Republic of Iraq
Ministry of Higher Education
Al-Mustaqbal University
Radiology Techniques Department
Second Stage \ Special Radiological Procedures-1

Lecture No. (one)

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Lecture No. (two part 1)

Methods of Imaging the Hepatobiliary System

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Ultrasound of the Liver

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Methods of Imaging the Hepatobiliary System

1. Plain film

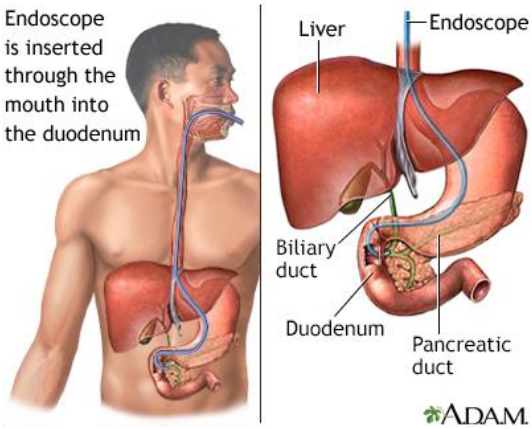
2. Ultrasound (US):

(a) Transabdominal

(b) Endoscopic

(c) Intraoperative

3. Computed tomography (CT), including:



(a) Routine ‘staging’ (portal venous phase) CT

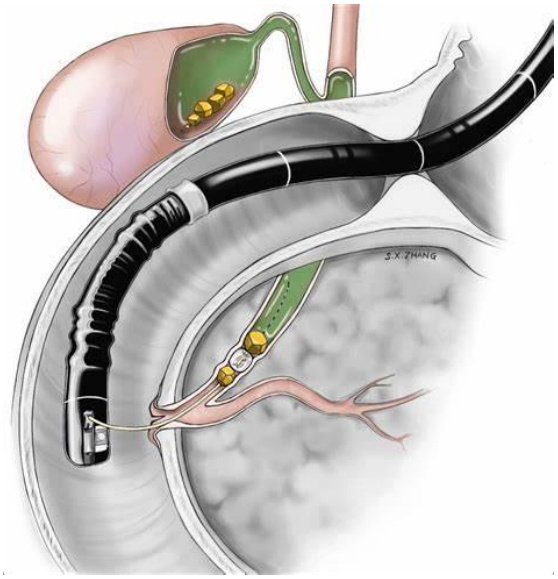
(b) Triple phase ‘characterization’ CT

(c) CT cholangiography

4. Magnetic resonance imaging (MRI)

5. Endoscopic retrograde cholangiopancreatography (ERCP)

6. Percutaneous transhepatic cholangiography (PTC)



7. Operative cholangiography

8. Postoperative (T-tube) cholangiography

9. Angiography—diagnostic and interventional

10. Radionuclide imaging:

(a) Static, with colloid

(b) Dynamic, with iminodiacetic acid derivatives.

Methods of Imaging the Pancreas

1. Plain abdominal films

2. US:

(a) Transabdominal

(b) Intraoperative

(c) Endoscopic

3. CT

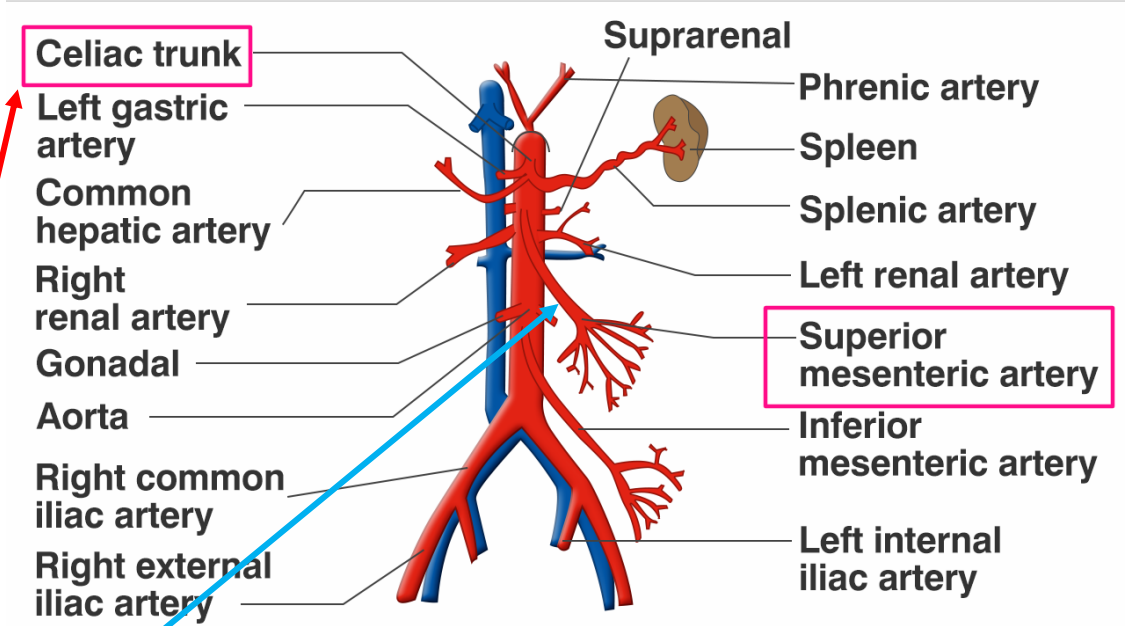
4. MRI

5. ERCP

6. Arteriography:

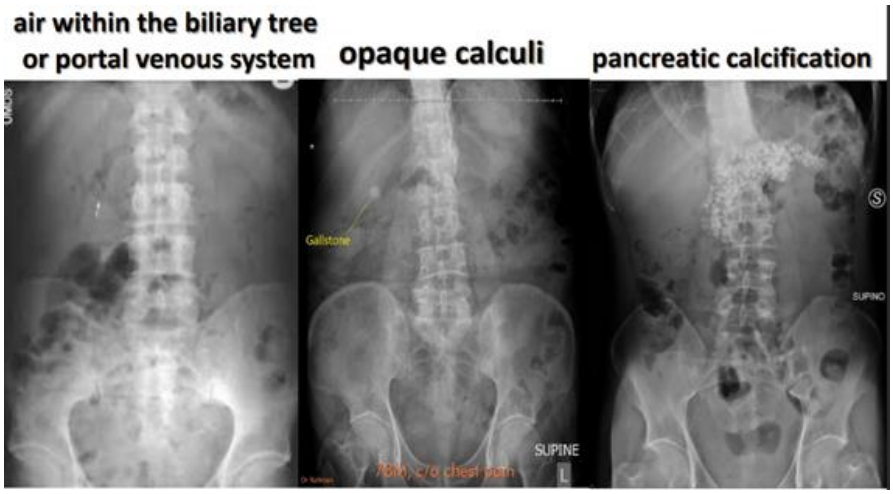
(a) Coeliac axis

(b) Superior mesenteric artery



Plain Films

Not a routine indication. **May incidentally demonstrate** **air** within the biliary tree **or** portal venous system, opaque calculi **or** pancreatic calcification.



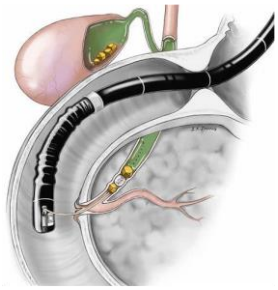
Pneumobilia, also known as aerobilia, is accumulation of gas in the biliary tree.

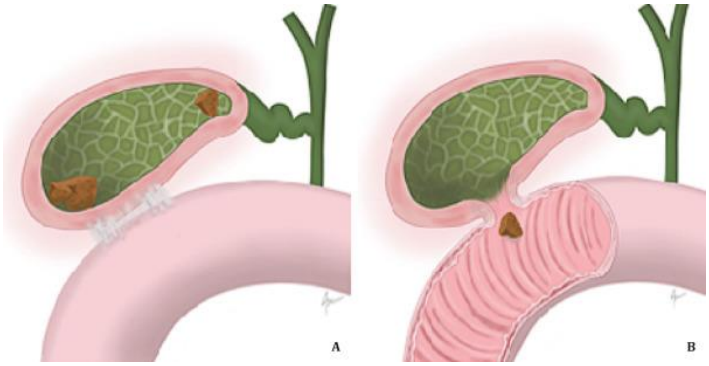
Etiology

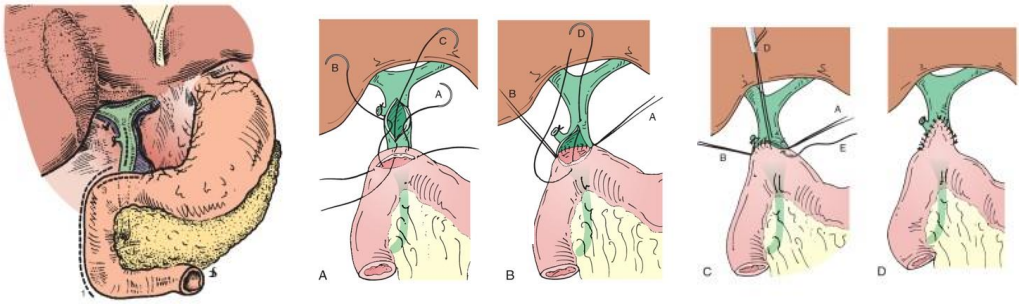
1. recent biliary instrumentation (ERCP)
2. incompetent sphincter of Oddi
3. biliary-enteric anastomosis
4. spontaneous biliary-enteric fistula
5. infection

biliary-enteric fistula

ERCP







biliary-enteric anastomosis

Ultrasound of the Liver

Indications

1. Suspected focal or diffuse liver lesion

2. Jaundice

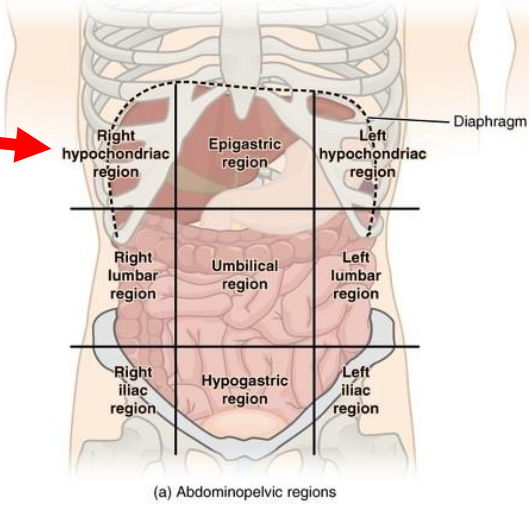
3. Abnormal liver function tests

4. Right upper-quadrant pain or mass

5. Hepatomegaly

6. Suspected portal hypertension

7. Staging known extrahepatic malignancy, **superseded by** CT



(a) Abdominopelvic regions

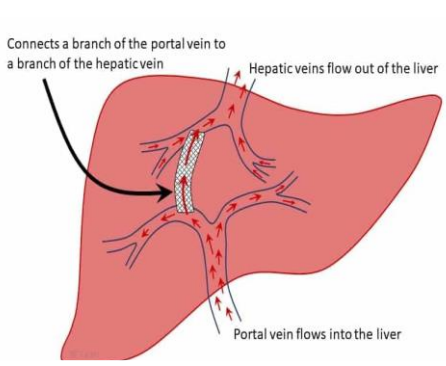
8. Pyrexia of unknown origin, **now superseded by** CT for patients over 30 years old

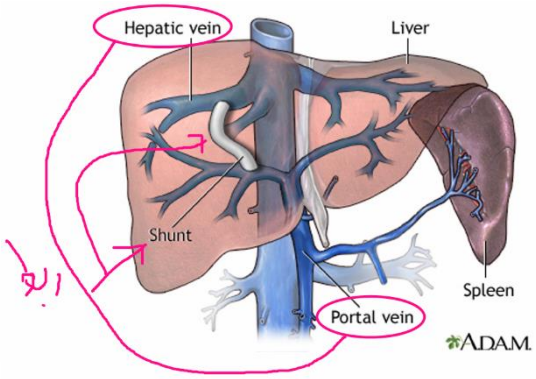
9. To provide real-time image guidance for the **safe** placement of needles for biopsy

10. Assessment of portal vein, hepatic artery or hepatic veins

11. Assessment of patients with surgical **shunts** or transjugular intrahepatic portosystemic shunt (TIPS) procedures

12. Follow-up after surgical resection or liver transplant





Contraindications

None.

Patient Preparation

Fasting or **restriction to clear fluids only required if the** gallbladder **is also to be studied.**

Equipment

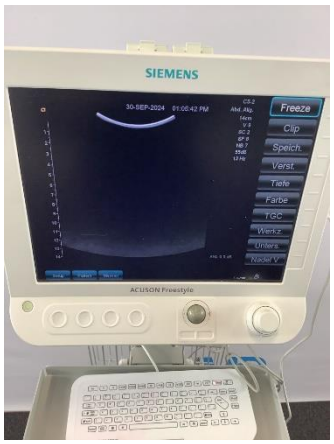
3–5-MHz **transducer** and contact gel.

Q. Selection of the appropriate preset protocol and positioning of focal zone will depend upon the type of machine, manufacturer and patient habitus.

Intravascular Ultrasound Machines

Contrast-enhanced Ultrasound Machines

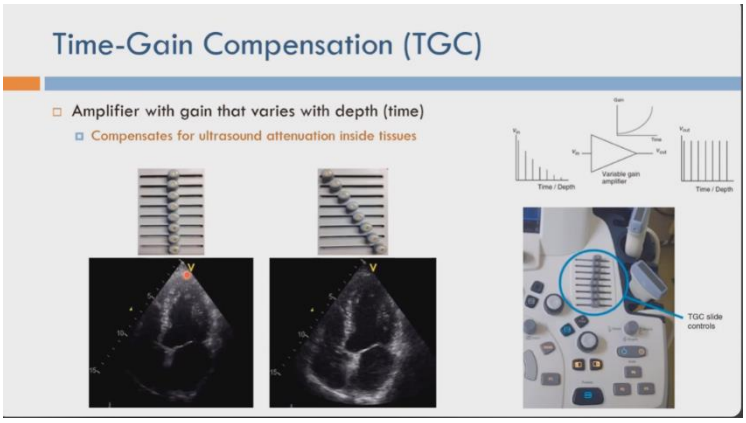
Needle Electrode based Ultrasound Machines

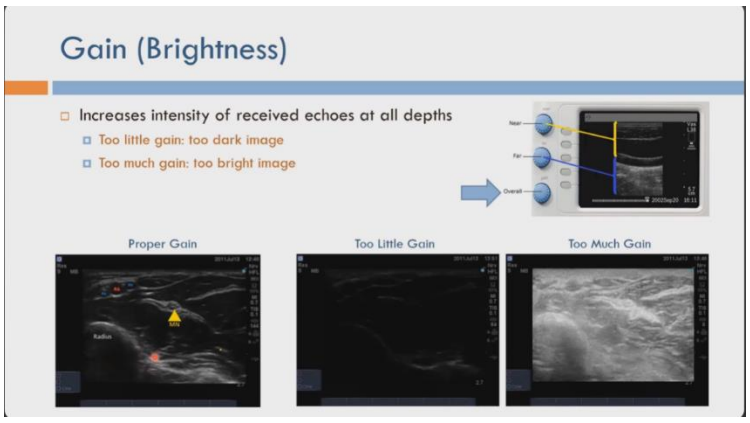


Technique

1. Patient supine

2. Time-gain compensation **(TGC) set** to give uniform reflectivity throughout the right lobe of the liver





1. Suspended respiration = intercostal = when liver small or high
2. Suspended inspiration = subcostal = to bring liver below ribs
3. Suspended expiration = not use

3. Suspended inspiration

4. Longitudinal scans from epigastrium or left subcostal region ac**ross to** right subcostal region. ***The transducer** should be **angled** cephalad **to include** the **whole** of the **left** and **right lobes**.

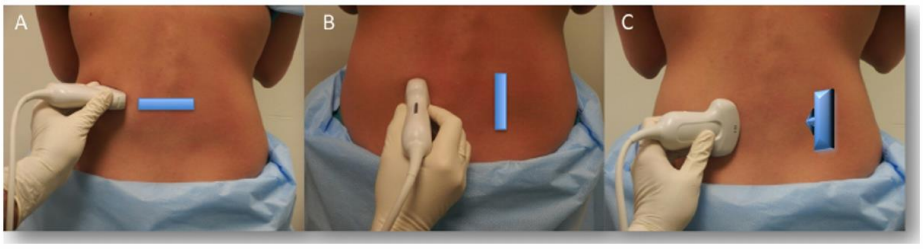
5. Transverse scans, subcostally, **to visualize** the whole liver

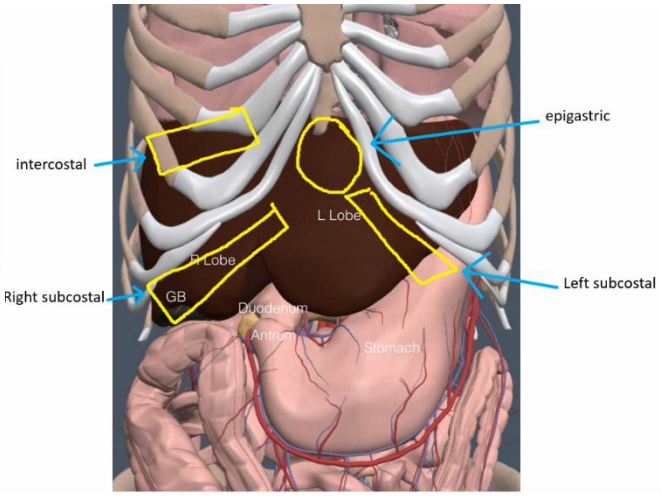
6. **If visualization is incomplete**, **due to** a **small** or **high-positioned liver**, then additional right intercostal, longitudinal, transverse and oblique *scans* **may be useful**.

*Suspended respiration **without deep inspiration** may **allow useful intercostal scanning.**

***In patients** who are **unable to hold their breath**, **real-time scanning** during quiet respiration is **often adequate**.

*Upright **or** left lateral decubitus **positions** are alternatives **if visualization is still incomplete.**



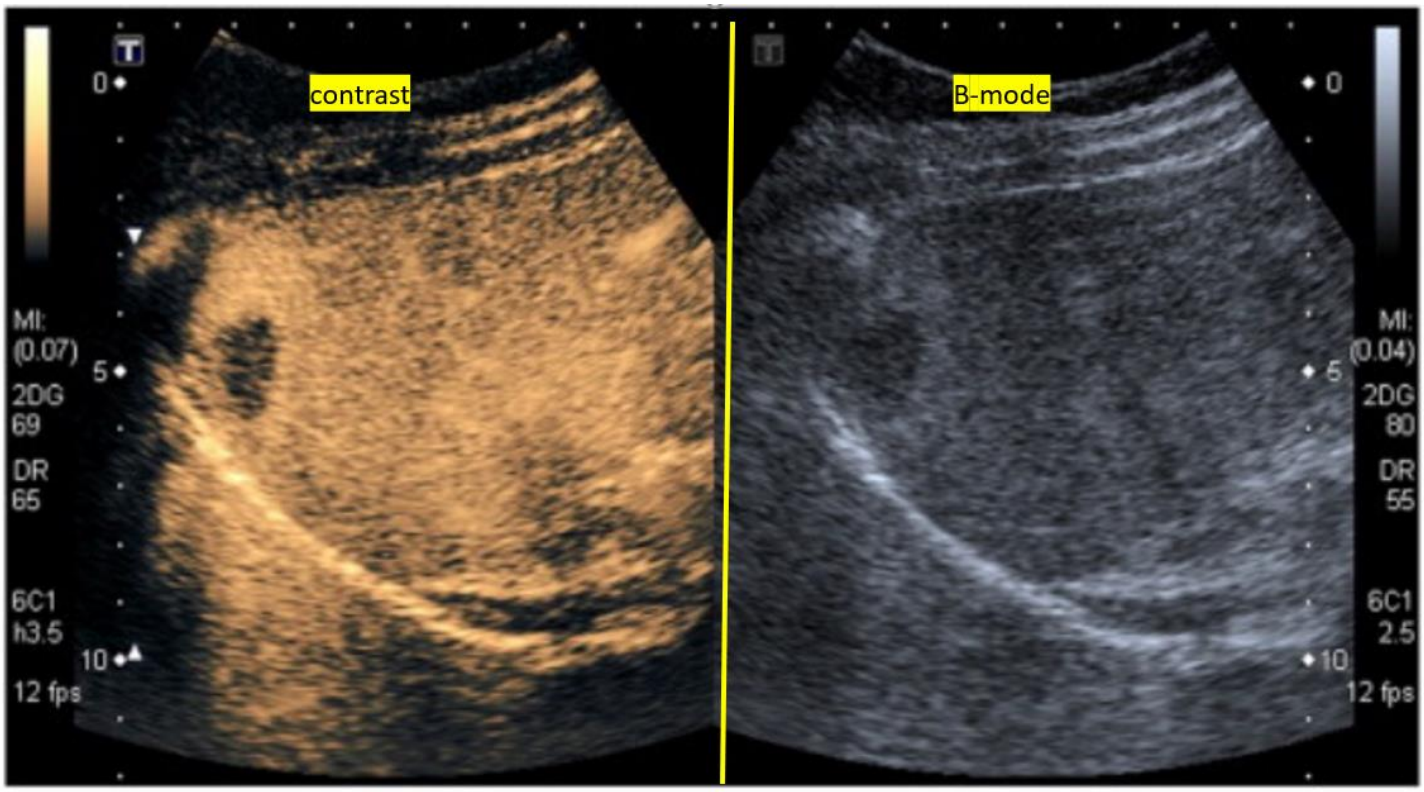


7. **Contrast-enhanced ultrasound** of the liver uses microbubble agents to **enable the contrast enhancement pattern of focal liver lesions**, analogous to contrast-enhanced CT or MRI, to be assessed and thus to characterize them.

It requires specific software on the ultrasound machine. The lesion to be interrogated is identified on conventional B mode scanning, and then the scanner is **switched to** low mechanical index (to avoid bursting the bubbles too quickly) contrast-specific scanning mode, with a **split screen** to allow the contrast-enhanced image to be simultaneously viewed with the B mode image. The **images are recorded *after* bolus injection** of the **contrast agent flushed with saline.**

• **Advantages**: **Feasible** even in the presence of **impaired renal function**

• **Disadvantages**: Limited to single lesion visualization **per pass**



Ultrasound imaging of a human liver with microbubble contrast agents: non-linear mode preferentially showing bubbles (left) and standard linear B-mode image (right).

Additional Views

1. Hepatic veins 2. Portal vein 3. Hepatic artery 4. Spleen

Hepatic veins

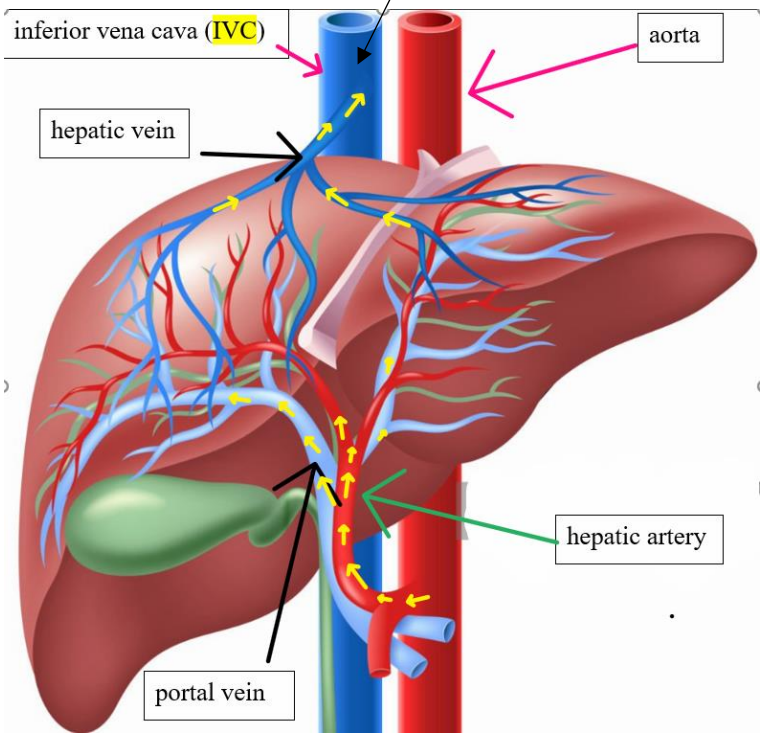
1. These are **best seen** using a transverse intercostal or epigastric approach.

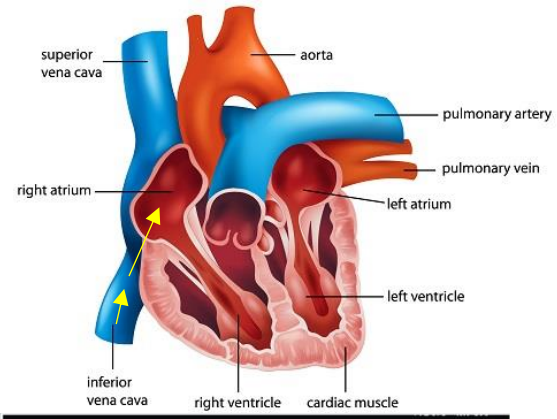
2. During **inspiration**, in real time, these can be seen traversing the liver **to** enter the inferior vena cava (IVC).

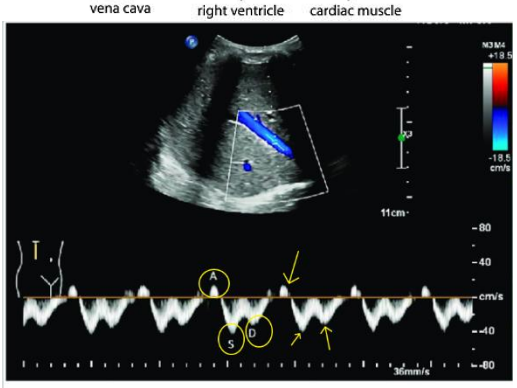
3. **Hepatic vein walls** do not have increased reflectivity in **comparison** to **normal liver parenchyma**.

4. **The normal hepatic vein waveform on Doppler *is*** triphasic, reflecting right atrial pressures.

***Power Doppler** may be useful to examine flow within the hepatic segment of the IVC since it is angle-independent.







Normal hepatic vein flow pattern detected by Doppler. The hepatic vein has a triphasic waveform, which consists of an A wave above the baseline (representing atrial systole), and two waveforms below the baseline (S and D, representing venous return during ventricular systole and diastole, respectively).

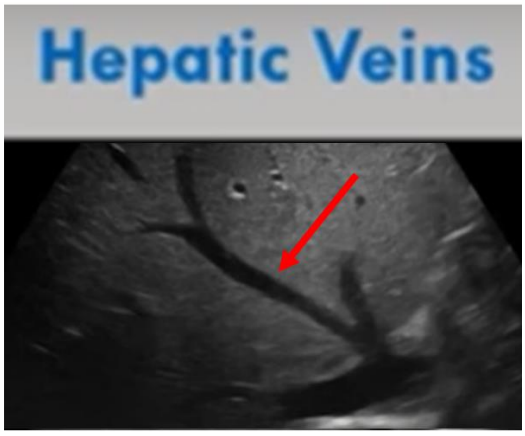
Portal vein

1. The longitudinal view of the portal vein is ***shown*** by an **oblique** subcostal or intercostal approach.

2. Portal vein walls are of increased reflectivity in **comparison to parenchyma**.

3. The normal portal vein blood flow is toward the liver.

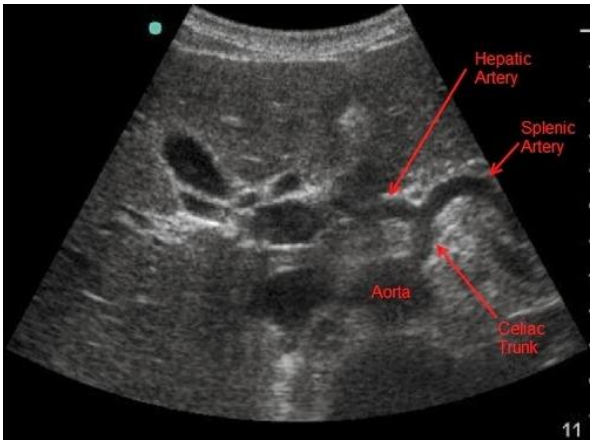
4. **There is usually** continuous flow, ***but*** **the velocity may vary with respiration**.

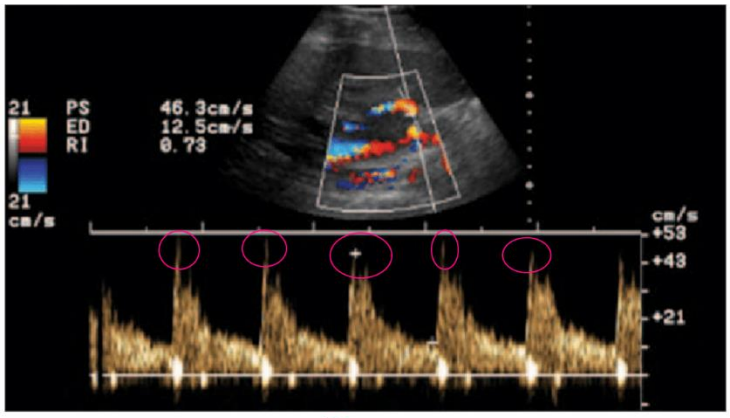


Hepatic artery

1. This may be traced from the coeliac axis, which is **recognized** by the 'seagull' appearance of the origins of the common hepatic artery and splenic artery.

2. There is normally forward flow throughout **systole** and **diastole**, with a sharp systolic peak.





Normal spectral waveform of hepatic artery with sharp systolic upstroke in 44-year-old man 3 months after transplantation. PS = peak systolic velocity, ED = end-diastolic velocity, RI = resistive index.

Spleen

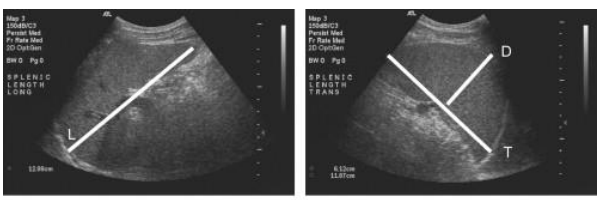
The spleen size ***should*** **be measured in all cases of** suspected liver disease or portal hypertension.

*Ninety-five percent (95%) of **normal adult spleens measure** 12 cm or less in length, **and** less than 7 × 5 cm in thickness.

*The **spleen size** is **commonly assessed** by 'eyeballing' and **measurement** of the longest diameter.

***In children**, splenomegaly should be **suspected if the spleen** is more than 1.25 times the **length of** the adjacent kidney (left kidney);

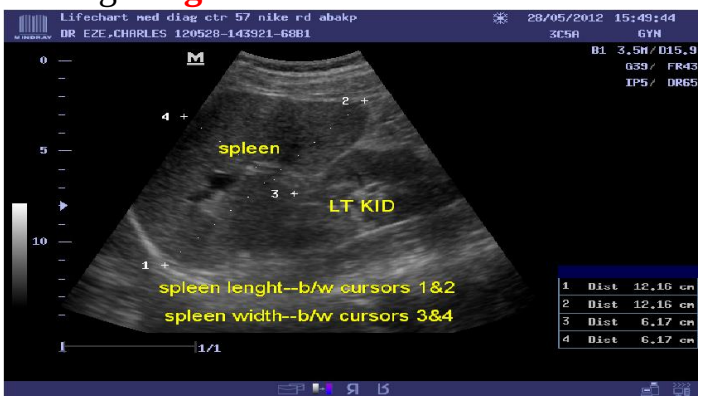
***Normal ranges** have also been **tabulated** according to **age** and **sex**.



Longitudinal diameter (L) is the greatest dimension of the spleen on a longitudinal image through the hilum

Transverse diameter (T) is the greatest dimension on a transverse image through the hilum

Diagonal diameter (D; thickness) measured in transverse image through the hilum as the distance from the hilum to the outer convex surface, approximately perpendicular to the transverse diameter



General Information

-digestive system --gastrointestinal tract (GIT)- barium swallow, meal, follow-through, enema

-hepatobiliary system- cholangio-(C) cholangiopancreato (CP)

-urinary system

-reproductive system

-cardiovascular system

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cranial-cephalad-toward the head- Up- ⬆

caudally-toward the feet- Down- ⬇

Angiography (blood vessel, artery, vein, arteriovenous. vascular)
Arteriography---------- artery

Plain Film = early - initial

Contrast

1. x ray (CT, Fluoroscopy, Conventional x ray) iodine rarely barium

2. MRI gadolinium

3. US microbubble agents