Quick Start Guide and Abdominal cases

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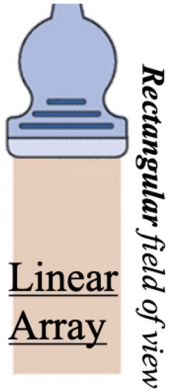
Cases

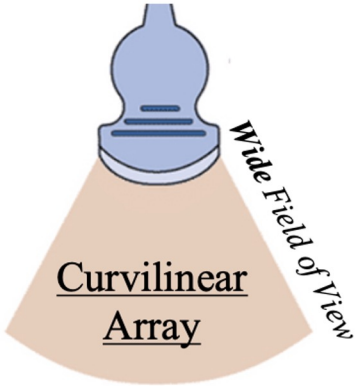
- Quick Start Guide
- How to scan the Liver and Gallbladder
- Choledocholithiasis
- Distended gallbladder and CBD
- Steatosis
- Ascites
- Paracentesis & evidence
- More Cases & Links

Quick Start Guide

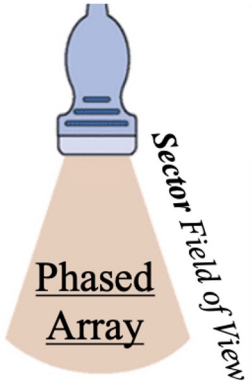
Ultrasound Transducer Probe Selection



Range: 5-10 Hz
Depth: 9 cm
Indication:
- Skin/ Soft Tissue
- Breast
- MSK
- Veins/ Arteries
- Pleura



Range: 2-5 Hz
Depth: 30 cm
Indication:
- Abdominal Aorta
- Kidney
- Liver
- Abd Free fluid
- Bladder

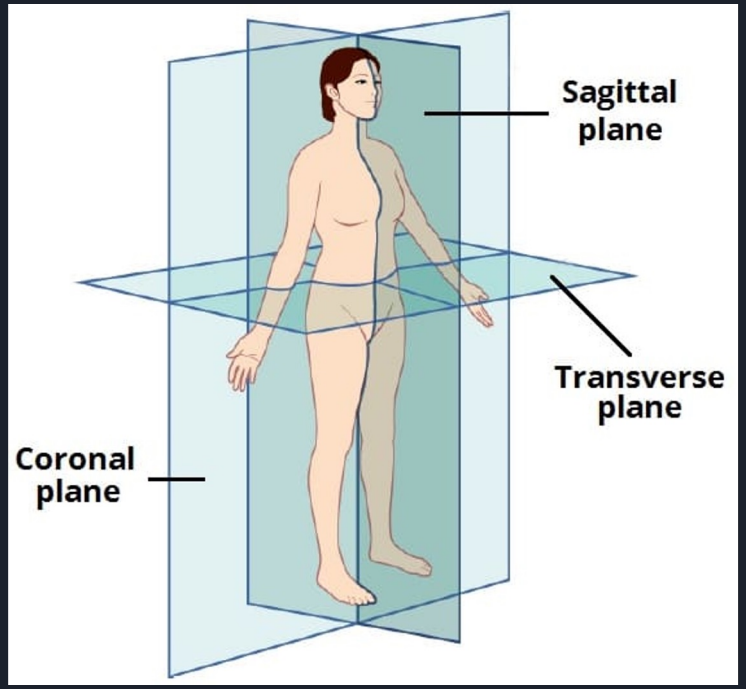


Range: 1-5 Hz
Depth: 35 cm
Indication:
- Heart
- Lungs/ Pleura
- IVC
- Abdomen

Key Terms

- Echogenicity:
  - outcome of soundwaves reflecting from a structure, “brightness” of the imaged structure is related to its characteristics.
- Hyperechoic
  - structures of high density produce brighter images as more soundwaves are reflected (example: bone, lesions)
- Hypoechoic:
  - structures of low density produce darker images as less soundwaves are reflected, and more are being absorbed.
- Anechoic images:
  - blacked out image that may indicate fluid (example: blood, ascites, urine, etc.)
- Image Artifacts:
  - features of an ultrasound “image” that does not represent the specific area being examined.

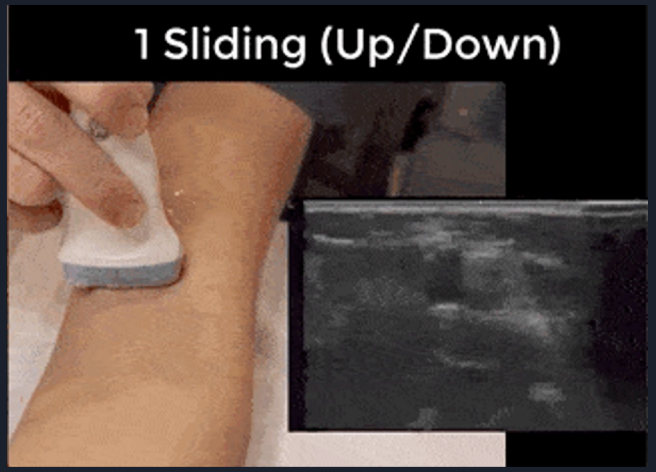
Key Terms

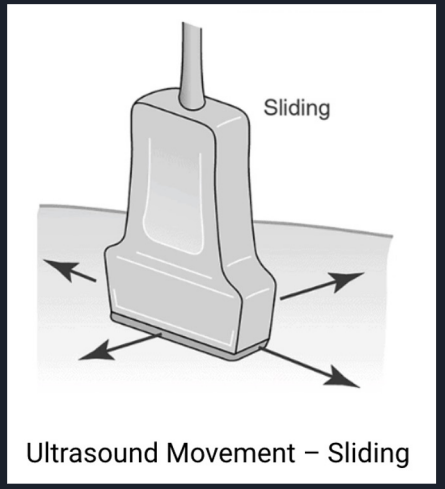


- Sagittal Plane
- Transverse Plane
- Coronal Plane
- Long Axis:
  - ultrasound array (beam) is on the longitudinal plane, parallel to the structure
- Short Axis:
  - ultrasound array (beam) is on the transverse plane, perpendicular to the structure

Key Terms

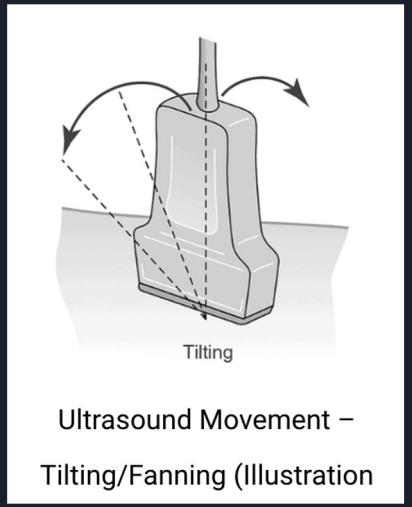
- B-Mode (Brightness Mode)
  - a setting that creates a two-dimensional (2D) grayscale image on your ultrasound screen and is the most commonly used mode. It is also commonly called 2D mode.
- Ultrasound M-mode
  - a motion versus time display of the B-mode ultrasound image along a chosen line. The motion is represented by the Y-axis and time is represented by the X-axis.
- Doppler modes
  - Color doppler
  - Pulse Wave doppler
  - Continuous wave doppler





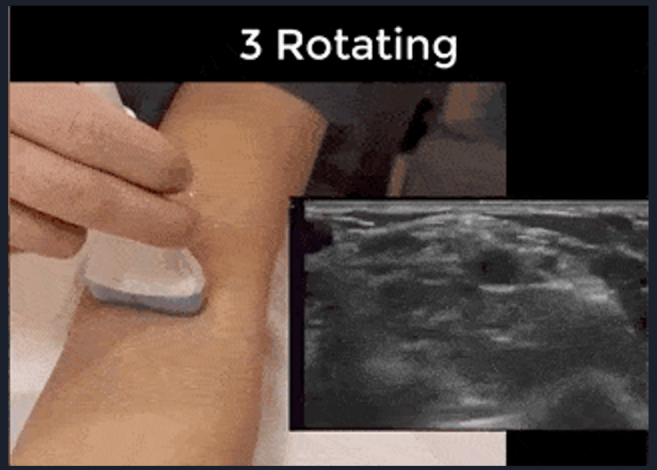
Ultrasound Movement – Sliding

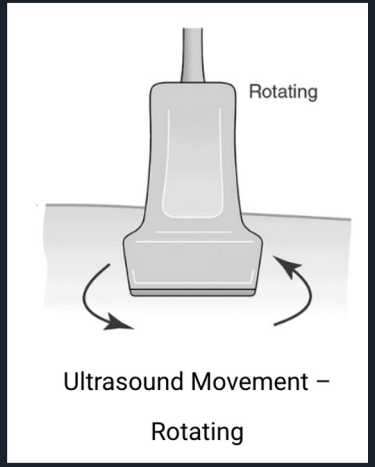
AKA “translating”



Ultrasound Movement – Tilting/Fanning (Illustration

AKA “toggling”



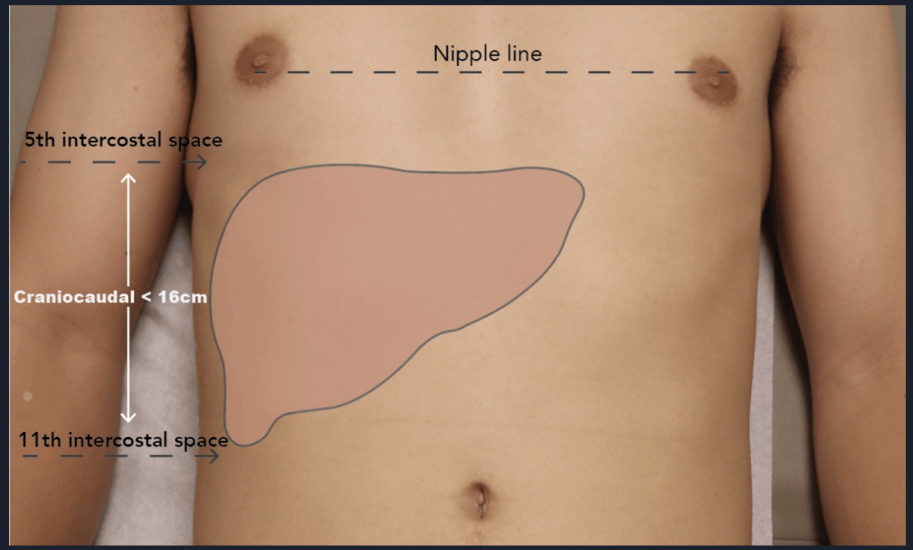


Ultrasound Movement – Rotating

Ultrasound Movement – Rocking

AKA “heel-toe”

How to Scan the Liver and Gallbladder



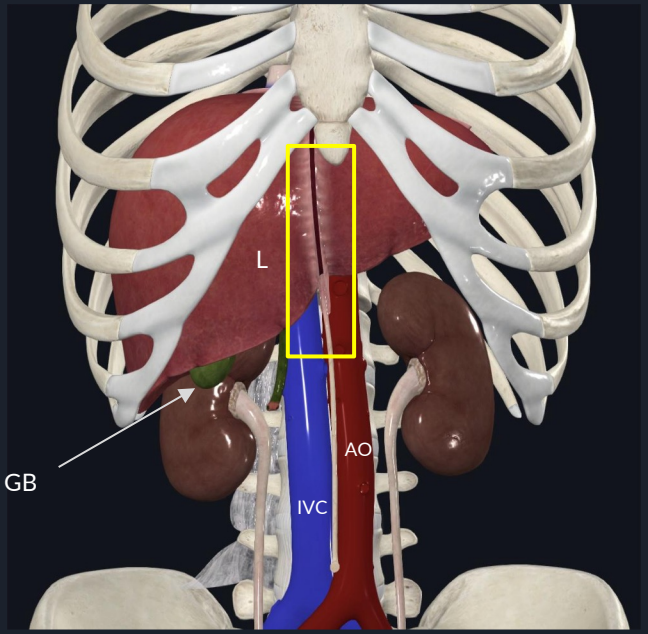
Patient Preparation

- Your patient should be supine with the head of the bed flat.
- Ask the patient to bend their legs at the knees, if possible, to help relax the abdominal muscles.
- Some applications such as the gallbladder ultrasound exam will require your patient to be on the left lateral decubitus position.

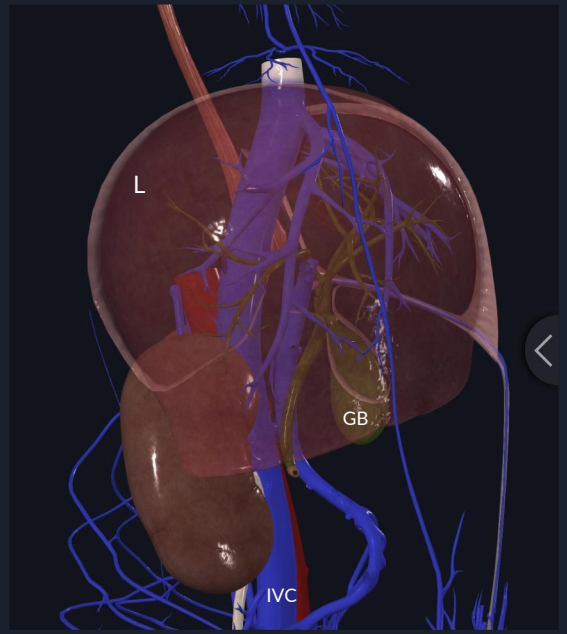
Ultrasound Machine Preparation

- Transducer: Curvilinear Ultrasound Probe (Ideal Choice) or Phased Array Probe.
- You may need to use a Linear Probe for appendicitis and pediatric applications
- Preset: Abdomen
- Machine Placement: Position the ultrasound machine on the right side of the patient with the screen facing you. With this configuration you can face both the patient and the ultrasound screen, scanning with your right hand and manipulating buttons on the machine with the left hand.

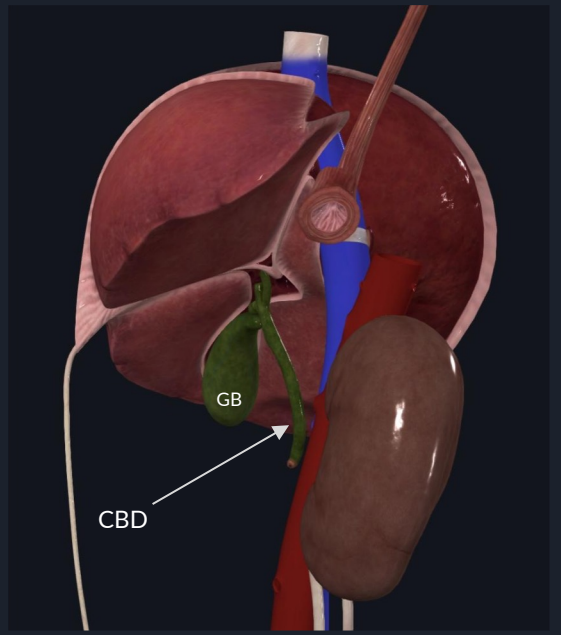
(Chiem, Dinh et al; pocus101.com)



Anterior view



View from patient's right side

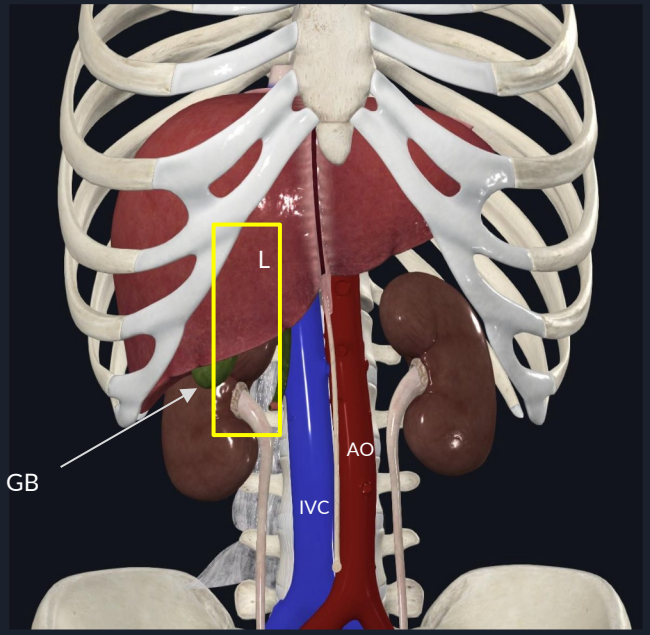


View from patient's left side

- One can start by placing the probe in the sagittal plane under the xiphoid process and finding the liver since it's first and easiest landmark to find.
- As with any organ, slide/translate across the long and short-axis to identify its size and orientation.
- For some patients, the liver remains entirely under the ribs and for others it extends far inferiorly into the abdomen.

Then identify the gallbladder, portal triad, IVC, and kidneys. I place these anatomical diagrams here because of some noteworthy anatomical characteristics:

- The IVC runs through the liver (which differentiates it from the aorta)
- The IVC is to the patient's right of the aorta
- If you scan from the patient's left side, you could potentially see the kidney, IVC, and aorta in one scan
- The gallbladder usually lies in it's fossa in the liver but can be highly variable in it's orientation (cephalo-caudal and left-to-right directions)



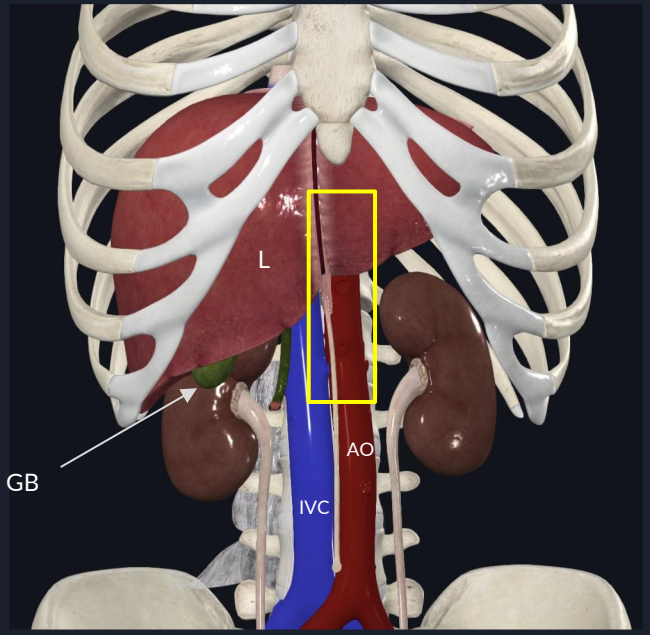
Anterior view

Assess the liver's echogenicity and capsular contour.

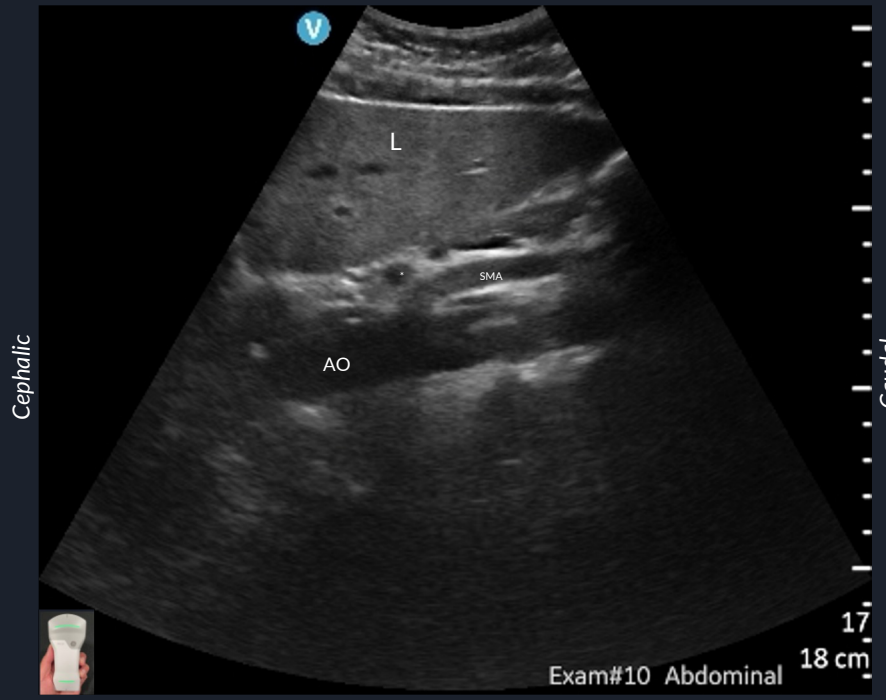
- Normally, the liver has a homogenous echogenicity similar in brightness to the renal cortex (Rumack). Check for notable variations, such as increased or decreased echogenicity, masses, or lesions.
- The liver should have a smooth capsular contour, again similar to that of the kidney. Note any marked coarseness or nodularity.

Measure the liver span in the craniocaudal dimension.

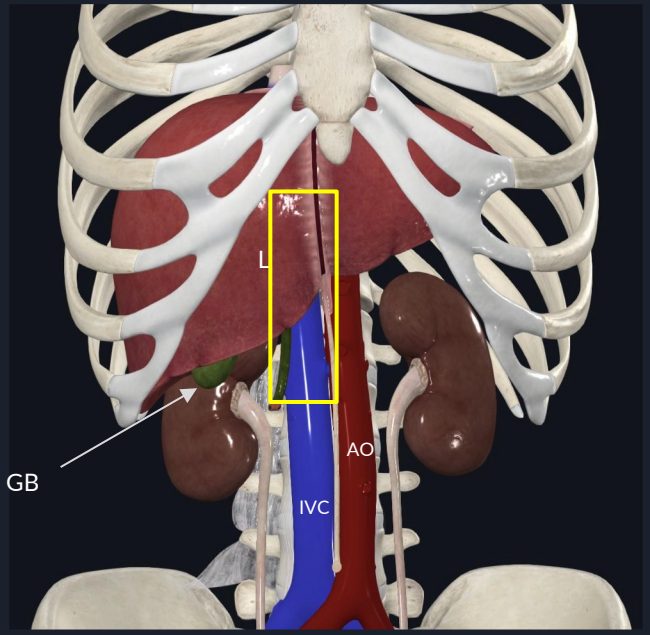
- Once you have visualized the structures listed above, freeze the image and measure the liver span from the diaphragmatic surface to the inferior border, as pictured below.
- Sometimes, the ultrasound window is too narrow to capture the liver's diaphragmatic surface and tip together on the screen. Estimate, to the best of your ability, where either of these surfaces would end if you could see them both, and place your calipers at your best guess.



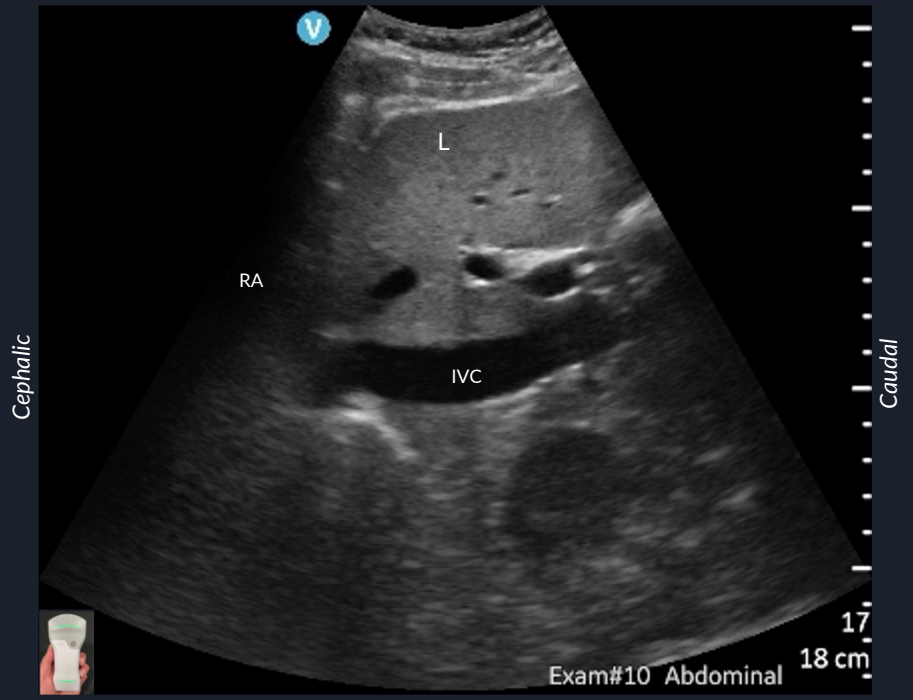
Anterior view



If you translate laterally to patient's left side, with a sagittal plane, you will see the aorta. This differs from the IVC because it does not go through the liver, does not lead into the right atrium, and you may identify the SMA (and celiac* even).

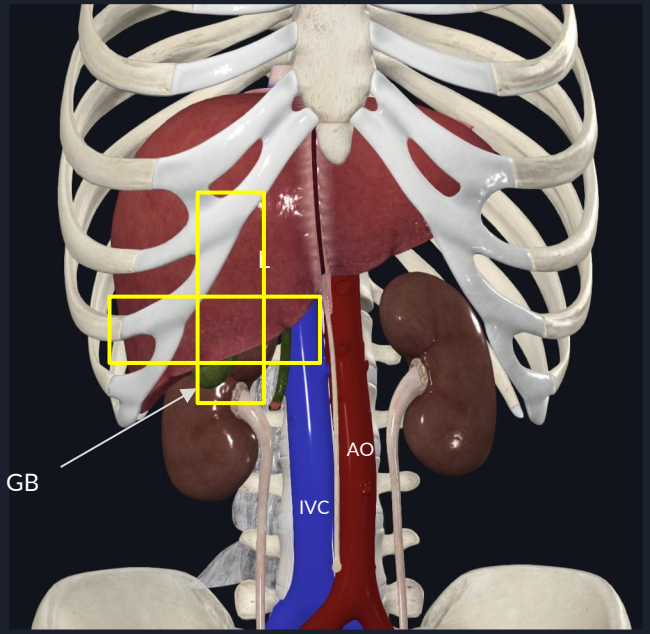


Anterior view

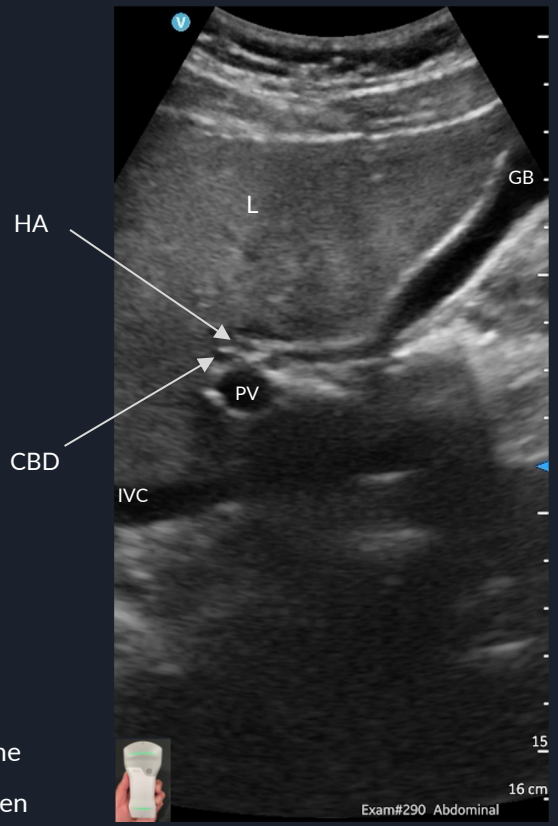


If you translate towards the patient's right side, along a sagittal plane, you will see the IVC. Notice how it goes through the liver and into the right atrium. The diameter can decrease by deep inspiration.

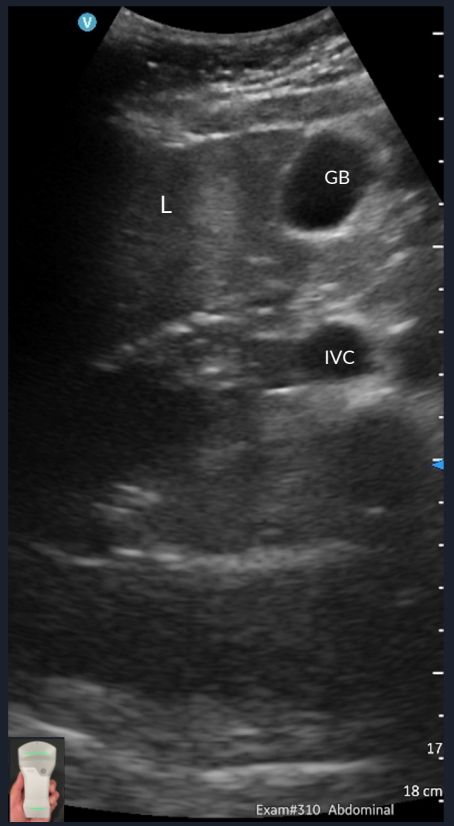
Note that the IVC and other organs can "pulsate" due to transmitting vibrations of the aorta and heart.



Anterior view

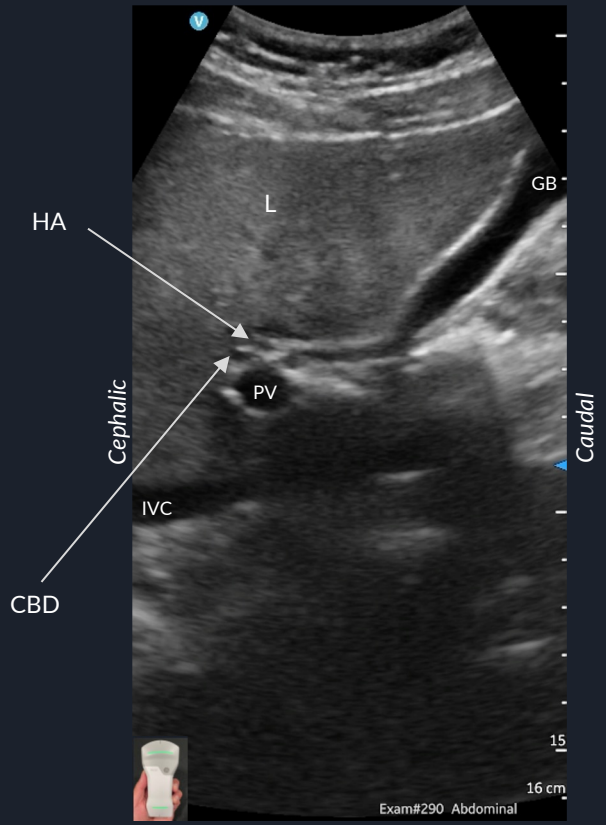


Long-axis plane: Normal

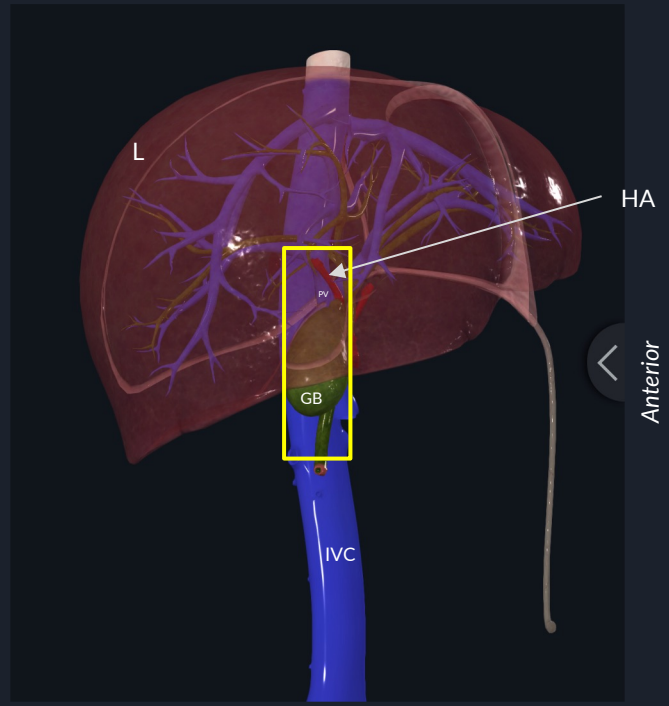


Short-axis plane: Normal

- The liver and gallbladder can be seen subcostally or intercostally. Additional important landmarks to see are the portal triad, the main lobar fissure, IVC, and kidney. GB stones, CBD dilation, and liver disease are pathologies often seen.
- Important pitfalls: non-fasting states can cause deflation of the gallbladder making it hard to see; recently eating also causes more bowel gas which can totally obscure scanning, the variable orientation of the GB will require rotating, fanning, and panning.

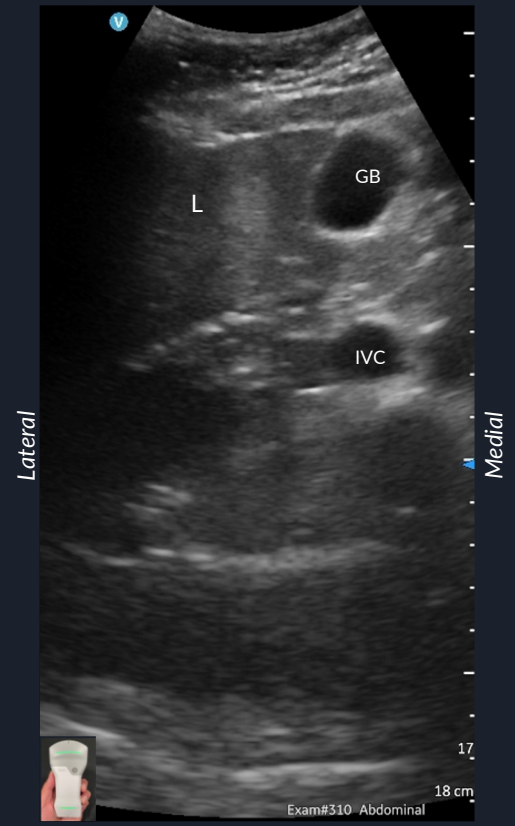


Long-axis plane of GB: Normal

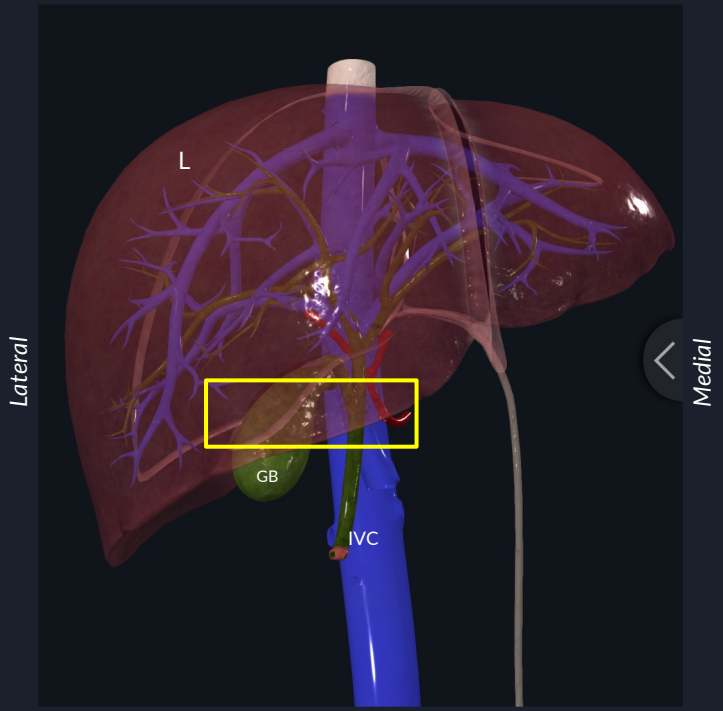


View from patient's right side

This is my attempt to show the how the US scan correlates to a 3D anatomical diagram. Notice how you can see the IVC in it's long-axis. Notice how the portal triad is seen in it's short-axis while the gallbladder is oriented in it's long-axis.

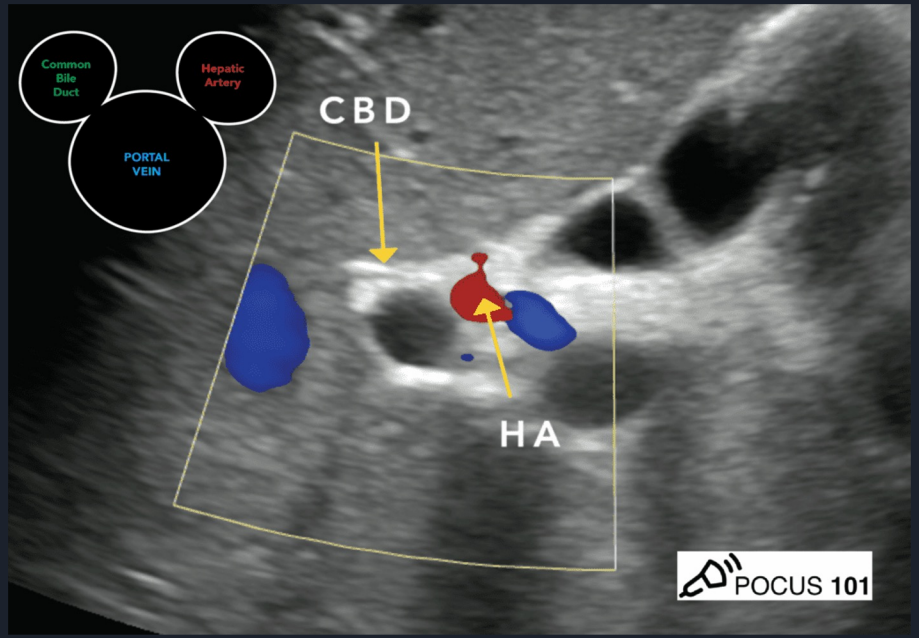


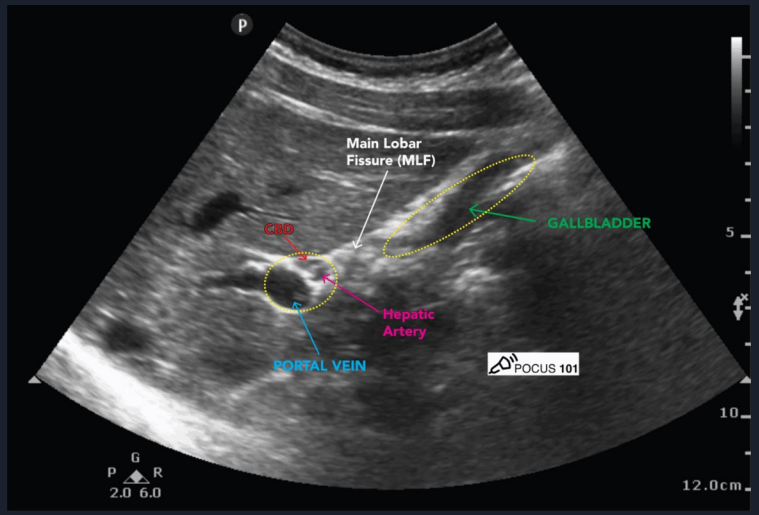
Short-axis plane of GB:
Normal

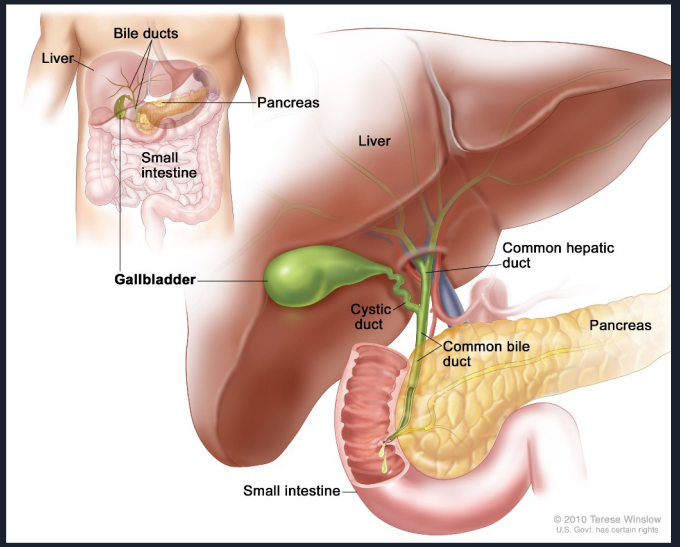


Transverse plane

In this transverse view, the IVC and gallbladder are seen in the short-axis. It is more of an inferior plane so we really only see the right lobe of the liver.

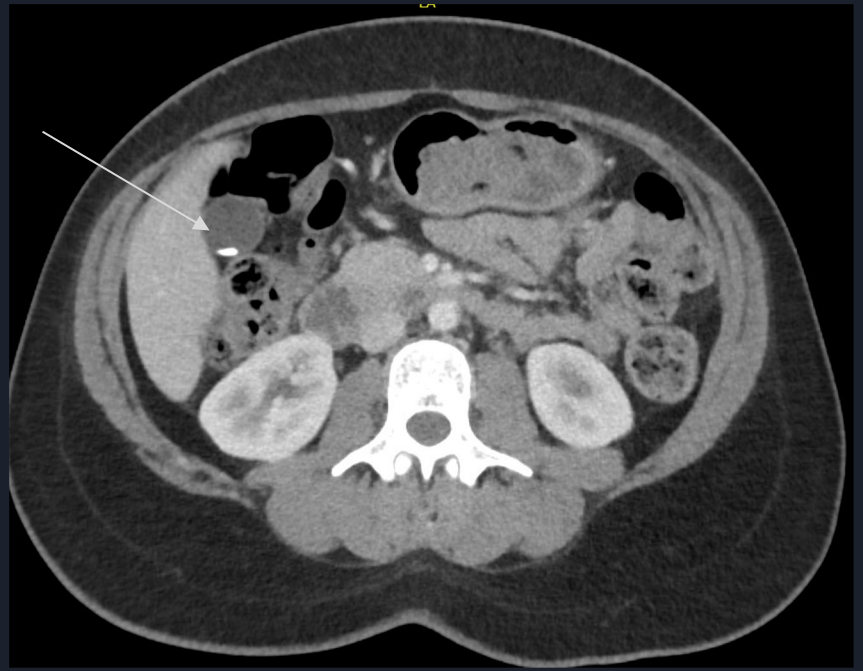




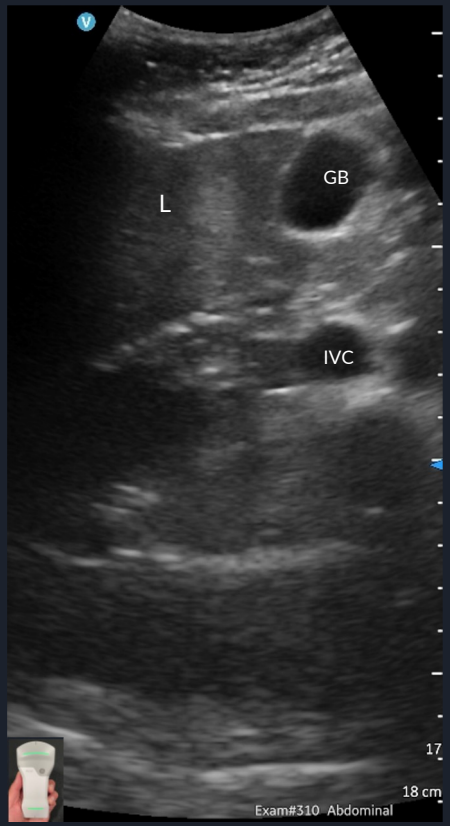


When scanning the liver and gallbladder try to identify the “Mickey Mouse” sign. The portal vein makes up the head while the hepatic artery and CBD create the ears. Use color doppler to distinguish the HA from the CBD. (Images from Chiem, Dinh et al; pocus101.com)

Choledocholithiasis

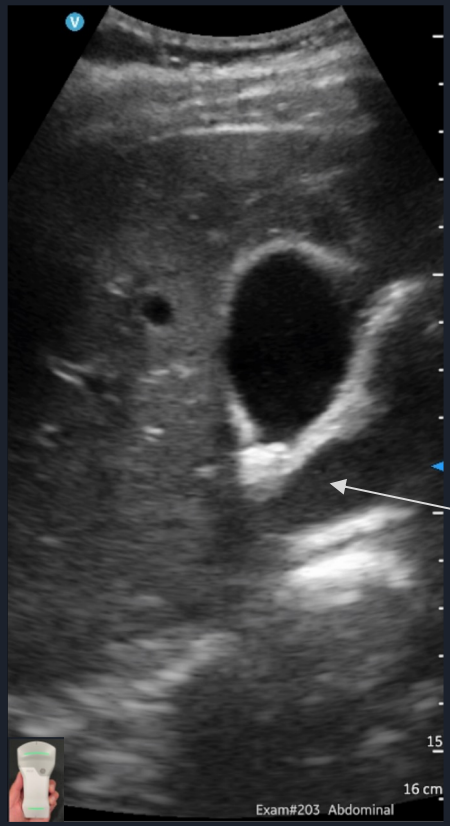


CTAP with contrast: “Hepatobiliary: No focal hepatic lesions. No biliary ductal dilatation. Calcified gallstone seen within the gallbladder. No pericholecystic inflammatory changes. Mild periportal and pericholecystic edema is likely on the basis of IV fluid administration. IMPRESSION: Cholelithiasis without pericholecystic inflammatory changes.”



Short-axis plane: Normal

Short-axis plane: Calculus

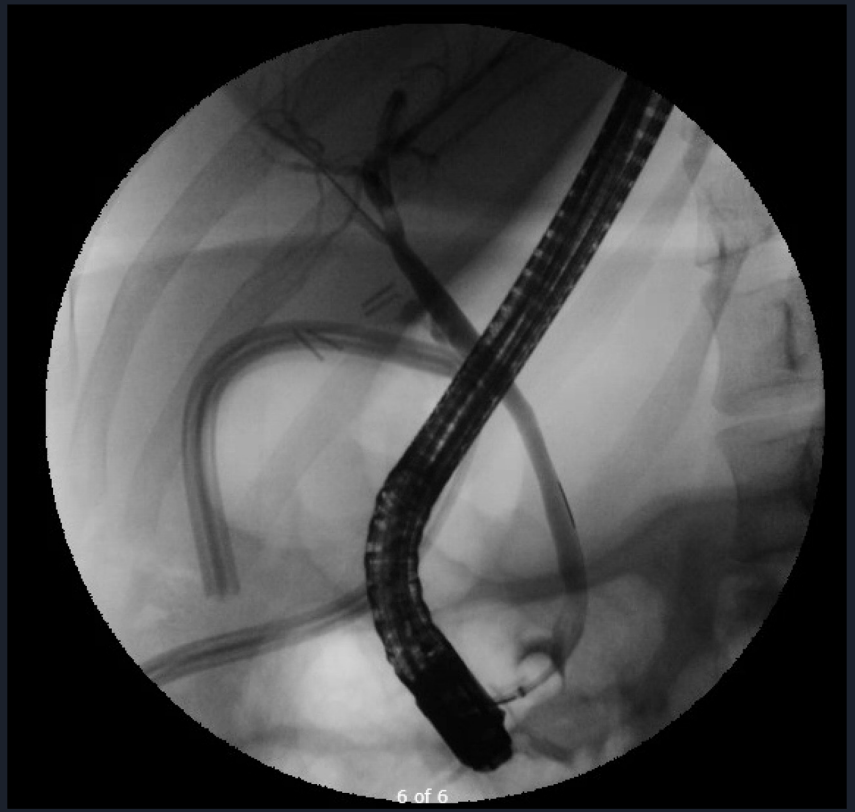


Hyperechoic focus with posterior shadowing

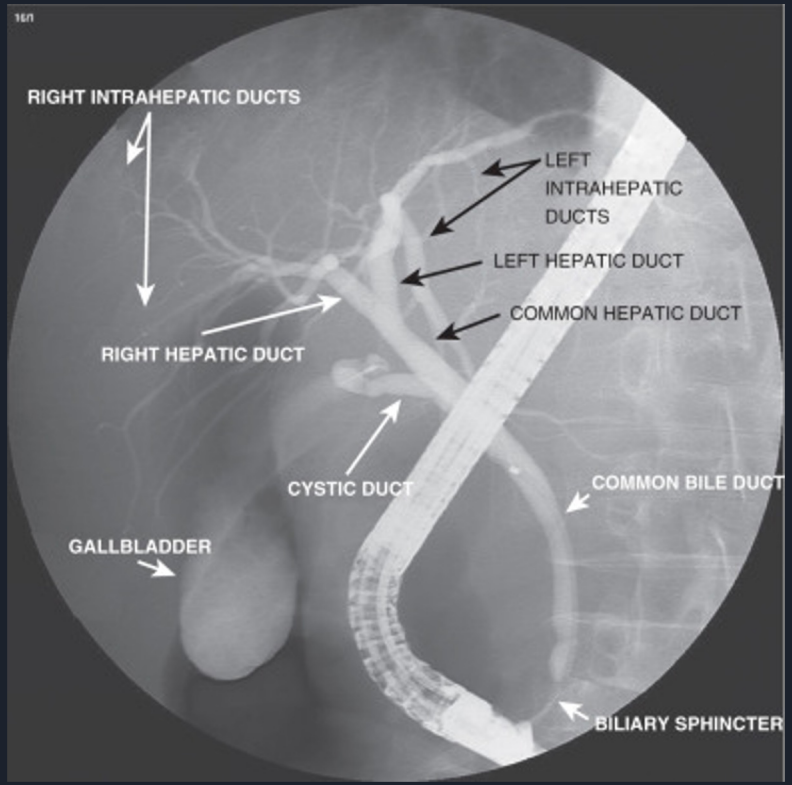
Short-axis plane: Calculus

US (x2): short-axis view of gallbladder showing calculus in gallbladder neck and possible cystic duct. (compare to normal scan on left)

Intraoperative Cholangiogram: “FINDINGS: Contrast was introduced via a cystic duct cannula and outlined a normal biliary duct system. There was ampullary spasm and no flow into the duodenum. No obvious stones or other filling defects. IMPRESSION: Ampullary spasm with no flow into the duodenum. Otherwise normal cholangiogram.”



ERCP: “Contrast extended to the entire biliary tree. The CBD contained one stone. Biliary sphincterotomy was done. Biliary tree was swept with balloon. One 4mm stone was removed. No stones remained. Sludge was swept from the duct. Impression: choledocholithiasis was found. The biliary tree was swept and sludge was found.”



Reference ERCP

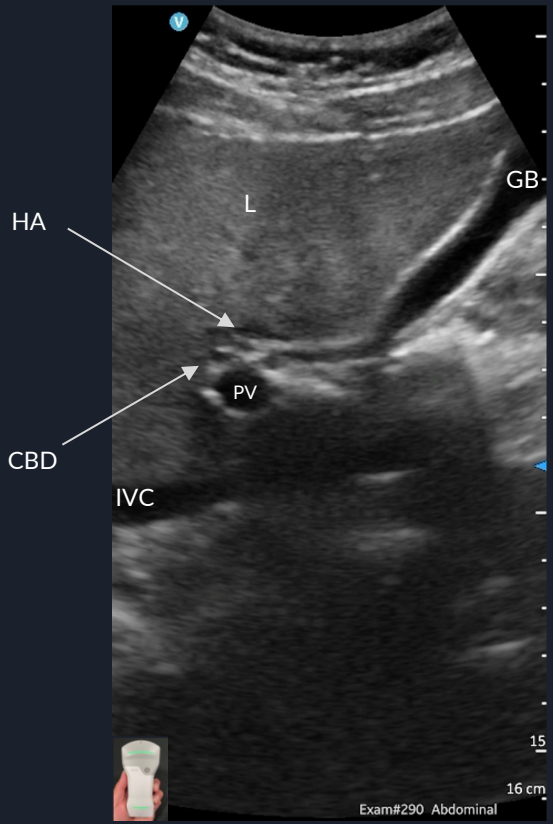
Dilated GB

Liver: There is intrahepatic biliary tree dilatation. This is new from prior study. There is also dilatation of the common bile duct and there is some dilatation of the pancreatic duct. These findings are new from prior study. There is no high density calculus seen in the biliary tree at this time to indicate a definite calculus. Noncalcified calculus cannot be excluded. A neoplastic lesion at the distal aspect of the common bile duct/pancreatic duct cannot be excluded. Follow-up MRCP or ERCP is recommended..

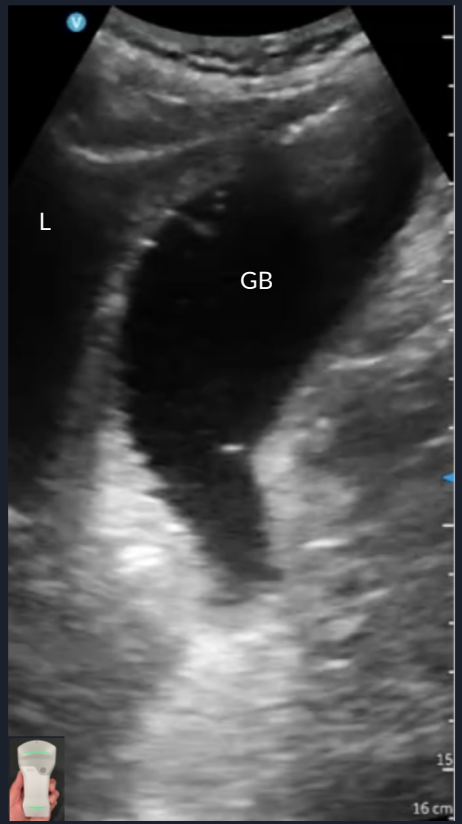
Gallbladder: There is gallbladder distention. There is cystic duct dilatation. There is no definite density calculus present in the gallbladder to indicate a calculus. There is some slight gallbladder wall thickening. This is nonspecific.

Pancreas: There is a 1.2 cm focus of low density present along the anterior-medial aspect of the uncinate process of the pancreas, image 71, series 900 and image 52, series 901. This is nonspecific.

No acute abdominal process identified



Long-axis plane: Normal liver and gallbladder

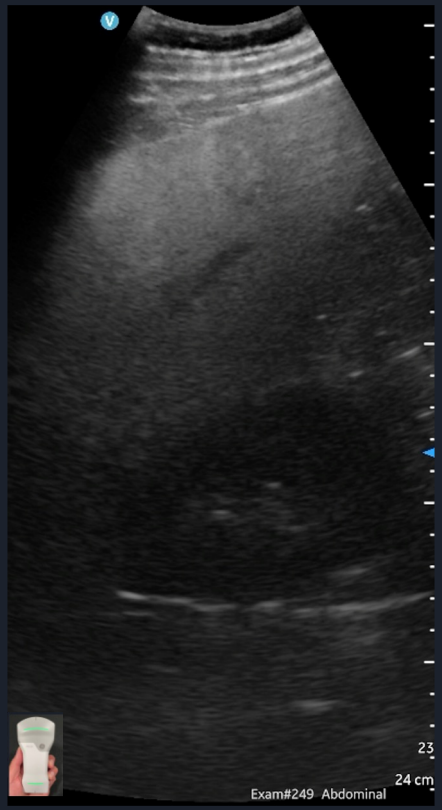


Long-axis plane: Dilated gallbladder

US (right): Dilated gallbladder with long-axis dimension at 11 cm and short-axis at 5 cm.

Steatosis

Transabdominal sagittal view of the liver and kidney. The liver is normally near isoechoic to the renal cortex.

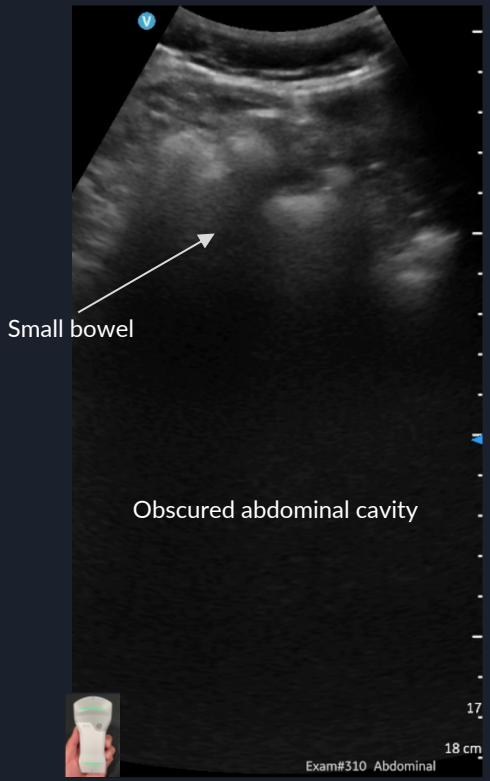


~Coronal plane

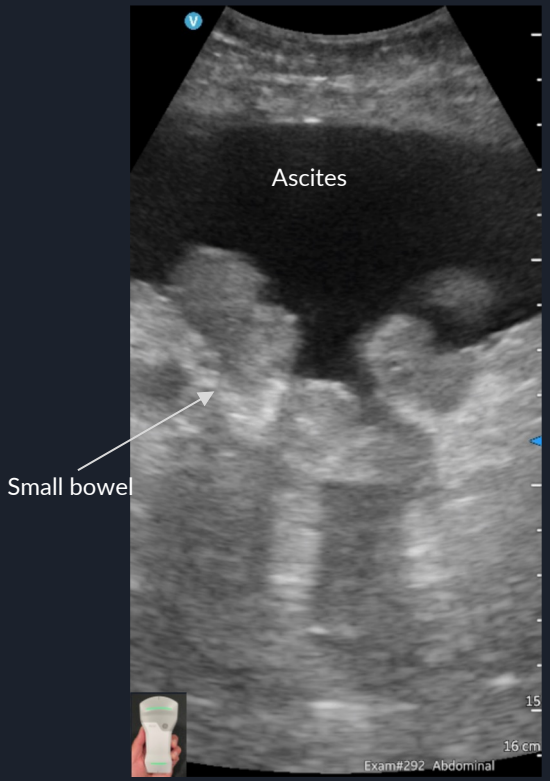
~Coronal plane

Steatosis is characterized in the liver by increased attenuation of the liver compared to the renal cortex (normally liver is near isoechoic to the renal cortex). Liver texture becomes more coarse. Hepatomegaly is usually seen. As the liver becomes more fatty, visualization of portal vein and hepatic veins and diaphragm is impaired.

Ascites



Transverse plane (LLQ): Normal

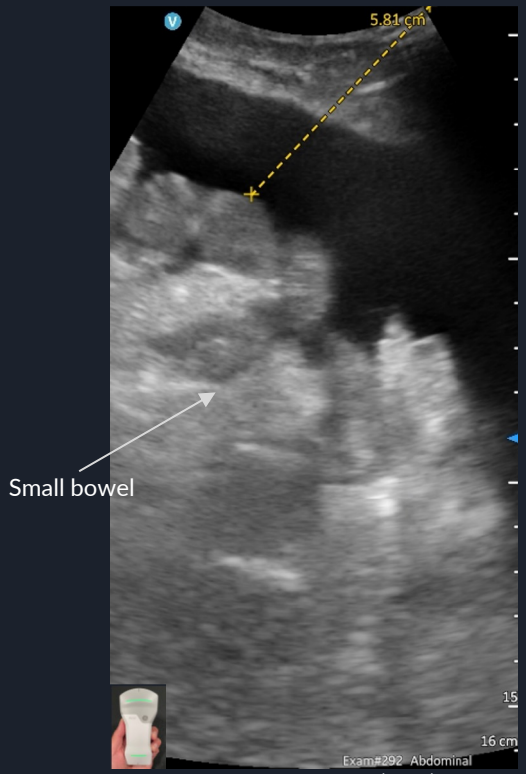


Transverse plane (LLQ): Ascites

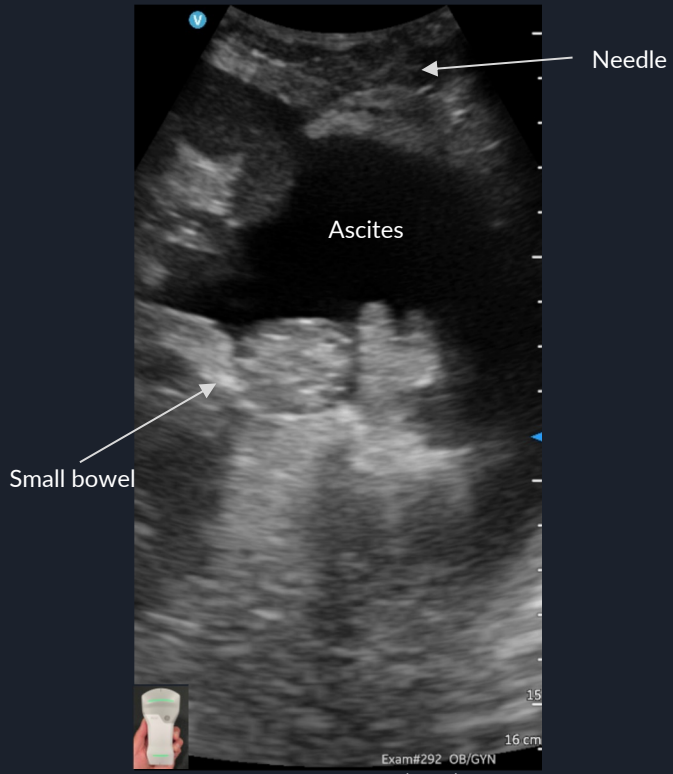
Ascites is the most common complication of cirrhosis leading ot hospital admission. US can differentiate ascites from other causes of abdominal distention such as adipose tissue, abdominal wall edema, gas-filled loops of bowel. Ascites shows as an anechoic collection usually located in the lower quadrants or most gravitationally dependent areas of the abdominopelvic cavity and sometimes around the liver, kidneys, spleen, and diaphragm.

US (Left): normal bowel is usually filled with some air so this obscures anything in the far field or posterior to it.
US (right): compared to the normal example of bowel (left scan), the right scan shows free floating loops of small bowel tethered by the mesentery posteriorly.

Paracentesis



Transverse plane (LLQ)



Transverse plane (LLQ)

2.4 L removed

Ultrasound guidance has proven to reduce the risk of complications and improve procedural success rates when performing paracentesis (Soni POCUS). There are two methods to use US: static or dynamic. In the static method you use US to mark the optimal area for needle placement and then proceed with the procedure without US. The dynamic method requires you to use US to visually see the needle during insertion.

The above example shows measurement of the abdominal wall and ascites can help you know how much “clearance” you have for needle insertion. The clip scan shows the needle placed as planned.

J Med Econ. 2012;15(1):1-7. doi: 10.3111/13696998.2011.628723. Epub 2011 Oct 19.

Evaluation of hospital complications and costs associated with using ultrasound guidance during abdominal paracentesis procedures

Pankaj A Patel [1], Frank R Ernst, Candace L Gunnarsson

Affiliations + expand

PMID: 22011070
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US guidance for paracentesis is safer

- 1297 abdominal paracentesis
- 723 (56%) with ultrasound and 574 (44%) without.
- The incidence of AEs was lower in ultrasound-guided procedures:
  - all AEs (1.4% vs 4.7%, p = 0.01),
  - post-paracentesis infection (0.41% vs 2.44%, p = 0.01),
  - hematoma (0.0% vs 0.87%, p = 0.01), and
  - seroma (0.14% vs 1.05%, p = 0.03).

More Cases!

- Intro for US for Family Medicine: link
- Musculoskeletal cases: link
- Abdominal cases: link
- Lung cases: link
- Other cases: link