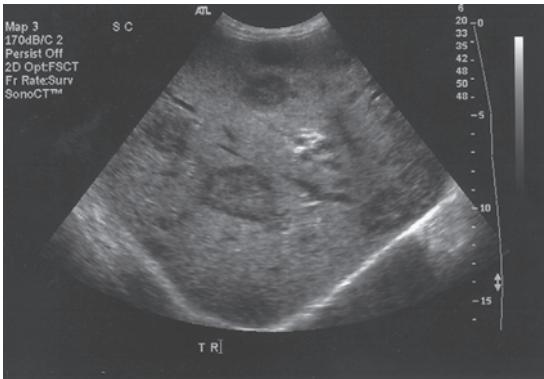
**Figure 2-25 Hepatoma.** Transverse view of the liver showing a large hepatoma, which presents as a discrete mass with well-defined borders (between arrows). The mass is slightly more echogenic than the adjacent areas of normal liver texture (L).

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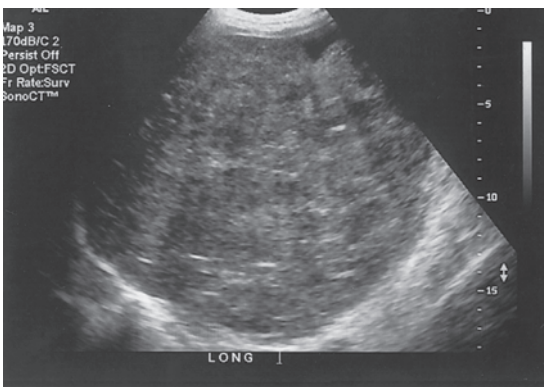
- Metastatic lesions commonly have the following features:
  - Multiple masses (Figure 2-26A)
  - Hypoechoic mass with echogenic center (bull's-eye appearance) (Figure 2-26 B)
  - Echogenic calcification(s)
  - Diffusely inhomogeneous liver parenchyma without discrete mass(es) (Figure 2-26C)
- Low-level echoes in portal vein, hepatic vein, IVC, and bile ducts may represent tumor (Figure 2-27).
- Benign tumors (e.g., adenomas and focal nodular hyperplasias) can mimic hepatomas and metastasis



(A)

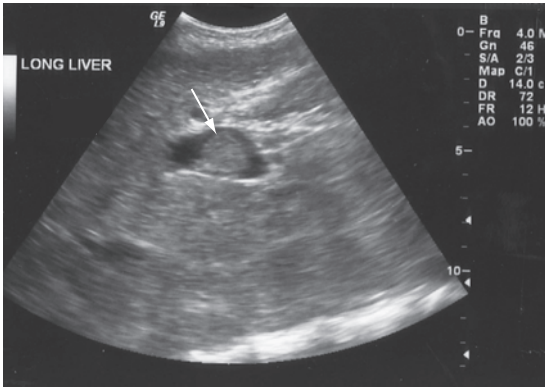


(B)



(C)

**Figure 2-26A–C Liver Metastasis.** Longitudinal (A and C) and transverse (B) views demonstrating various sonographic patterns of metastasis. In (A), liver masses are of varying echogenicities when compared with the adjacent liver texture. Mass (M1) is isoechoic, mass (M2) hyperechoic, and mass (M3) is hypoechoic. In (B), a bull's-eye appearance is seen as hypoechoic masses with an echogenic center. In (C), the liver is diffusely inhomogeneous without a discrete mass or masses.



**Figure 2-27** Tumor/thrombus in portal vein. The echogenic mass (arrow) seen in the portal vein represents tumor: Note the inhomogeneity of liver texture consistent with metastatic disease.