Ultrasound – Complete Abdominal Evaluation

PURPOSE:
To evaluate liver, gallbladder, bile ducts, pancreas, kidneys, spleen, aorta, and inferior vena cava (IVC).

SCOPE:
Applies to all studies performed in:
- UT Southwestern Zale-Lipshy University Hospital, William P. Clements Jr. University Hospital, and all University Hospital-based Clinics Imaging Services (UTSW)
- Parkland Health and Hospital System Department of Radiology (PHHS)

ORDERABLE:
- US Abdomen

CHARGEABLES:
- US Abdomen Complete (CPT 76770)

INDICATIONS:
- Signs or symptoms (eg. pain) referred to the abdomen or retroperitoneum
- Abnormal lab values (examples: increased LFTs, amylase/lipase, etc)
- Abnormal findings on other imaging studies
- Follow up known abdominal or retroperitoneal abnormalities
- Evaluate for metastasis in setting of pre-existing malignancy
- *For cirrhosis/chronic liver disease and HCC screening, evaluation of portal hypertension/ascites, or jaundice, consider order change to US Liver (and reference appropriate protocol).*

CONTRAINDICATIONS:
No absolute contraindications

EQUIPMENT:
Curved array transducer with a frequency range of approximately 1-9 MHz that allows for appropriate penetration and resolution depending on patient's body habitus.
** Linear array transducer with frequency range of 7-18 MHz that allows for evaluation of the liver surface, depending on patient's body habitus.*

PATIENT PREPARATION:
- OUTPATIENTS: Patient should be NPO for 6-8 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 entire liver, gallbladder/bile ducts, pancreas, kidneys, spleen, aorta, and IVC.

**In the setting of known or suspected chronic liver disease/cirrhosis, portal hypertension/ascites, or HCC*

EXAM INITIATION:

- Review any prior imaging, making note of abnormalities requiring specific evaluation.
- 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, right lateral decubitus (RLD), and/or left lateral decubitus (LLD) position

TECHNIQUE CONSIDERATIONS:

- Deep inspiration facilitates imaging of the liver dome, right hepatic lobe, and right kidney in the supine position via subcostal approach.
- In LLD position, the right liver, gallbladder, and right kidney shift towards the midline, improving accessibility for scanning and facilitating intercostal scanning for the posterior liver and dome.
- Cine sweeps allow for better evaluation of focal or indeterminate findings.
- Liver:
    - Liver should be evaluated for focal and/or diffuse abnormalities. Liver echogenicity should be compared with that of the right kidney and pancreas.
    - Cine sweeps, including as much hepatic parenchyma as possible, should be acquired in the transverse and longitudinal orientations.
    - A combination of intercostal and subcostal imaging, supine and LLD, helps ensure all areas of liver are optimally imaged.
    - In the absence of ascites, nodular liver surface contour is best seen with a linear array transducer.
    - Evaluate the parenchyma adjacent to the gallbladder fossa, fissure for the falciform ligament, and portal bifurcation for areas of focal fatty sparing.
    - ** Evaluate the area around the ligamentum teres for a dilated paraumbilical vein in the setting of portal hypertension.*
- Gallbladder and Bile Ducts:
    - Fasting for 6-8 hours prior to exam will permit adequate distension (not needed for ER or IP exams, although follow-up imaging may be needed if GB distention is desired)..
    - Gallbladder and intra/extrahepatic bile ducts should be evaluated for dilatation, wall thickening, and intraluminal findings.
        - Color Doppler may be used to differentiate hepatic arteries and portal veins from dilated intrahepatic bile ducts
    - In addition to supine and LLD imaging, upright or prone imaging of the gallbladder 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 compression immediately over the gallbladder fundus, in an unaltered patient, and in the absence of the patient having received pain medication. This should be distinguished from diffuse abdominal tenderness.

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    - 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.
    - For suspected cholecystitis, please see US Gallbladder protocol for details regarding hepatic and cystic artery Duplex analysis.
- Pancreas:
    - Pancreas should be evaluated for diffuse and/or focal abnormalities, pancreatic duct dilatation with diameter measurement (if visualized), and for peripancreatic adenopathy or fluid.
    - Air in the transverse colon and/or stomach may obscure the pancreas and may be displaced by graded transducer pressure. Orally administered water may afford better visualization of the pancreas via RLD approach through the distal stomach.
- Kidneys:
    - Examine the right kidney from an anterolateral or direct lateral approach in the supine or LLD position with the liver as a sonographic window
    - Examine the left kidney from a posterolateral or direct lateral approach in the RLD position with the spleen as a sonographic window
    - Renal echogenicity (in comparison to liver), cortex, pelvis, and the perirenal region should be assessed for abnormalities on real time survey.
    - Color/Power Doppler should be used to assess for uniform parenchymal perfusion, and to evaluate for twinkling artifact seen with renal calculi.
    - If pyelonephritis is suspected
        - Doppler evaluation of the renal cortex (including entire upper, mid, and lower segments) is useful for detecting perfusional variations.
        - For improved cortical perfusion, use micro-Doppler techniques (if available):
            - Philips - MicroFlow Imaging (MFI / MFI-HD)
            - GE - MicroVascular Imaging (MVI)
            - Siemens - Slow Flow
- Spleen:
    - Longitudinal measurements: *Length & Width (AKA Thickness)*
    - Transverse measurement: *AP (AKA Height or Trans) - 90 degrees to Long image*
    - Color Doppler evaluation at splenic hilum to document vessel patency, check for varices or evaluate.
        - For splenomegaly, LUQ pain, abnormalities on prior imaging, or if requested by provider, power, and/or microflow may be used to further evaluate splenic perfusion for segmental hypoperfusion/infarction
- Aorta and IVC:
    - Longitudinal images of the proximal (upper) IVC and proximal, mid, and distal aorta are taken along the long axis of the vessel.
    - Measurements of the aorta are taken at the greatest diameter of the vessel from outer edge to outer edge.

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- The mid and lower abdominal aorta is often obscured by bowel gas. Bowel loops can be displaced with graded compression with a curvilinear probe, especially in thin patients. A coronal image of the aorta in the RLD or LLD position can also be useful in this situation.

DOCUMENTATION:

- Pancreas
  - Transverse images:
    - Representative images of the head/uncinate, neck, body, and tail, with cine sweep of any focal abnormality.
    - Measure pancreatic duct, if visualized. If dilated, image duct as close to pancreatic head as possible.
- Liver
  - Longitudinal images (minimum):
    - LEFT LOBE
      - Left lobe left of midline
      - Left lobe at midline. Include proximal abdominal aorta
        - LABEL AORTA IMAGE. Include celiac artery and SMA.
      - Left lobe with IVC. Include caudate lobe, MPV, and pancreatic head.
        - LABEL IVC IMAGE
      - Left lobe with left portal vein
      - CINE CLIP: from lateral tip to IVC/right of midline
    - RIGHT LOBE
      - Right lobe with gallbladder
      - Right lobe with right kidney
      - Right lobe including right hemi-diaphragm and pleural space
      - Right lobe far lateral
      - CINE CLIP: from midline to lateral most margin, using multiple acoustic windows if necessary.
  - Transverse images (minimum):
    - LEFT LOBE
      - Left lobe dome with hepatic veins
      - Left lobe with left portal vein
      - Left lobe inferior tip
      - CINE CLIP: from dome to inferior most margin
    - RIGHT LOBE
      - Right lobe dome with hepatic veins
      - Right lobe with right portal vein
      - Right lobe with main portal vein
      - Right lobe with gallbladder
      - Right lobe with right kidney
      - Right lobe near inferior liver tip
      - CINE CLIP: from dome to inferior most margin, using multiple acoustic windows if necessary
  - REPEAT IN LLD: RIGHT LIVER, LONG AND TRANS, STILL IMAGES AND CINE CLIPS

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        - A combination of intercostal and subcostal imaging may be necessary to ensure optimal visualization of all areas of liver.

    *Liver Capsule (if liver disease suspected)
        - With a linear 9, 12, or 18MHz transducer, include high-resolution images of hepatic capsule and underlying parenchyma for nodularity, both left lobe and right lobe (if visualized well), TRV and LONG
        - To best image the liver contour specifically, decrease image depth to view only 1-3 cm of liver parenchyma.
        - CINE CLIP in LONG ONLY during a complete breathing cycle (inhalation and exhalation), with probe stationary, from both left lobe and right lobe (if visualized well).
    - Doppler (for all exams):
        - Main portal vein
            - Color Doppler (Dual/Split screen with grayscale)
            - *For history or findings of chronic liver disease/cirrhosis:
                - Diameter measurement (inner wall-to-inner wall, on grayscale)
            - Spectral waveform with peak velocity, angle-corrected.
            - *Can refrain from repeating MPV diameter and PSV for US Liver if performed within a Liver Doppler*

- Gallbladder and Bile Ducts
    - Common duct with largest diameter measurement at porta hepatis.
    - Gallbladder:
        - Longitudinal images:
            - Representative images of gallbladder, including the neck, mid body, and fundus
            - Color Doppler of wall if thickened/edematous.
            - CINE CLIP
        - Transverse images:
            - Representative images of gallbladder at neck, mid body, and fundus
            - CINE CLIP
        - *For suspected cholecystitis, please see US Gallbladder protocol for details regarding hepatic and cystic artery Duplex analysis.*
    - REPEAT IN LLD: GALLBLADDER, LONG AND TRANS, STILL IMAGES AND CINE CLIPS
        - Looking for mobile stones/biliary precipitate (sludge).
        - Standing, RLD and/or prone imaging may be needed to differentiate a mobile from impacted gallstone

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- Kidneys
  - Right side, then Left
  - Longitudinal images:
    - Far Medial
    - Mid segment
      - Without and with longitudinal measurement
      - Without and with color Doppler if pelvicaliectasis is suspected
    - Far Lateral
    - (Right Kidney Only): Right Kidney – Liver comparison image
    - CINE CLIP:
      - Lateral to Medial
      - Cine clip through any focal abnormality
    - Color Doppler:
      - Image(s) of parenchyma to show homogeneous perfusion
        - May need separate color Doppler boxes of upper pole, mid kidney, and lower pole
        - If any suspected echogenic focus or concern for stone:
          - Renal2 preset – with and without Color Doppler cine for twinkling artifact (dual-screen preferred)
          - Still images with and without color required if stone identified
          - Measure largest single dimension of stone or echogenic foci
      - If pyelonephritis is possible or suspected, use lower velocity setting and optimal color gain to demonstrate flow in small cortical vessels.
        - For improved cortical perfusion, micro-Doppler techniques (if available):
          - Philips - MicroFlow Imaging (MFI / MFI-HD)
          - GE - MicroVascular Imaging (MVI)
          - Siemens - Slow Flow
  - Transverse images:
    - Upper (or Sup) pole
    - Upper (or Sup) mid
    - Mid
    - Lower (or Inf) mid
    - Lower (or Inf) pole
    - CINE CLIP: from above upper pole through lower pole
      - Cine clip through any focal abnormality

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- Spleen
  - Longitudinal images
    - Representative images Including left hemidiaphragm and adjacent pleural space if possible, with cine sweep of any focal abnormality
    - Measurements
      - *Length:* From inferior most tip to highest point along diaphragm (Red Line), *crossing through the splenic hilum (arrow).*
      - *Width/Thickness: oriented 90 degrees* relative to longitudinal measurement at the hilum/hilar vessels, calipers placed at greatest thickness (Green Line).
  - Transverse images:
    - Representative images from dome to tip, with cine sweep of any focal abnormality.
    - Measurement
      - *AP/Height/Trans:* (Blue Line) measured at level of hilum/hilar vessels, does not have to cross through hilum but calipers placed at greatest width
  - Color Doppler evaluation at splenic hilum to document vessel patency, direction of flow; detect varices.
  - Splenic Volume**See appendix for examples of accurate spleen measurements.*

- Ascites*:
  - Transverse images:
    - RLQ; LLQ; Midline pelvis
  - Stationary cine images of mobile debris, if present

- Aorta/IVC (If not completely documented when imaging Liver)
  - Longitudinal images:
    - Representative image of each: proximal, mid, and distal segment of the aorta.
    - Representative image of proximal segment of the IVC
  - Representative transverse images, and images without and with measurements, if abnormal.

- Data Page(s)

PROCESSING:

- Review examination images and data
- Export all images to PACS
- Confirm data in Imorgon (where applicable)
- Document relevant history, if the patient was altered or received pain medication prior to the examination, and any study limitations

REFERENCES:

ACR-AIUM Practice Guideline (Revised 2007)

**In the setting of known or suspected chronic liver disease/cirrhosis, portal hypertension/ascites, or HCC*

REVISION HISTORY:

STATUS	NAME & TITLE	DATE	BRIEF SUMMARY
Submission	David T. Fetzer, MD	11/22/2015	Submitted
Approval	David Fetzer, MD, Director	11/22/2015	Approved
Review	David Fetzer, MD	11/12/2018	
Revisions	David Fetzer, MD	09/11/2016	New protocol for measuring spleen. Added new size cutoffs.
	David Fetzer, MD	04/18/2018	Add info on liver cine sweeps. Included info to direct operator to "US Liver" in cases of suspected liver disease, portal hypertension, HCC screening
	David Fetzer, MD	11/12/2018	Included use of Color Doppler in eval of kidneys
	David Fetzer, MD	12/11/2019	Routine formatting updates; updates to Documentation section to reflect preferred image acquisition order
	David Fetzer, MD	02/23/2020	Clarifications regarding cine sweeps needed through liver. Removed liver length measurement
	David Fetzer, MD	06/01/2020	Added caveats regarding liver capsule, ascites check. Removed long images of pancreas
	David Fetzer, MD	01/20/2021	Added aorta prox, mid, and distal images, per ACR requirements.
	David Fetzer, MD	03/08/2022	Clarified that fasting not needed for ER/IP orders. Added GB wall eval with color Doppler
	David Fetzer, MD	06/15/2022	Highlighted requirement for right kidney-liver image. Added additional information regarding micro-Doppler techniques for renal cortical perfusion
	David Fetzer, MD	04/24/2023	For suspected cholecystitis, please see US Gallbladder protocol for details regarding hepatic and cystic artery Duplex analysis.
	David Fetzer, MD	09/26/2023	Removed Medial/Lateral Long Spleen Images and Trans Spleen images superior to inferior
	Jana Smith, RDMS, RVT	05/01/2025	Added requirements for still images and cine clips of liver in LLD. Revised change history table format. Added Parkland logo. Added spleen measurement images and verbiage for clarification.
	Skye Smola, RDMS, RVT; David Fetzer, MD	8/27/2025	Spleen measurements adjusted; "Right" added to liver as LLD clarifier

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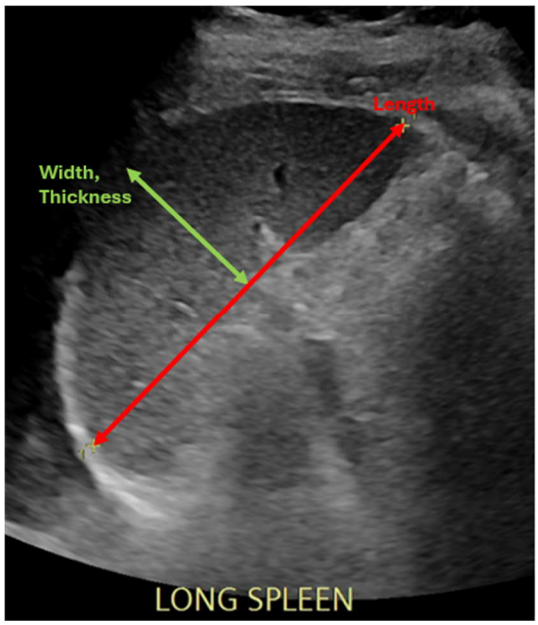
Appendix:

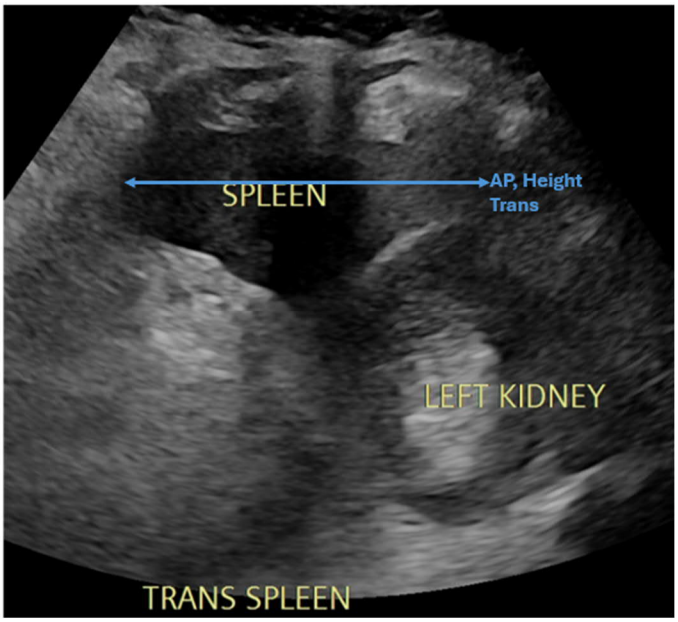
Spleen Measurements

- NORMAL
  - Normal Length: < 12 cm in most patients
  - Normal volumes[+]: 209, SD +/- 76 cc (< 231 cc in women; < 334 cc in men)

- SPLENOMEGALY
  - Consider splenomegaly ("borderline") when:
    - Length ≥ 12 cm in women; ≥ 13 cm in men –or–
    - Volume[+] > 250 cc in females; > 300 cc in males
  - Definite splenomegaly when:
    - Length ≥ 13 cm in women; ≥ 14 cm in men –or–
    - Volume[+] > 300 cc in females; > 350 cc in males

Additional reference images for Spleen measurements found here.





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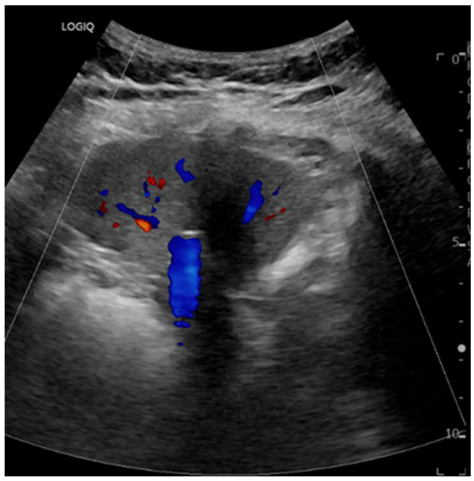

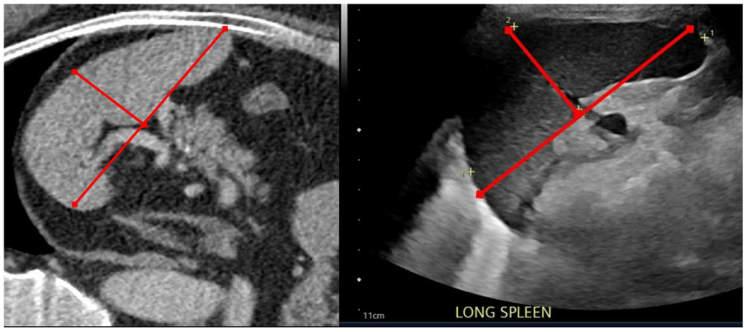

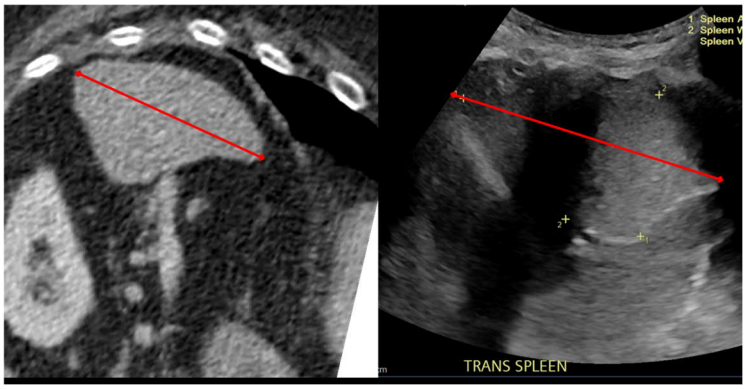

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