Ultrasound – Complete Abdominal Evaluation

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

SCOPE:
Applies to all ultrasound complete abdomen studies performed at:

- Children's Health Systems of Texas Hospitals and Clinics, Imaging Services (CHST)

INDICATIONS:
- Signs or symptoms (e.g. 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.

CONTRAINDICATIONS:
No absolute contraindications

EQUIPMENT:
- Curved array transducer with a frequency range of approximately 2-9 MHz that allows for appropriate penetration and resolution depending on patient's body habitus.

- Curved array transducer with a frequency range of approximately 1-5 MHZ that allows for appropriate penetration and resolution depending on patient's body habitus.

- ** Linear array transducer with frequency range of 9-18 MHz that allows for evaluation of the liver surface, depending on patient's body habitus.*

PATIENT PREPARATION:
- Patient should be NPO for recommended hours based on patients age allowing for distention of gallbladder:

    - 0 – 6 months = 2 hours NPO
    - 7 months – 3 years = 3 hours NPO
    - 4 years - 9 years = 5 hours NPO
    - 10+ years = 6 - 8 hours NPO

EXAMINATION:

GENERAL GUIDELINES:
A complete examination includes evaluation of the entire liver, gallbladder/bile ducts, pancreas, kidneys, spleen, bladder, aorta, and IVC.

EXAM INITIATION: AIDET

- 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) positions
- ***In the setting of known or suspected chronic liver disease/cirrhosis, portal hypertension/ascites, abdominal Doppler may need to be done** (refer to abdomen Doppler protocol)*

TECHNIQUE CONSIDERATIONS:

- Review any prior imaging, making note of abnormalities requiring 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 as appropriate, such as in the setting of diffuse liver disease or possible biliary atresia without an identified gall bladder.
- 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 known or suspected chronic liver disease/cirrhosis, portal hypertension/ascites, or HCC.***

Gallbladder and Bile Ducts

- Fasting for appropriate hours for patients age to exam will permit adequate distension.
- Gallbladder and intra/extrahepatic bile ducts should be evaluated for dilatation, wall thickening, and intraluminal findings.
  - Measure the GB wall (GB lumen to hepatic parenchyma)
- 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, 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.

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 small bowel 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.
- The spleen should also be used as a window as an attempt to visualize the pancreatic tail.

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 & spleen), cortex, pelvis, and the perirenal region should be assessed for abnormalities on real time survey. Abbreviated images including length measurements are included in this exam.
- Color/Power Doppler should be used to assess for uniform parenchymal perfusion and to evaluate for twinkle artifact as seen with renal calculi.

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) aorta and IVC are taken along the long axis of the vessel. Transverse images of the proximal (upper) aorta and IVC are taken perpendicular to the long axis of the vessel. Abbreviated images are included in this exam.
- Measurements, if necessary, 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:

Liver

- Longitudinal images:
  - Left lobe left of midline
  - Left lobe at midline. Include proximal abdominal aorta, celiac artery, and SMA.
  - Left lobe with IVC. Include caudate lobe, MPV, and pancreatic head.
  - Left lobe with left portal vein
  - Right lobe with gallbladder
  - Right lobe with right kidney
  - Right lobe including right hemidiaphragm and adjacent pleural space
  - Right lobe far lateral
  - Main portal vein with and without color Doppler

- Transverse images:
  - Main portal vein bifurcation. Include color doppler image.
  - Dome with hepatic veins. Include color doppler image Include entire right and left lobe (on separate images as needed)
  - Left lobe with left portal vein
  - 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 sweeps, including as much hepatic parenchyma as possible:
  - Transverse orientation, left and right lobes, from dome to inferior most margin
  - Longitudinal orientation of left lobe from midline to lateral most tip, right lobe sub or intercostal (using multiple acoustic windows if necessary).
  - Cine sweeps of any focal abnormality

- ***Liver Capsule. *In the setting of known or suspected chronic liver disease/cirrhosis, portal hypertension/ascites, or HCC. With a linear 9 or 12MHz transducer, it includes high-resolution images of the left hepatic lobe capsule and underlying parenchyma for nodularity. Obtain both representative still images and a cine sweep of the left lobe. ****

- Doppler:
  - Main portal vein
  - Color Doppler and spectral waveform at porta hepatis (for all exams)
  - *Peak velocity with angle correction**
  - *Main portal vein diameter, inner wall-to-inner wall**

Gallbladder/bile ducts

- Longitudinal images:
  - Representative images of gallbladder at neck, mid body, and fundus, with cine sweep of any focal abnormality.

- Annotate image if focal tenderness was or was not observed (example: "+ pain" or "no tenderness"). Document if patient altered or received pain medication.
- Common duct with largest diameter measurement at porta hepatis

- Transverse images:
  - Representative images of gallbladder at neck, mid body, and fundus, with cine sweep of any focal abnormality.
  - Gb wall measurement

Pancreas

- Longitudinal 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 the duct as close to the pancreatic head as possible.
    - ***In the setting of known or suspected chronic liver disease/cirrhosis, portal hypertension/ascites.***
- Transverse images:
  - Representative images of the head/uncinate, neck, body, and tail, with cine sweep of any focal abnormality.

Kidneys

- Longitudinal images:
  - Medial segment
  - Mid segment with and without measurement x 2
    - With and without color Doppler
  - Lateral segment
  - Cine sweeps of any focal abnormality
- Transverse images:
  - Upper pole
  - Mid segment
  - Lower pole
  - Measure the antero-posterior diameter of the renal pelvis
- Cine sweeps of any focal abnormality

Spleen

- Longitudinal images:
  - Representative images from medial to lateral, including left hemidiaphragm and adjacent pleural space, if possible, with cine sweep of any focal abnormality.
  - Longitudinal spleen measurement, from inferior most tip to highest point along diaphragm, ***crossing through the splenic hilum***.
  - Color Doppler evaluation at splenic hilum to document vessel patency
  - Color and/or Power Doppler evaluation of splenic parenchyma to evaluate for segmental hypoperfusion/infarction
- Transverse images:
  - Representative images of the spleen from dome to tip, with cine sweep of any focal abnormality.

- Transverse measurements: *oriented 90 degrees* relative to longitudinal measurement, calipers placed at greatest thickness. Width measured transverse to longitudinal measurements at same position.

Aorta/IVC

- Longitudinal images:
  - Representative image of each proximal (superior) segment
- Transverse images:
  - Representative images with and without measurements, if abnormal

Bladder

- Longitudinal images:
  - Representative images of the bladder
- Transverse images:
  - Representative images of the bladder
- Cine sweeps:
  - Provide representative images of mobile debris or abnormalities as needed

Ascites Check

- *Longitudinal or transverse images: RUQ; LUQ; RLQ; LLQ; Midline pelvis*
  - *Stationary cine images of mobile debris, if present*

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

PROCESSING:

- Export all images to PACS
- Review examination images and data on PACS
- Document relevant history and impressions in primordial
  - If the patient was altered or received pain medication prior to the examination and any study limitations
- Present images to Radiologist

REFERENCES:

Siegel, Marilyn, (2002). Pediatric Sonography. Philadelphia, PA: Lippincott Williams and Wilkins.

REVISION HISTORY:

SUBMITTED BY:	**C. LaQuin Oliver, BA, RDMS**	**Title:**	Radiology Manager Dallas Sonography
APPROVED BY:	Neil Fernandes MD	**Title**	Chief Ultrasound Radiologist
APPROVAL DATE:	2/24/2023		
REVIEW DATE(S):	2/17/2023		C. LaQuin Oliver, RDMS
REVISION DATE(S):	2/17/2023	**Brief Summary:**	Added hepatic veins w/wo color doppler Added view of left kidney w/spleen