Ultrasound – Complete Abdominal Evaluation

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

SCOPE:
Applies to all US Abdomen Complete studies performed in Imaging Services / Radiology

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 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 entire liver, gallbladder/bile ducts, pancreas, kidneys, spleen, aorta, and IVC.

EXAM INITIATION:
- Introduce yourself to the patient
- Verify patient identity using patient name and DOB

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

- 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) positions

TECHNIQUE CONSIDERATIONS:

- Review any prior imaging, making note of abnormalities requiring specific evaluation.
- 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 liver, gallbladder, and right kidney shift towards the midline, improving accessibility for scanning and facilitating intercostal scanning for the posterior liver.
- Liberal use of cine sweeps allows 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.
    - Evaluate the parenchyma adjacent to the gallbladder fossa, fissure for the falciform ligament, and portal bifurcation for areas of focal fatty sparing.
    - In the absence of ascites, nodular liver surface contour is best seen with a linear array transducer.
    - ** 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.
    - 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/or 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.
    - 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.

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- 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 adjusted for evaluation of the **renal cortex** (including entire upper, mid, and lower segments) for perfusion variations. **For improved cortical perfusion, use micro-Doppler techniques (if available):**
      - **Philips - MicroFlow Imaging (MFI / MFI-D)**
      - **GE - MicroVascular Imaging (MVI)**
      - **Siemens - Slow Flow**
- Spleen:
  - Longitudinal spleen measurement: taken from inferior most tip to highest point along diaphragm, *crossing through the splenic hilum.*
  - Transverse measurements: *oriented 90 degrees* relative to longitudinal measurement, calipers placed at greatest thickness and width at the same level.
  - Focal abnormalities documented with size measurements and color Doppler
- 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.
  - 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.

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- 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 LOOP: 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 LOOP: from midline to lateral most margin, using multiple acoustic windows if necessary.
  - Transverse images (minimum):
    - Dome with hepatic veins
    - LEFT LOBE
      - Left lobe dome
      - Left lobe with left portal vein
      - Left lobe inferior tip
      - CINE CLIP: from dome to inferior most margin
    - RIGHT LOBE
      - Right lobe dome
      - Right lobe with right portal vein
      - Right lobe with main portal vein
      - Right lobe with gallbladder
      - Right lobe with right kidney
      - Right lobe near liver tip
      - CINE CLIP: from dome to inferior most margin, using multiple acoustic windows if necessary
  - *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
    - CINE CLIP in LONG 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)

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- *For history or findings of chronic liver disease/cirrhosis:
  - Main portal vein diameter, inner wall-to-inner wall
  - Spectral waveform
  - Peak velocity with angle correction

- **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 LOOP
    - Transverse images:
      - Representative images of gallbladder at neck, mid body, and fundus
      - CINE LOOP
    - For suspected cholecystitis, please see US Gallbladder protocol for details regarding hepatic and cystic artery Duplex analysis.
- REPEAT IMAGES IN LLD
  - Gallbladder, long and transverse, looking for mobile stones/biliary precipitate (sludge).
    - Standing or even RLD or prone imaging may be needed to differentiate a mobile from impacted gallstone
  - Repeat TRV images of hepatic dome
  - Repeat Long images of right lateral margin of right lobe
  - Repeat any images of areas not see well supine

- **Kidneys**
  - Right, 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
        - Color Doppler image of any suspected echogenic focus for twinkling artifact
      - **If pyelonephritis is possible or suspected,** use lower velocity setting and optimal color gain to demonstrate flow in small cortical vessels.

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- **For improved cortical perfusion, micro-Doppler techniques (if available):**
  - **Philips - MicroFlow Imaging (MFI / MFI-D)**
  - **GE - MicroVascular Imaging (MVI)**
  - **Siemens - Slow Flow**
- Transverse images:
  - Upper pole
  - Upper mid
  - Mid
  - Lower mid
  - Lower pole
  - CINE CLIP: from above upper pole through lower pole
    - Cine clip through any focal abnormality

- **Spleen**
  - Transverse images
  - Longitudinal images, including left hemidiaphragm and adjacent pleural space if possible, with cine sweep of any focal abnormality.
  - Color Doppler evaluation at splenic hilum to document vessel patency, direction of flow; detect varices.
    - If enlarged, color and/or Power Doppler evaluation of splenic parenchyma to evaluate for segmental hypoperfusion/infarction
  - Longitudinal spleen measurement: from inferior most tip to highest point along diaphragm, *crossing through the splenic hilum.*
  - *Transverse measurements: *oriented 90 degrees* relative to longitudinal measurement, calipers placed at greatest thickness. Width measured transverse to longitudinal measurements at same position.
    - Splenic Volume

- **Ascites Check*:**
  - Longitudinal or 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.

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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)

REVISION HISTORY:

SUBMITTED BY:	David T. Fetzer, MD	**Title**	Medical Director
APPROVED BY:	David T. Fetzer, MD	**Title**	Medical Director
APPROVAL DATE:	11-22-2015		
REVIEW DATE(S):	11-12-2018		David Fetzer, MD
REVISION DATE(S):	09-11-2016	**Brief Summary**	New protocol for measuring spleen. Added new size cutoffs.
	04-18-2018	**Brief Summary**	Add info on liver cine sweeps. Included info to direct operator to "US Liver" in cases of suspected liver disease, portal hypertension, HCC screening
	11-12-2018	**Brief Summary**	Included use of Color Doppler in eval of kidneys
	12-11-2019	**Brief Summary**	Routine formatting updates; updates to Documentation section to reflect preferred image acquisition order
	02-23-2020	**Brief Summary**	Clarifications regarding cine sweeps needed through liver. Removed liver length measurement
	06-01-2020		Added caveats regarding liver capsule, ascites check. Removed long images of pancreas
	01-20-2021		Added aorta prox, mid, and distal images, per ACR requirements.
	03-08-2022		Clarified that fasting not needed for ER/IP orders. Added GB wall eval with color Doppler
	06-15-2022		Highlighted requirement for right kidney-liver image. Added additional information regarding micro-Doppler techniques for renal cortical perfusion
	4-24-2023		For suspected cholecystitis, please see US Gallbladder protocol for details regarding hepatic and cystic artery Duplex analysis.

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	09/26/2023		Removed Medial/Lateral Long Spleen Images and Trans Spleen images superior to inferior

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