Ultrasound – Gallbladder Evaluation

PURPOSE:
Targeted evaluation of the gallbladder and intra- and extra-hepatic bile ducts for pathology.

SCOPE:
Applies to all ultrasound studies targeted to the gallbladder performed in Imaging Services / Radiology

INDICATIONS:
- Signs or symptoms (pain, jaundice, etc) referred to the gallbladder;
- Abnormal lab values (increased LFTs, etc);
- Abnormal findings on other imaging studies;
- Follow up known gallbladder abnormalities.

CONTRAINDICATIONS:
No absolute contraindications

EQUIPMENT:
Curvilinear array transducer with a frequency range of approximately 1-9 MHz that allows for appropriate penetration and resolution depending on patient's body habitus.

PATIENT PREPARATION:
- OUTPATIENTS: Patient should be NPO for 4-6 hours prior to study, allowing for distention of gallbladder and decrease in bowel gas.
- ER/INPATIENTS: Fasting not needed given urgency of exam. Follow up imaging may be required if area of interest obscured by bowel gas, gallbladder distention is needed, etc.

EXAMINATION:

GENERAL GUIDELINES:

A complete examination includes evaluation of the gallbladder, intra-hepatic ducts, and extra-hepatic bile ducts.

EXAM INITIATION:
- Introduce yourself to the patient
- Verify patient identity using patient name and DOB
- Explain test
- Obtain patient history including symptoms. Inquire if the patient has received pain medication. Enter and store data page
- Place patient in supine and/or left lateral decubitus (LLD) positions

TECHNIQUE CONSIDERATIONS:
- Review any prior imaging, making note of associated abnormalities requiring evaluation.
- Fasting for 4-6 hours prior to exam will permit adequate gallbladder distention (not needed for ER or IP exams, although follow-up imaging may be needed if GB distention is desired).
- Liberal use of cine sweeps allows for better evaluation of focal or indeterminate findings.
- Deep inspiration facilitates imaging of the liver and gallbladder in the supine position via a subcostal approach.

- In LLD position, the gallbladder shifts towards midline, improving accessibility for scanning
- Gallbladder and intra/extrahepatic bile ducts should be evaluated for dilatation, wall thickening, and intraluminal findings, if abnormal.
- In addition to supine and/or LLD imaging, upright or prone imaging may be necessary to evaluate mobility of sludge and stones or to differentiate them from a polyp.
- Evaluation for a sonographic Murphy sign requires focal tenderness to **transducer pressure immediately over the gallbladder**, in an unaltered patient and in the absence of pain medication. This should be distinguished from diffuse or generalized abdominal tenderness.
- Color Doppler may be used to identify twinkling artifact within biliary sludge (small stones), and evaluate for gallbladder wall or hepatic parenchyma hyperemia.
- Color Doppler should be used to differentiate hepatic arteries and portal veins from dilated intrahepatic bile ducts.
- The common duct should be imaged longitudinally, adjacent to the main portal vein, distinguished from the hepatic artery by color Doppler.
- The duct should be measured from inner wall to inner wall at the porta hepatis near the crossing of the right hepatic artery. Remainder of the common duct should be evaluated as far distally toward the pancreatic head as possible if common duct measurement is abnormal or for obvious choledochocele variant, with an evaluation for obstructing intraluminal or extrinsic lesions, if possible
- A brief check for intra-hepatic biliary ductal dilatation should be performed. Linear probe evaluation of the left lobe may be useful. Documentation should include images at the level of the intra-hepatic portal bifurcation, and along the main right and left portal veins, without and with color, to check for dilated ducts.
- Wall thickening and edema should be documented without and with thickness measurements, and without and with color Doppler to assess for wall hyperemia.
- Spectral Doppler with measurement of Peak Systolic Velocity (PSV) of the hepatic and cystic arteries may be useful in equivocal cases of acute cholecystitis:
    - Applies to ER/Inpatients, or Urgent Care patients;
    - Applies to patients with pain, nausea/vomiting, elevated WBC count, elevated LFTs (Alk Phos; Bilirubin), or other signs/symptoms/concerns for acute cholecystitis;
    - Applies when there is wall thickening, edema, and/or equivocal or indeterminant Murphy's sign;
    - Applies whether or not there are stones.
- Image may be annotated (but not required) if focal tenderness was or was not observed (example: "+/pos pain" or "no tenderness").
- In tech notes, document positive or negative Murphy's Sign and if patient altered or received pain medication (required).

DOCUMENTATION:

- Longitudinal images:
  - Representative supine still and cine sweep images of gallbladder including as much of neck, mid body, and fundus as possible, with additional sweeps of any focal abnormality.
  - Common duct with largest diameter measurement at porta hepatis.
  - Color Doppler of wall if thickened/edematous.
  - Repeat all still and cine sweep images in LLD
- Transverse images:
  - Representative supine still and cine sweep images of gallbladder at neck, mid body, and fundus, with additional cine sweep of any focal abnormality.
  - Repeat all still and cine sweep images in LLD
- Check for intrahepatic ductal dilatation:
  - Representative images of the intrahepatic bile ducts, along the portal veins, 1) at the level of the portal/intra-hepatic bile duct bifurcation, 2) at the level of the left, and 3) right portal veins, without and with color Doppler.
- Doppler:
  - In cases equivocal for acute cholecystitis, Duplex (color and Spectral Doppler) of hepatic artery (HA) and cystic artery, with PSV, should be obtained:
    - Typically only applies to ER/Inpatients, or Urgent Care patients;
      - In rare cases, outpatients with specific suspicion of acute chole;
    - Applies to patients with pain, nausea/vomiting, elevated WBC count, elevated LFTs (specifically Alk Phos; Bilirubin);
    - Applies when there is wall thickening, edema, and/or equivocal or indeterminant Murphy's sign;
    - Applies whether or not there are stones.
    - If gallbladder is normal, and there is no pain, leukocytosis, or elevated bilirubin, Doppler evaluation not needed.

On the following page, there is a sample of image acquisition required in this Documentation section.

- All Images are minimum required. Take additional images as needed.
- *Documentation in italics* are added as needed
- The order follows our on-cart protocol/scan-assist

Image	Mode
Lt Intrahepatic Ducts	
Trans Left Liver @ LPV	2D
Trans Left Liver @ LPV	Color
Rt Intrahepatic Ducts	
Trans Right Liver @ RPV	2D
Trans Right Liver @ RPV	Color
CBD	
Long CBD @ porta hepatis (dual screen)	2D/Color
Long CBD w/ Measure	2D
GB Supine	
Long GB Fundus/Body/Neck	2D
Long GB (Lat to Med)	2D Cine
Trans GB Neck	2D
Trans GB Mid/Body	2D
Trans GB Mid w/ Wall Measure	2D
Trans GB Fundus	2D
Trans GB (Neck to Fund)	2D Cine
GB Supine Focal Abnormality *(as needed)*	
Long Focal Abnormality w/ & w/o Measure	*2D*
Long Focal Abnormality	*Color*
Long Focal Abnormality	*2D Cine*
Trans Focal Abnormality w/ & w/o Measure	*2D*
Trans Focal Abnormality	*Color*
Trans Focal Abnormality	*2D Cine*

Image	Mode
GB LLD (Repeat GB Supine Images)	
Long GB Fundus/Body/Neck	2D
Long GB (Lat to Med)	2D Cine
Trans GB Neck	2D
Trans GB Mid	2D
Trans GB Mid w/ Measure	2D
Trans GB Fundus	2D
Trans GB (Neck to Fund)	2D Cine
GB LLD Focal Abnormality *(as needed)*	
Long Focal Abnormality	*2D*
Long Focal Abnormality	*Color*
Long Focal Abnormality	*2D Cine*
Trans Focal Abnormality	*2D*
Trans Focal Abnormality	*Color*
Trans Focal Abnormality	*2D Cine*
Acute Chole Doppler (*as needed)*	
PHA	*Color*
PHA w/ PSV	*Spectral*
Cystic Artery	*Color*
Cystic Artery w/ PSV	*Spectral*

Indication for Spectral Doppler: Typically for ER/IP or Urgent Care patients; In rare cases, OP w/ specific suspicion of acute chole

- Pt w/ pain, nausea/vomiting, elevated WBC count/leukocytosis, elevated Alk Phos/Bilirubin)
- wall thickening, edema, and/or positive Murphy's **OR** can't determine Murphy's sign;
- Applies *whether or not* there are stones.

If gallbladder is normal, and there is no pain, leukocytosis, or elevated bilirubin, Doppler evaluation not needed.

PROCESSING:

- Review examination images and data
- Export all images to PACS
- Document relevant history, if the patient was altered or received pain medication prior to the examination, absence or presence of sonographic Murphy sign, and any technical difficulties.

REFERENCES:

ACR-AIUM Practice Guideline (Revised 2007)**REVISION HISTORY:**

SUBMITTED BY:	David T. Fetzer, MD	**Title**	Medical Director
APPROVED BY:	David T. Fetzer, MD	**Title**	Medical Director
APPROVAL DATE:	11-09-2015		
REVIEW DATE(S):	11-12-2018		David T. Fetzer
Status	Name and Title	**Date**	**Brief Summary**
Revision(s):		05-24-2016	Added intrahepatic duct dilatation check
		03-08-2022	Clarified that fasting not needed to ER/IP orders. Added need for color Doppler eval of wall
		10-10-2022	Included information regarding Hepatic and Cystic Artery waveforms. Included Appendix information regarding GB polyp evaluation
Submitted and Approved	Skye Smola, RDMS, RVT, David T. Fetzer, MD	04-24-2023	Added clarification of when cystic and hepatic artery waveform is needed (or not). Added example image in Appendix
Submitted and Approved	Skye Smola, RDMS, RVT, David T. Fetzer, MD	7/26/24	Added explicit text to repeat cines in LLD, removed requirement to document Murphys on US image and moved it to technical considerations. Emphasized requirement to document altered status/meds given/Murphy's sign in tech notes; added image acquisition table

APPENDIX:

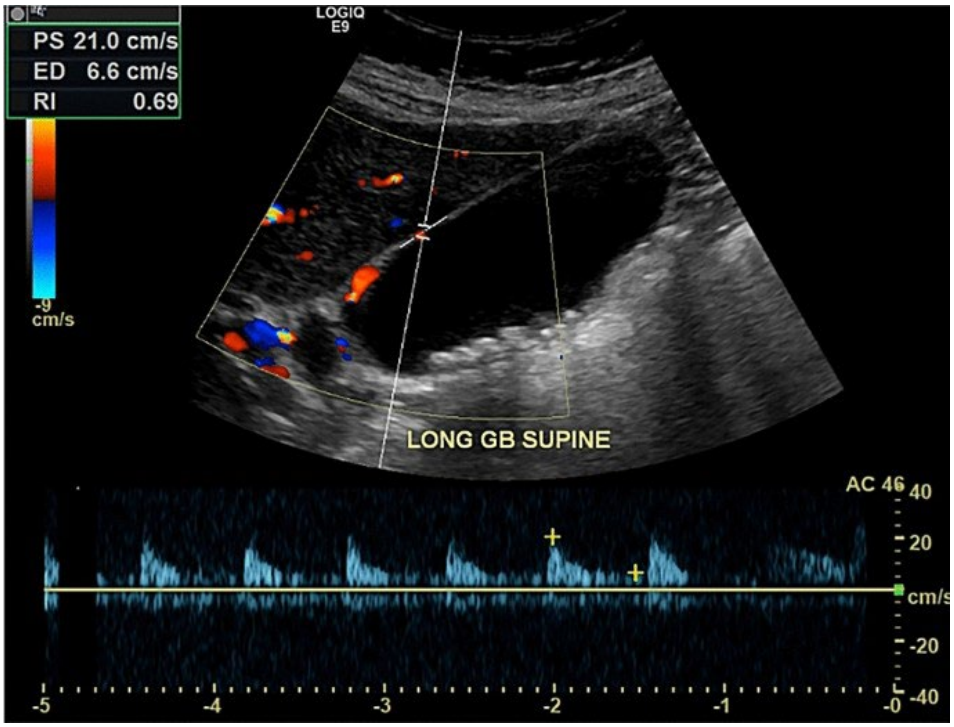
Hepatic and Cystic Artery Waveforms:

Hepatic Artery (HA):

- Peak systolic velocities (PSV) of HA ≥ 100 cm/s may help differentiate acute from chronic cholecystitis. DOI: 10.1007/s00261-017-1288-z
- PSV > 200 cm/s specific for acute hepatic dysfunction (including infection and sepsis). DOI: 10.1002/jcu.22885

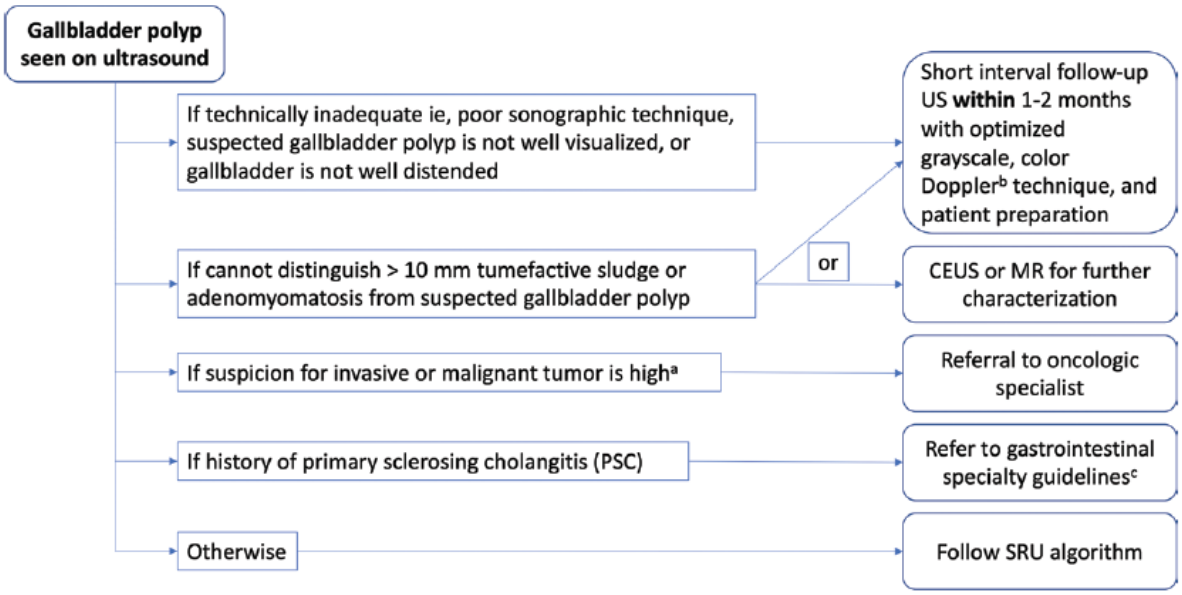
Cystic Artery:

-
- PSV ≥ 40 cm/s associated with acute cholecystitis (PPV 94.7%; accuracy 81.4%). DOI: 10.1007/s00261-021-03020-z

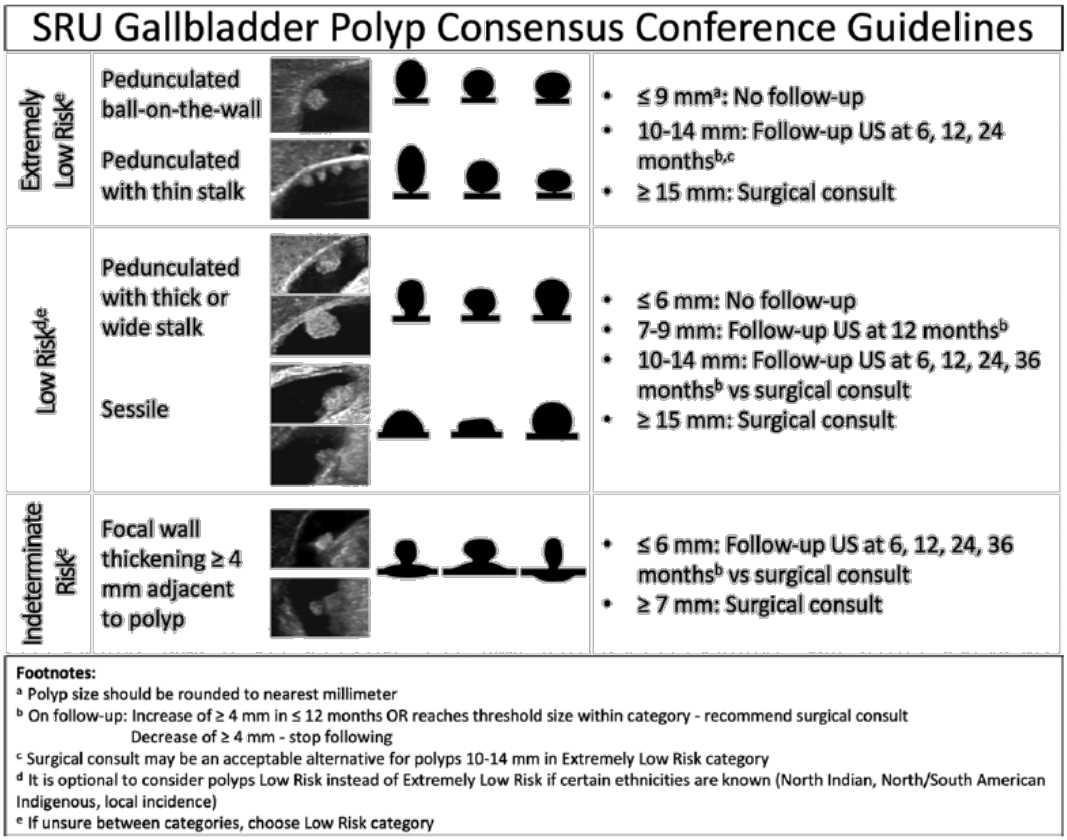


Example Duplex image showing spectral Doppler of cystic artery

Management of Gallbladder Polyps*



[a] Findings that may indicate invasive tumor include the following: wall invasion, concurrent liver masses, malignant biliary obstruction, or pathologic lymph node enlargement at the porta hepatis or para-aortic chain
[b] Higher sensitivity Doppler techniques such as power Doppler, B-Flow, and microvascular Doppler may help differentiate a polyp from tumefactive sludge
[c] American Gastroenterology Association https://www.cghjournal.org/article/S1542-3565(19)30744-X/pdf



* https://doi.org/10.1148/radiol.213079