

ABDOMINAL DOPPLER ULTRASOUND PROTOCOL (UABDD)

(UABDD is a combined charge of UABDL and UORGDC. If you are doing a Complete Abdomen Exam, will need to change the charge to UABDC and UORGDC separately.)

****INCLUDES AN ABDOMEN LIMITED EXAM WITH COMPLETE DOPPLER EXAM EVALUATING COLOR AND SPECTRAL DOPPLER OF PORTAL VEINS, HEPATIC ARTERIES, HEPATIC VEINS, AND SPLENIC VEIN. TO BE USED FOR -**

- General Abdominal Doppler Requests
- SOS/VOD Evaluations (See additional images needed at end of protocol)
- Budd Chiari Evaluations (See additional images needed at end of protocol)
- Post liver transplant donor follow up

****SEE SEPARATE PROTOCOLS FOR EVALUATION OF TIPS, PORTAL VEIN THROMBOISIS, PORTAL HYPERTENSION AND PRE-LIVER TRANSPLANT WORKUP.****

PATIENT PREP: NPO at least 4 hours. Exceptions can be made for urgent and ER exams. Include in the report that the patient was not NPO for exam when relevant.

IMAGES TO OBTAIN

PANCREAS:

- Transverse image of head, body (showing splenic vein) and tail.
- Sagittal image of head, body and tail.
- Transverse image of head showing porto-splenic confluence.
- Document and measure pancreatic duct if visible.
- Take image of "Pancreas Area" if not well seen.

LIVER:

Left lobe – subcostal/epigastric approach

- Transverse images:
 - Left hepatic vein confluence into IVC
 - Left lobe visualizing dome of liver
 - Left lobe with left portal vein
 - Cine clip sweeping through LHL in transverse from superior to inferior
- Sagittal images:
 - Left lobe with left portal vein and ligamentum teres.
 - Left lobe with hepatic vein
 - Cine clip sweeping through LHL in sagittal from medial to lateral

Caudate lobe – subcostal/epigastric approach

- Sagittal image of the caudate lobe.
- Transverse image of the caudate lobe.

Right lobe - subcostal or intercostal approach

- Sagittal images:
 - Right lobe to visualize dome of liver
 - Right liver with middle hepatic vein draining into IVC
 - Main interlobar fissure with gallbladder and CHD and MPV
 - Right lobe and right portal vein.
 - Right hemidiaphragm to assess for pleural effusions and ringdown.
 - Right lobe showing echo texture between liver and right kidney.
 - Right lobe and right kidney documenting approximate liver size. Measurement of length of the liver is not needed unless requested.
 - Cine clip sweeping through RHL in sagittal from medial to lateral
- Transverse images:
 - Right lobe showing right and middle hepatic veins.
 - Right lobe at right portal vein.
 - 2D image through MPV
 - COLOR image of MPV showing patency and direction of flow
 - Right lobe and right kidney.
 - Cine clip sweeping through RHL in transverse from superior to inferior

LIVER CAPSULE -FOR HCC SCREENING ONLY

- Image of contour of liver capsule taken with linear transducer to assess for nodularity, preferably of the left lobe.

COLOR DOPPLER IMAGES- (Be sure to optimize your color image.)

- Color images of MPV, Right PV and Left PV showing direction of flow.
- Color image of the splenic vein at the pancreas showing direction of flow.
- Color image documenting any collaterals or varies if present in periportal area, LUQ, epigastric region, or the presence of a recanalized umbilical vein.

SPECTRAL DOPPLER IMAGES: (Be sure to optimize your spectral doppler images.)

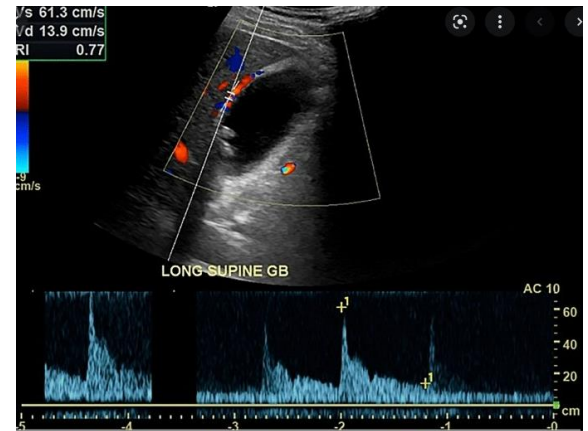
- Middle, Right and Left Hepatic Veins – Velocity is not needed except for in cases where color flow is seen aliasing or presence of hepatic vein stent.
 - Phasicity of hepatic veins should be assessed during suspended/mid respiration or shallow breathing, deep inspiration may dampen hepatic flow.
 - If monophasicity is seen, use LLD positioning to reassess.
- Main, Right and Left Portal Veins - angle corrected velocity measurement.
MPV velocity is usually between 30-60cm/s, velocities less than <10cm/s indicate portal hypertension.
- Proper, Right and Left Hepatic Arteries – Measurement of RI with angle correction and showing a linear segment of the artery to verify direction of flow.
 - Normal range is 0.5 -0.8
- Splenic vein at splenic hilum - angle corrected velocity measurement. If patient has had a splenectomy no spectral is needed.

BILE DUCTS:

- Sagittal image of CBD and CHD with and without measurements in 2D and color doppler at the level of the porta hepatis. If dilated, follow CBD as distal as possible to look for stones/mass and measure as distal as possible as well.
- Document and measure any intrahepatic bile duct dilatation with 2D and color imaging.

GALLBLADDER:

- Sagittal image of gallbladder.
- Transverse image of gallbladder.
- Measurement of gallbladder wall in sagittal section only. Do not include liver surface. If liver edge is edematous, try to measure free GB wall. Normal wall thickness is <3mm.
- Take image and cine through GB if there is any abnormality (stones, polyp, adenomyomatosis.) Take color image of any mass seen.
- LLD POSITION: Transverse and sagittal image of gallbladder with patient in LLD position to check for stones/polyps and mobility.
- If evaluating for cholecystitis, or if suspicious GB findings such as thickened wall or distension:
 - Evaluate for Murphy's sign and include in the report.
 - Gallbladder length measurement. Normal <8cm
 - Color doppler of gallbladder wall to assess for hypervascularity
 - Spectral doppler velocity of the cystic artery which can be seen within wall of anterior gallbladder.
 - Normal velocity <40cm/s
 - If artery cannot be visualized, include color doppler of area and comment in report that it could not be seen.
 - Add code UORGDL if cystic artery is sampled.



RIGHT KIDNEY:

- Sagittal image of right kidney in medial, middle and lateral views.
- Sagittal measurement of right kidney. Take cine only if abnormality is present.
- Transverse images of superior/mid/inferior right kidney.
- Color Doppler image of any mass or pelviectasis.

SPLEEN:

- Sagittal and transverse images through spleen
- Sagittal length measurement of spleen
- Sagittal image through left hemidiaphragm and spleen to assess for pleural effusions and ringdown.
- Sagittal image through spleen and left kidney.
- Color Doppler image of any abnormality.

LOWER QUADRANTS:

- Document RLQ and LLQ (to check for ascites).

ADDITIONAL IMAGES AS NEEDED

DIAGNOSIS OF PORTAL HYPERTENSION INCLUDES:

- Low portal venous flow (<10cm/s)
- Hepatofugal portal venous flow
- Portosystemic collaterals or varices
- Recanalized umbilical vein
- Dilated portal vein
- Splenomegaly
- Ascites

BUDD CHIARI ADDITIONAL IMAGES NEEDED:

- Include spectral doppler of IVC.
- Sagittal and transverse 2D images of IVC

VOD/SOS ADDITIONAL IMAGES NEEDED:

- Craniocaudal measurement of liver
- MPV diameter
- HV diameters, measure within 2 cm of IVC
- ~~ELASTOGRAPHY OF LIVER. See protocol for technique and required images~~

VOD (or SOS) Checklist:

1. **Liver craniocaudal size** – increase in 2 of 3 measurements of >2cm relative to baseline
2. **Spleen size** >1cm increase relative to baseline
3. **Gallbladder wall** thickening >6mm
4. **PV diameter** (at MPV) - >12mm
5. **HV diameter** (close to IVC) <3mm
6. **Paraumbilical vein** – presence and flow within
7. **PV spectral doppler** <10cm/s
8. **Hepatic artery RI** > 0.75
9. **Hepatic vein** monophasicity
10. **Ascites**

Variable	Lassau's criteria
Gray-scale ultrasound	
Hepatomegaly	Liver enlargement: increase in 2 of 3 measurements of > 2 cm in adults and >1 cm in children relative to baseline
Splenomegaly	Spleen enlargement: increase >1 cm relative to baseline measurement of the greatest axis
Gall bladder wall thickening	>6 mm
Portal vein diameter	>8 mm in children; >12 mm in adults
Hepatic vein diameter	<3 mm
Ascites	Presence
Paraumbilical vein	Visualization
Color Doppler ultrasound	
Absence/presence of flow	Flow recorded in paraumbilical vein
Flow direction	Reversed flow in the main portal vein
Spectral Doppler ultrasound	
Portal vein velocity/density/congestion	Flow demodulation (disappearance of velocity variations with breathing); decreased spectral density in portal vein; maximal flow in the main portal vein <10 cm/s; portal vein congestion index \geq .1; monophasic flow in hepatic veins
Hepatic artery resistive index	\geq .75

****SEE SEPARATE PROTOCOL FOR EVALUATION OF TIPS, PORTAL VEIN THROMBOBSIS, AND PORTAL HYPERTENSION.****

ADDITIONAL NOTES

1. If a patient is coming in for pain, please document within the indication section or the “other” section what the current status of pain is. For instance, how long the patient has had pain, if it’s getting worse or better, and where exactly the pain is. Always take an image where the patient is hurting the most (label as “area of pain”). If this area is located where bowel is, take an image of the area with a linear transducer. When describing the pain, write “per patient, ...” in the indication. Example: Per the patient, his pain is now in the RLQ and getting worse.
2. Cine clip of any abnormality.
3. Say “Not well seen” if structure is not well seen and include the reason why.
4. Any masses, cysts, stones or abnormalities should be measured in three dimensions and have a 2D picture and a color image documented.

ABDOMEN DOPPLER ULTRASOUND IMAGE LIST

IMAGE	MODE	IMAGE	MODE
Panc Trans H/B/T	2D	GB Sag	
Panc Sag H/B/T	2D	GB Wall w/measurement	2D+
Splenic Vein at panc	Color	GB Sag w/ color	Color
<i>Panc Duct if dilated</i>	<i>2D +</i>	GB Trans	2D
		GB Sag LLD	2D
Left Liver Sag (medial portion)	2D	GB Trans LLD	2D
Left Liver Sag (lateral portion)	2D	<i>GB length if r/o chole</i>	<i>2D+</i>
Left Liver Sag M-L	Cine	<i>Cystic duct if r/o chole</i>	<i>Spectral</i>
Caudate Liver Sag	2D		
Caudate Liver Trans	2D	CHD w/measurement and color	Color+
Left Liver Trans (at hepatic vein)	2D	CBD w/measurement and color	Color+
Left Liver Trans (at portal vein)	2D		
Left Liver Trans S-I	Cine	Right Kidney Sag Mid	2D
LPV <i>without color</i>	2D	Right Kidney Sag Mid w/ measurement	2D +
LPV <i>w/ color</i>	Color	Right Kidney Sag Med	2D
LPV <i>velocity w angle correction</i>	Spectral cm/s	Right Kidney Sag Lat	2D
LHA <i>RI w angle correction</i>	Spectral RI	Right Kidney Trans Sup	2D
LHV <i>waveform only unless stent</i>	Spectral	Right Kidney Trans Mid	2D
		Right Kidney Trans Inf	2D
Right Liver Trans (at hepatic vein)	2D		
Right Liver Trans (at portal vein)	2D	Spleen Sag x2	2D x2
Right Liver Trans (at hepatic vein)	2D	Spleen Sag w/ measurement	2D +
Right Liver Trans S-I	Cine	Spleen Trans	2D
Right Liver Sag/Rt Chest	2D	Splenic Vein	Spectral cm/s
Right Liver Sag	2D		
Right Liver Sag / RK	2D	RLQ	2D
Right Liver Sag L-M	Cine	LLQ	2D
MPV <i>without color</i>	2D	<i>For cirrhosis/HCC screening: Capsule</i>	<i>Linear</i>
MPV <i>w/ color</i>	Color		
MPV <i>velocity w angle correction</i>	Spectral cm/s	<i>SOS/VOD: Elastography x 5, <30% EQI</i>	<i>Elasto</i>
PHA <i>RI w angle correction</i>	Spectral RI		
RPV <i>without color</i>	2D	<i>MFI for lesions</i>	<i>MFI</i>
RPV <i>w/ color</i>	Color		
RPV <i>velocity w angle correction</i>	Spectral cm/s		
RHA <i>RI w angle correction</i>	Spectral RI		
MHV <i>waveform only unless stent</i>	Spectral		
RHV <i>waveform only unless stent</i>	Spectral		
<i>IVC if indicated</i>	<i>Spectral cm/s</i>		

ABDOMEN DOPPLER PROTOCOL HISTORY

	Date	Changes made	By whom
Updated	10/25/21		Becky Marion
Updated	03/03/22	-Added color of SV at pancreas -Added Spectral of SV at hilum -Added measure size of HVs for Budd Chiari -Added angle correction for HAs w length of artery shown -Removed pelvis/bladder area images -Created separate TIPS, PHT, PVT protocols -Changed NPO requirement to 2-6 hrs	03/03/22 Protocol Meeting Attendees Dighe, Lee, Kolokythas
Approved	3/14/22		Manjiri Dighe
Added	5/4/2022	Elastography for VOD	Renee Betit Fitzgerald
Added	10/10/2022	Cystic duct and GB length for cholecystitis c	Renee Betit Fitzgerald
Added	10/27/2022	Cine sweeps of RHL &LHL in trv and sag	Renee Betit Fitzgerald
Removed	3/1/2024	Elastography no longer needed for SOS/VOD unless requested	Manjiri Dighe
Added	4/15/2024	Image list	Renee Betit Fitzgerald