LIVER ULTRASOUND EXAMINATION
(WITH OR WITHOUT ELASTOGRAPHY)

POLICY: Liver ultrasound will be performed with an order from a physician or other qualified clinical practitioner. The examination will be supervised and interpreted by a radiologist or other licensed practitioner who is qualified by reason of training to understand the normal anatomy and pathophysiology of the liver, and integration of ultrasound with other imaging techniques to optimize the probability of detecting disease.

PURPOSE: Liver ultrasound is performed to assess the anatomy of the liver and related structures (biliary system and spleen), and document normal and abnormal structures therein. In addition, liver elastography can be performed to quantitatively assess the degree of fibrosis within the liver parenchyma utilizing image guided hepatic elastography technology.

INDICATIONS: Liver ultrasound and/or elastography is indicated for patients with signs, symptoms, and/or laboratory evidence of chronic disease involving the liver, portal venous system, spleen, and coagulation mechanism (e.g. chronic hepatitis, ETOH abuse, etc). Liver ultrasound is intended to be a screening examination to evaluate for hepatocellular carcinoma, while liver elastography can detect the presence and degree of fibrosis of the liver (cirrhosis).

PATIENT PREPARATION: Outpatients should be fasting for a minimum of eight hours prior to the exam. Non urgent inpatients should be fasting for at least six hours if possible. Emergency Room and acute patients can be examined without fasting. Patients should be instructed to take prescribed oral medication on their normal schedule with small sips of water. The preparation for patients receiving diabetic medication (oral or injectable) must be approved by the radiologist or nurse.

PROCEDURE: The examination involves conventional gray scale, real-time imaging of upper abdominal organs. Each organ should be imaged in its entirety (e.g. long and transverse views) before imaging the next organ. When any measurement is performed, an image should be captured with and without measurements.

If requested, image guided liver elastography will be performed in conjunction with liver ultrasound examination. Multiple liver elastography samples and measurements are obtained to quantitatively evaluate the degree of fibrosis within the liver.

The order of organ imaging will be (minimal number of images in parenthesis):

B-MODE IMAGING:
- liver (12 images, 4 cines)
- gallbladder (3 images, 1 cine)
- biliary system (3 images)
- spleen (4 images)

LIVER ELASTOGRAPHY:
- liver (10 images)
B-MODE IMAGING
Gray scale, real-time images are intended to demonstrate the hepatic size, echogenicity relative to the spleen and right kidney, contour, and any focal abnormalities. Images of the spleen shall demonstrate its size, texture, and any focal abnormalities. The peritoneal recesses of the upper abdomen included in images of the liver and spleen can be assessed for ascites and/or pleural effusions. The examination can be performed in supine or decubitus positions, with respiration suspended at a level that optimizes images of the desired anatomy. With the exception of surface images of the liver, a curved array (or sector) transducer should be employed to image the abdominal organs.

LIVER:
The anterior subcostal approach should be employed when it feasible to do so. An intercostal approach can be used as an alternate or supplementary window when necessary.
- **Minimal stored images should include:**
  - three sagittal views of the liver to the right of the porta hepatis, labeled *Liver Long*; one image will include the maximal cephalocaudad length of the right lobe measured from the diaphragm to its inferior tip in a parasagittal plane; one image should also include the right kidney to allow comparison of the relative echogenicity of the two organs
  - one sagittal view of the liver to include the main portal vein in the porta hepatis, labeled *Liver Long*
  - one sagittal view of the medial segment of the left lobe to include the inferior vena cava and caudate, labeled *Liver IVC Long*
  - one sagittal view of the lateral segment of the left lobe, labeled *Liver Long*;
  - two transverse views of the left lobe to include the left lateral contour of the liver, the left portal vein and the fissure of the ligamentum teres, labeled *Liver Trans*
  - one transverse view of the liver to include the venous confluence of the hepatic veins and the inferior vena cava, labeled *Liver Trans*
  - one transverse color Doppler view of the the main portal vein demonstrating patency and flow direction, labeled *Liver MPV Trans*
  - three transverse views of the right lobe to demonstrate representative views of the superior, middle, and inferior one thirds of the right lobe, including its lateral and posterior contours, labeled *Liver Trans*; images will include the dome, right hepatic vein and right portal vein
  - one sagittal cine of the entire right lobe of the liver, from the lateral right margin through the porta hepatis, labeled *Liver Long Rt-Lt*
  - one transverse cine of the entire right lobe of the liver, from the dome through the inferior margin, labeled *Liver Trans Sup-Inf*
  - one sagittal cine of the entire left lobe of the liver, from the porta hepatis through the lateral left margin, labeled *Liver Long Lt-Rt*
  - one transverse cine of the entire left lobe of the liver, from the superior margin through the inferior margin, labeled *Liver Trans Sup-Inf*
  - one image of the surface contour of the liver, obtained using linear transducer, labeled *Liver Surface Contour*
BILIARY SYSTEM:
The gallbladder should be examined to consider stones, wall thickness and irregularities, pericholecystic structures, and tenderness to palpation with the ultrasound transducer (Murphy’s Sign).
The gallbladder must be examined with the patient in at least two different positions to assess the mobility of intraluminal objects (e.g. gallstones). In the presence of gallstones, multiple positions should be employed in order to differentiate mobile gallstones from gallstones lodged in the neck of the gallbladder.
The intrahepatic branches of the bile ducts should be investigated in each lobe of the liver, and the extrahepatic segment of the bile duct examined through its entire course from the porta hepatis to the sphincter of Oddi, searching for enlargement or intraluminal objects (e.g. stones).

• Minimal stored images should include:
  • two longitudinal views of the gallbladder with the patient in a position that optimizes visualization of the gallbladder, labeled GB Long; images should include the neck and fundus of the gallbladder, as well as the gallbladder wall
  • one longitudinal cine of the gallbladder, labeled GB Long
  • one longitudinal view of the gallbladder with the patient in a different position (e.g. exaggerated left lateral decubitus, upright, prone/kneeling) focused on the most dependent segment of the gallbladder, labeled GB LLD (or Upright, Prone, etc.)
  • one transverse view with the patient in a position that optimizes visualization of the body of the gallbladder, labeled GB Trans
  • two views of the extrahepatic bile duct at the point of its maximal luminal diameter, labeled Bile Duct; color Doppler may be utilized to isolate the bile duct from surrounding vessels; images should include a measured maximal diameter

SPLEEN:
The spleen should be investigated to consider its size, entire contour, and parenchymal pattern.
The spleen should be examined with the patient in any position that optimizes its visualization (e.g. supine, right lateral decubitus, upright).

• Minimal stored images of the spleen should include:
  • two longitudinal views, labeled Spleen Long; images should include the maximal length measurement and the left kidney to allow comparison of the relative echogenicity of the two organs
  • one view orthogonal to the long axis view, labeled Spleen Trans;
  • if indicated, a volume measurement of the spleen may be obtained using three orthogonal dimensions: maximal length, height (perpendicular to the length) and width.
LIVER ELASTOGRAPHY
Liver elastography measurements may be obtained, in addition the b-mode images described above, at the request of the referring provider.
Liver elastography should be performed with the patient fasting, in a supine or LPO (30 degrees) position, and with his/her arm raised. An intercostal approach of the right lobe of the liver should be used. The region of interest selected should be at least 1-2cm beneath the liver capsule and free of blood vessels if possible. Elastography sample should be acquired with the patient's breathing suspended.
The following may raise stiffness values: Valsalva, abdominal straining, heart motion, direct transducer pressure, post prandial state, close proximity to the liver capsule, acute hepatitis. Do not adjust the color gain; it will result in false information. Avoid artifact: vertical, linear color patterns; speckled, color mosaic appearance. At least ten samples should be obtained (all in the same location), measured and a report generated. The report worksheet should be image-captured at the end of the exam. The median value should be recorded. If the median value is >7.1kPa, then the interquartile range (IQR) should be calculated and recorded. IQR/Median should be calculated and recorded. If IQR/Median=<0.30, then the data set is considered reliable; if >0.30, then the reliability of the data set is questionable.
- Interpretation of images and measurements are vendor specific.
  - GE Shear Wave Elastography
    - Shear Wave Elastography results are demonstrated qualitatively with a color map in a region of interest as well as a quantatative measurement (m/s or kPa).
    - Degree of fibrosis, according to GE's elastography cutoff values, in terms of Shear Wave speed (m/s) and kilopascals (kPa):
      
      F0 (Normal): <1.35m/s; <5.48kPa
      F1: 1.36-1.66m/s; 5.49-8.29kPa
      F2: 1.67-1.77m/s; 8.30-9.40kPa
      F3: 1.78-1.99m/s; 9.41-11.9kPa
      F4: >1.99m/s; >11.9kPa