ABDOMINAL HEPATIC DUPLEX ULTRASOUND (NON-TIPS)

I. Patient Preparation:
   a. NPO for 8 hours prior to exam for adults, adolescents, and school-aged children.

II. Equipment:
   a. Performed with real-time scanner using a sector or curved linear transducer with frequencies ranging from 3.5 MHz to 5.0 MHz. Higher frequencies are often necessary for children and infants. On occasion, large patients may require a lower frequency of 2.5 MHz. Doppler frequencies range from 3.5 to 5.0 MHz.

III. Indications:
   a. Hepatitis
   b. Liver failure
   c. Portal hypertension
   d. Portal vein thrombosis
   e. ETOH abuse
   f. Budd-Chiari
   g. Ascites

IV. Imaging Protocol:
   a. <u>Liver</u>
      i. Image the liver in the sagittal (longitudinal) and transverse planes. At least 3 images of the left and right lobes in **both** sagittal and transverse planes must be acquired.
      ii. Record mid-sagittal view of liver with calipers measuring maximum hepatic length.
      iii. Record image of Morrison's pouch and evaluate for any evidence of ascites.
      iv. Evaluate porta hepatic and periportal region for any evidence of varices.

   b. <u>IVC</u>
      i. Obtain grayscale image of the IVC.
      ii. Perform PD or Color Doppler evaluation of proximal inferior vena cava.
      iii. Record color Doppler with spectral Doppler tracing.
      iv. Evaluate for flow pattern and direction. Flow is best demonstrated after release of a Valsalva maneuver when thoracic pressure is decreased.
      v. <u>Criteria for Doppler evaluation of IVC</u>
         1. Normal flow direction is towards the heart, but a slight reversed component may be seen normally due to reflux of blood from heart during atrial systole.
         2. Normal flow patterns may be phasic reflecting transmitted cardiac pulsation.
         3. Phasic in response to respiratory changes.
         4. Abnormal flow patterns include absent, reversed, turbulent or continuous flow.

   c. <u>Hepatic Veins</u>
      i. Obtain grayscale images of the **right, left and main hepatic veins.**
      ii. Perform PD or Color Doppler evaluation of **right, left and main hepatic veins** in the longitudinal plane.
      iii. Record color Doppler with spectral Doppler velocity tracing for **right, left and main hepatic veins**.
      iv. Evaluate flow pattern and direction.
      v. <u>Criteria for Doppler evaluation of hepatic veins:</u>

1. Normal flow direction is hepatofugal (away from the liver).
2. Normal flow patterns may be biphasic or triphasic with a small reversed component reflecting transmitted cardiac and respiratory pulsations. (waveform will appear similar to letter "W").
3. Bi-directional.
4. Abnormal flow patterns include absent, reversed (hepatopedal), turbulent or continuous flow.

d. Portal Veins

i. Obtain grayscale images of **right, left and main portal veins**.
ii. Perform PD or color Doppler evaluation of **right, left and main portal veins** in the longitudinal plane.
iii. Record color Doppler with spectral Doppler velocity tracing for each vein evaluated. ***Angle correction required on Main Portal Vein velocity***
iv. Evaluate or flow pattern and direction.
v. Obtain diameter measurement of Main Portal Vein.
    1. Portal vein may be enlarged and exceed 13 mm in diameter.
vi. Criteria for Doppler evaluation of portal vein:
    1. Normal flow direction is hepatopedal (towards liver); flow direction in branches of portal vein can be compared to flow direction of adjacent hepatic artery – two should display the same flow direction.
    2. Normal low pattern is primarily monophasic (exhibits slight variation with respiration), low velocity nonpulsatile and unidirectional.
    3. Normal flow velocities are 20-30 cm/sec for main portal vein. (Significant decreased velocity in portal vein 9.7 to 12.4 cm/sec is common in patients with portal hypertension.
    4. Abnormal flow patterns include reversed (hepatofugal – seen with late or severe portal HTN), absent, flat (seen with liver cirrhosis) pulsatile (seen with CHF or tricuspid insufficiency or elevated right atrial pressure).
vii. Evaluate periportal area for any evidence for the formation of portosystemic varices and collateral vessels.

e. Hepatic Artery

i. Perform PD or color Doppler evaluation in the longitudinal plane, in the region of the porta hepatis.
ii. Record color Doppler with spectral Doppler velocity tracing. ***Angle correction required on for Hepatic Artery velocity***
iii. Evaluate flow pattern.
    1. Normal hepatic artery flow shows continuous forward, diastolic, low resistance waveform.

f. Splenic Vein

i. Obtain grayscale image of the splenic vein posterior to the pancreas.
ii. Perform PD or color Doppler evaluation of the splenic vein in the longitudinal plane, posterior to the pancreas.
iii. Record color Doppler with spectral Doppler velocity tracing posterior to the pancreas.
iv. Evaluate for flow pattern and direction.
v. Criteria for Doppler evaluation of splenic vein:
    1. Normal flow direction is hepatopedal (towards liver).
    2. Normal flow pattern is unidirectional.

3. Abnormal flow patterns include reversed (hepatofugal), absent or turbulent.

g. <u>Spleen</u>

i. Record long and transverse axis views of spleen with calipers measuring maximum splenic length. Length should be less than 13 cm.
ii. Record image of the splenic/left renal space and evaluate or any evidence of ascites.
iii. Evaluate for any evidence of varices in splenic hilum.

V. Abdominal Hepatic Duplex Ultrasound Required Images:

Long liver left (lateral, mid, medial)
Long liver right (lateral, mid, medial)
Long mid sagittal liver with hepatic length
Long Liver/Right Kidney
Trans liver left (superior, mid, inferior)
Trans liver right (superior, mid, inferior)
Long IVC grayscale
Long IVC with Color and Spectral Doppler (measure PV)
Hepatic veins grayscale (left, mid, right)
Long left hepatic vein with color Doppler
Long left hepatic vein with color and Spectral Doppler (measure PV)
Long middle hepatic vein with color Doppler
Long middle hepatic vein with color and Spectral Doppler (measure PV)
Long right hepatic vein with color Doppler
Long right hepatic vein with Color and Spectral Doppler (measure PV)
Long Main Portal Vein grayscale without and with diameter measurement
Long Main Portal Vein with color Doppler
Long Main Portal Vein with color and Spectral Doppler (measure PV with appropriate angle correct)
Long left Portal Vein grayscale
Long left Portal Vein with color Doppler
Long left Portal Vein with color and Spectral Doppler (measure PV)
Long right Portal Vein grayscale
Long right Portal Vein with color Doppler
Long right Portal Vein with color and Spectral Doppler (measure PV)
Long Hepatic Artery grayscale
Long Hepatic Artery with color Doppler
Long Hepatic Artery with color and Spectral Doppler (measure PV with appropriate angle correct)
Long Splenic Vein grayscale
Long Splenic Vein with color Doppler
Long Splenic Vein with color and Spectral Doppler (measure PV)
Long Spleen with length measurement
Long Spleen/Left Kidney
Trans spleen