1. Long images of aorta (prox, mid, and dist) with AP measurements.
2. Trans images of aorta (prox, mid, and dist) with R/L measurements.
3. Long images of R/L common iliac arteries with AP measurements.
4. Trans images of common iliac arteries with R/L measurements.
5. Mid-aorta color Doppler image with velocity measurement.
6. IVC long image. Include AP measurement if over 3.75 cm.
7. Longitudinal measurement of each kidney.

Document plaque, mural thrombus formations, and arrhythmias.
Document tortuosity when significant.

Abdominal Aorta/Common Iliac Interpretation Criteria

Velocity Criteria

Velocity Criteria (compared to Normal Segment)	% Stenosis
< 2x velocity elevation at stenosis	0 - 49
2x – 3x velocity elevation at stenosis	50 - 74
> 3x velocity elevation at stenosis	75 - 99

Size Criteria

- Area above celiac axis: aneurysmal if > 3.9 cm in males and > 3.1 in females.
- Infrarenal abdominal aorta: aneurysmal if ≥ 3 cm in diameter or ≥ 1.5 times diameter of proximal aorta.
- Ectatic abdominal aorta: 2.5 - 2.9 cm cross-sectional dimension.
- Common iliac artery: aneurysmal if ≥ 2.0 cm cross-sectional dimension.
- Ectatic common iliac artery: 1.5 - 1.9 cm cross-sectional dimension.

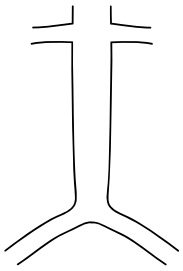
Aorta Worksheet

SONOGRAPHER NOTES

INDICATIONS	DATE/TIME	
	SONOGRAPHER	

		Additional Findings/Limitations
Prox (cm)	_____ x _____ AP Trans	
Mid (cm)	_____ x _____ AP Trans	
Dist (cm)	_____ x _____ AP Trans	
Right Common Iliac (cm)	_____ x _____ AP Trans	
Left Common Iliac (cm)	_____ x _____ AP Trans	
Aortic PSV (cm/s)		
IVC	❑ Normal ❑ Dilated ❑ Occluded	
Right Kidney (cm)	_____ Long	
Left Kidney (cm)	_____ Long	

Comments



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US Aorta Worksheet

Name / MR # / Label

Abdomen

1. Aorta: Long images of aorta with AP measurements (prox, mid, and dist).

2. IVC: Long image. Include AP measurement if over 3.75 cm. If IVC filter or catheter seen, localize with respect to hepatic/renal veins.

3. Pancreas: Images to include head, uncinate process, body, and tail.
   - Document any pancreatic abnormalities, including peripancreatic fluid, adenopathy, masses, calcifications. Image distal common bile duct in region of pancreatic head.
   - Measure pancreatic duct if seen.

4. Liver: Long and trans images of right, left, and caudate lobes.
   - Must show hepatic veins, portal veins, and color Doppler waveform of main portal vein
   - Largest single measurement (cm).
   - If liver has nodular appearing contour, image liver surface with high frequency linear probe.

5. Gall Bladder: Long and trans images in two positions (supine and LLD) when possible.
   - If GB absent, image GB fossa.
   - Take wall measurement.
   - Evaluate for pericholecystic fluid.
   - Evaluate for presence/absence of sonographic Murphy's sign.
   - Measure any masses/polyps in two directions.
   - Note stones/sludge and check for mobility.

6. Biliary System:
   - Evaluate/image intrahepatic ducts along right and left branches of portal vein.
   - Measure/document bile duct at porta hepatis.
   - When visualized, measure/document common bile duct at pancreatic head.

7. Kidneys: Long images (medial, mid, lateral) and trans images (upper, mid, lower) of both kidneys.
   - Record max measurement (long and trans) of kidneys.
   - Image comparison to adjacent liver/spleen.
   - Single color Doppler image of kidneys.
   - If absence of right kidney, image renal fossa.
   - If hydronephrosis seen, also show ureteral jets.
   - If stones present, measure largest dimension of largest stone.

8. Adrenals: If visualized, image in long and trans. Note any masses or abnormalities.

9. Spleen: Long and trans spleen images to include long measurement.
   - If spleen larger than 13 cm, measure in three dimensions.
   - If splenule noted, take measurements in three dimensions and try to show vascular attachment to spleen.

10. Image right and left lower quadrants. Image right and left hemidiaphragm/pleural space.

Abdomen Worksheet

SONOGRAPHER NOTES

INDICATIONS	DATE/TIME	
	SONOGRAPHER	

		Additional Findings/Limitations
Aorta	Prox _____ cm Mid _____ cm Dist _____ cm	
IVC	❑ Normal ❑ Occluded ❑ Dilated	
Pancreas	❑ Normal ❑ Partially Visualized ❑ Not Visualized	
Liver	_____ cm ❑ Normal echotexture ❑ Fatty ❑ Coarsened	
Portal Vein	❑ Hepatopetal ❑ Thrombus ❑ Hepatofugal	
Gall Bladder	❑ Normal ❑ Absent Wall thickness _____ cm ❑ Stones ❑ Mobile ❑ Pericholecystic fluid Sonographic Murphy's (when appropriate) ❑ Negative ❑ Positive ❑ Cannot evaluate	
Biliary	Common Duct _____ cm	
Right Kidney	❑ Hydro (then image jets) _____ (Long) x _____ (Trans) cm	
Left Kidney	❑ Hydro (then image jets) _____ (Long) x _____ (Trans) cm	
Spleen	_____ cm	

Comments

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MFP SFP Other

US Abdomen Worksheet

Name / MR # / Label

RUQ/GB

1. Aorta: Long images of aorta with measurements (prox, mid, and dist).

2. IVC: Long image. Include AP measurement if over 3.75 cm. If IVC filter or catheter seen, localize with respect to hepatic/renal veins.

3. Pancreas: Images to include head, uncinate process, body, and tail.
   - Document any pancreatic abnormalities, including peripancreatic fluid, adenopathy, masses, calcifications. Image distal common bile duct in region of pancreatic head.
   - Measure pancreatic duct if seen.

4. Liver: Long and trans images of right, left, and caudate lobes.
   - Must show hepatic veins, portal veins, and color Doppler waveform of main portal vein.
   - Largest single measurement (cm).
   - If liver has nodular appearing contour, image liver surface with high frequency linear probe.

5. Gall Bladder: Long and trans images in two positions (supine and LLD) when possible.
   - If GB absent, image GB fossa.
   - Take wall measurement.
   - Evaluate for pericholecystic fluid.
   - Evaluate for presence/absence of sonographic Murphy's sign.
   - Measure any masses/polyps in two directions.
   - Note stones/sludge and check for mobility.

6. Biliary System:
   - Evaluate/image intrahepatic ducts along right and left branches of portal vein.
   - Measure/document bile duct at porta hepatis.
   - When visualized, measure/document common bile duct at pancreatic head.

7. Right Kidney: Long images (medial, mid, lateral) and trans images (upper, mid, lower).
   - Record max measurement (long and trans).
   - Image comparison to adjacent liver.
   - Single color Doppler image of kidney.
   - If absence of right kidney, image renal fossa and length measurement of left kidney.
   - If kidney measurement under 9 cm or over 13 cm, image left kidney.
   - If hydronephrosis is seen, document ureteral jet.
   - If stones present, measure largest dimension of largest stone.

8. Image right hemidiaphragm/pleural space.

RUQ/GB Worksheet

SONOGRAPHER NOTES

INDICATIONS	DATE/TIME	
	SONOGRAPHER	

		Additional Findings/Limitations
Aorta	Prox _____ cm Mid _____ cm Dist _____ cm	
IVC	❑ Normal ❑ Occluded ❑ Dilated	
Pancreas	❑ Normal ❑ Partially Visualized ❑ Not Visualized	
Liver	_____ cm ❑ Normal echotexture ❑ Fatty ❑ Coarsened	
Portal Vein	❑ Hepatopetal ❑ Thrombus ❑ Hepatofugal	
Gall Bladder	❑ Normal ❑ Absent Wall thickness _____ cm ❑ Stones ❑ Mobile ❑ Pericholecystic fluid Sonographic Murphy's (when appropriate) ❑ Negative ❑ Positive ❑ Cannot evaluate	
Biliary	Common Duct _____ cm	
Right Kidney	❑ Hydro (then image jets) _____ x _____ cm Long Trans	

Comments

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US RUQ/GB Worksheet

Name / MR # / Label

Renal/Retroperitoneal

1. Aorta: Long images of aorta with measurements (prox, mid, and dist).

2. Common Iliac Arteries: Image right and left common iliac arteries in long and transverse with single trans (largest) diameter measurement.

3. IVC: Long image.
   - Include AP measurement if over 3.75 cm.
   - If IVC filter or catheter seen, localize with respect to hepatic/renal veins.

4. Bladder: Image long and trans.
   - Measure wall if thickened.
   - Demonstrate ureteral jets if hydronephrosis seen in either kidney or if suspected ureteral stone.
   - If requested, pre- and post-void residual volumes.

5. Kidneys: Long images (medial, mid, lateral) and trans images (upper, mid, lower) of both kidneys.
   - Record max measurement (long and trans) of kidneys.
   - Image comparison to adjacent liver/spleen.
   - Single color Doppler image of kidneys.
   - If absence of kidney, image renal fossa.
   - If hydronephrosis seen, also show ureteral jets.
   - If stones present, measure largest dimension of largest stone.

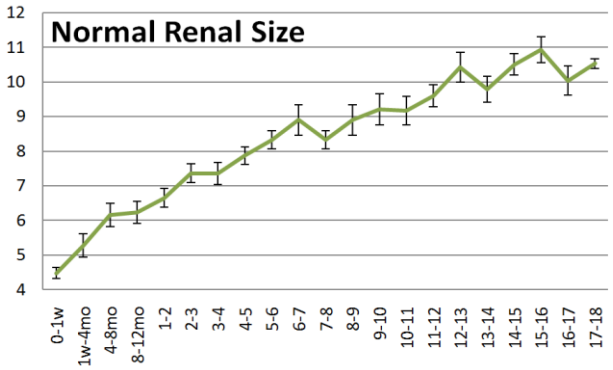
6. Prostate: Image and measure, if seen.

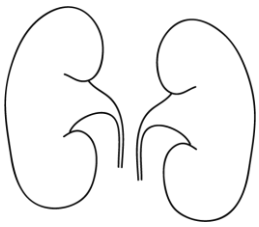
Renal/Retroperitoneal Worksheet

SONOGRAPHER NOTES

INDICATIONS	DATE/TIME	
	SONOGRAPHER	

Aorta	Prox	cm
	Mid	cm
	Dist	cm
R Com Iliac		cm
L Com Iliac		cm
IVC	❑ Normal	_____ cm if > 3.75 cm
Bladder	❑ Normal	
Prostate (if applicable)	_____ x _____ x _____ cm	



RIGHT		LEFT
_____ x _____ Long AP	**Size (cm)**	_____ x _____ Long AP
❑ No ❑ Yes	**Hydro**	❑ No ❑ Yes
❑ Normal ❑ Abnormal	**Echotexture**	❑ Normal ❑ Abnormal
❑ No ❑ Yes	**Ureteral Jets (if applicable)**	❑ No ❑ Yes
Lesions and stones (size, characteristics, flow)		Lesions and stones (size, characteristics, flow)

Findings/Limitations/Comments

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MFP SFP Other

US Renal/Retroperitoneal Worksheet

Name / MR # / Label

Clinical Protocol

Mesenteric Arteries

1. Aorta: Long images of aorta with measurements (prox, mid, and dist).

2. IVC: Long image.
   - Include AP measurement if over 3.75 cm.
   - If IVC filter or catheter seen, localize with respect to hepatic/renal veins.

3. Aorta velocity: At level of CA/SMA.

4. Celiac artery (CA) velocity: Prox, mid, and dist.
   - If significantly elevated velocities noted in CA, take measurement with deep held inspiration and expiration to evaluate for median arcuate ligament syndrome.

5. Hepatic artery (HA) velocity: At origin when possible.

6. Splenic artery (SPL A) velocity: At origin when possible.

7. Superior mesenteric artery (SMA) velocity: Prox, mid, and dist.

8. Inferior mesenteric artery (IMA): Show patency and velocity measurement when possible.

Mesenteric Arteries Worksheet

SONOGRAPHER NOTES

INDICATIONS	DATE/TIME	
	SONOGRAPHER	

AORTIC PSV _____ cm/s

AORTA DIAMETER

PROX _____ cm

MID _____ cm

DIST _____ cm

❑ IVC

CELIAC PSV PROX _____ cm/s

MID _____ cm/s

DIST _____ cm/s

HEPATIC A PSV _____ cm/s

SPLENIC A PSV _____ cm/s

SMA PSV PROX _____ cm/s

MID _____ cm/s

DIST _____ cm/s

IMA PSV _____ cm/s

Interpretation Criteria

Celiac PSV greater than 200 cm/s and SMA PSV greater than 275 cm/s indicate stenosis greater than 70%.

Findings/Limitations/Comments

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_____

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MFP SFP Other

US Mesenteric Arteries Worksheet

Name / MR # / Label

Portal Vein

1. Aorta: Long images of aorta with measurements (prox, mid, and dist).

2. IVC: Long image.
   - Include AP measurement if over 3.75 cm.
   - If IVC filter or catheter seen, localize with respect to hepatic/renal veins.

3. Liver: Long and trans images of right, left, and caudate lobes.
   - Must show hepatic and portal veins.
   - Largest single measurement (cm).
   - If liver has nodular appearing contour, image liver surface with high frequency linear probe.

4. Color Doppler to show patency of splenic vein (SPL V) at confluence if possible.

5. Angle corrected color Doppler with velocities of:

   - Main portal vein (MPV)
   - Right portal vein (RPV)
   - Left portal vein (LPV)
   - Hepatic artery (HA) at the porta hepatis
   - Right hepatic vein (RHV)
   - Middle hepatic vein (MHV)
   - Left hepatic vein (LHV)

TIPS

Long color Doppler with velocities in prox (portal vein end), mid, and dist (hepatic vein end) sections of shunt.

Normal TIPS connection RPV to RHV. Flow in from RPV toward RHV. Portal veins flow towards shunt and HV flow towards IVC. When TIPS occluded or not functioning, flow may not be seen, flow seen from RHV towards RPV (reversal of flow in TIPS), very slow flow in PV, or reversal of flow in PV.

Interpretation Criteria

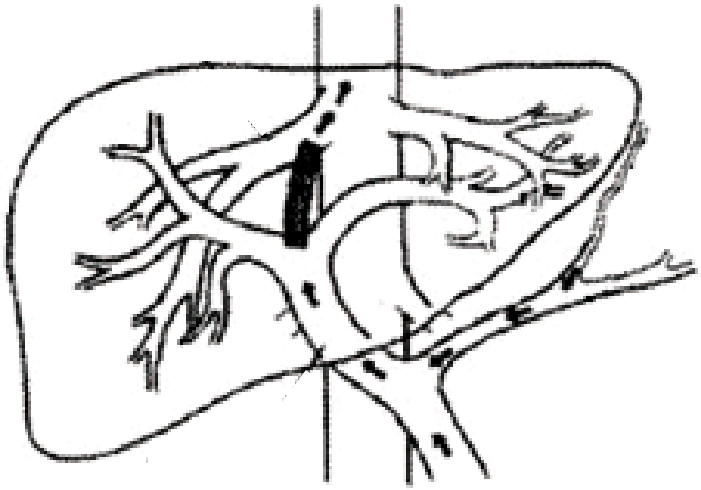
- Portal venous blood flow direction and velocity noted.
- Hepatofugal or to and fro flow considered abnormal.
- Thrombus in portal venous, hepatic venous, or hepatic artery system documented.
- Collateral formations also documented.

Portal Vein Worksheet

SONOGRAPHER NOTES

INDICATIONS	DATE/TIME	
	SONOGRAPHER	

Aorta	Prox	cm	**Comments**	
	Mid	cm		
	Dist	cm		
IVC				
Liver	_____ cm ❑ Normal echotexture ❑ Fatty ❑ Coarsened			
Splenic Vein	❑ Patent at confluence			
MPV		cm/s	RHV	cm/s
RPV		cm/s	MHV	cm/s
LPV		cm/s	LHV	cm/s
HA		cm/s		



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MFP SFP Other

US Portal Vein Worksheet

Name / MR # / Label

Clinical Protocol

Liver Elastography

1. Patient should hydrate well night before exam. Day of procedure, patient must be 4-6 hours NPO.

2. Patient should not be acutely ill, especially not in acute congestive heart failure. If patient appears acutely ill, or in CHF, please note on worksheet or on image.

3. Patient should be imaged supine or in slight left lateral oblique position (30 degrees) with intercostal approach. Image or worksheet should be labeled with patient position.

4. Right arm should be raised above head, if possible, to improve intercostal access.

5. Measurements should be obtained with shallow breath hold (no deep inspiration, no Valsalva, no expiration). Lock transducer in place.

6. ROI should be placed in right hepatic lobe, typically segment VII or VIII, about 2 cm deep and perpendicular to liver capsule.

7. ROI should avoid any large vessels, bile ducts, and rib shadows. ROI should not be within mass.

8. Use best B-mode image to place ROI. Do not move transducer between measurements. Lock transducer in place.

9. Follow vendor instructions for measurements:

SIEMENS	SAMSUNG	GE*
Obtain ten good measurements at same location/ROI. If measurement not good, "X.XX" will appear. If "X.XX" appears, repeat measurement.	For S-Shearwave imaging, five samples or more measured per site. For S-Shearwave, ten individual samples or more. Sample mean standard deviation should be 0.04 or higher.	Acquire at least ten samples. For measurements, place ten circular regions over saved shear wave elastography images. Circular YELLOW line indicates acceptable sample area measurement. Circular RED LINE indicates insufficient sample area for measurement.

*NOTE for GE: Measurements automatically recorded by system in worksheet. Ten measurement regions typically placed on different shear wave image frames or at non-overlapping locations on same frame so that ten independent measurements of liver stiffness obtained for each subject.

10. Median measurement (m/sec) should be reported.

11. Interquartile range (IQR) should be reported as measure of quality.

SIEMENS	SAMSUNG	GE*
IQR auto-calculated on machine	IQR manually calculated by sonographer	QR auto-calculated on machine

12. IQR/Median Value Ratio should be calculated and reported. This should be less than 0.30. If ratio greater than or equal to 0.30, second attempt at protocol should be performed.

SIEMENS	SAMSUNG	GE*
IQR/Median Value Ratio manually calculated by sonography	IQR/Median Value Ratio auto-calculated on machine	IQR/Median Value Ratio auto-calculated on machine

Make sure patient position and transducer frequency noted on image and/or worksheet so that follow-up can be performed with same parameters.

Liver Elastography Worksheet

SONOGRAPHER NOTES

INDICATIONS	DATE/TIME	
	SONOGRAPHER	

Important Patient Factors
(Known HCC, Hepatitis, NAFLD, Cholestasis, CHF, on CTX, etc.)

Patient NPO 4-6 hours? ❑ Yes ❑ No

System		Transducer	

Patient Positioning

❑ 30 degree left lateral oblique
❑ Supine
❑ Right arm over head
❑ Other

If Other, why?

ARFI Median Value from machine (m/sec)			**Calculated Ratio of IQR/Median Value** *If > 0.30, please repeat measurements*		
SIEMENS IQR from machine	**SAMSUNG IQR** Median x IQR/Median	**GE** from machine	**SIEMENS IQR/Median**	**SAMSUNG** from machine	**GE** from machine

SIEMENS (FMC) **Please circle STAGE based upon median value of ARFI**

ARFI Median Value (m/s)	< 1.20	1.2 - 2.2	> 2.2
Stage	**F0 - F1**	**F2 - F3**	**F4 (and some F3)**

SAMSUNG (KMC) **Please circle STAGE based upon median value of ARFI**

ARFI Median Value (m/s)	0.81 - 1.22	1.22 - 1.37	1.37 - 2.00	2.00 – 2.64+
kPa	2.0 - 4.5	4.5 - 5.7	5.7 - 12.0	12.0 - 21.0+
Stage	**F0**	**F0 - F1**	**F2 - F3**	**F3 - F4**

GE (Piedmont) **Please circle STAGE based upon median value of ARFI**

ARFI Median Value (m/s)	< 1.35	1.35 - 1.66	1.66 - 1.77	1.77 - 1.99	> 1.99
kPa	< 5.48	5.48 – 8.29	8.29 – 9.40	9.40 – 11.9	> 11.9
Stage	**F0**	**F1**	**F2**	**F3**	**F4**

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FMC KMC Piedmont

US Liver Elastography Worksheet

Name / MR # / Label

Appendix Protocol

Begin by placing transducer in transverse position and applying deep graded compression to displace gas and bring bowel closer to probe.

1. Image from hepatic flexure of colon and trace down to cecum.

2. Position of appendix can be variable. Focus on pain location, as pointed out by patient, but be sure to follow entire right colon.

3. External iliac artery and vein can sometimes provide good landmark for finding appendix.

4. Images

   – Provide cine clip of area of pain.

   – If appendix visualized, provide:

     - Cine clip of appendix;
     - Long grayscale image of length of appendix;
       Entire length of appendix must be imaged.
       More than one image often necessary if long or tortuous appendix.
       Sometimes only tip inflamed (e.g. "tip appendicitis").
     - Long color flow image of appendix;
     - Multiple gray scale transverse images of entire appendix;
     - Corresponding color flow transverse images of entire appendix; and
     - Either cine or still images with and without compression to show compressibility.

5. Measurements

   – Outer to outer diameter of appendix (including both walls and lumen), and
   – Largest wall thickness of appendix.

Interpretation Criteria for Acute Appendicitis

- Wall to wall measurement 6mm or greater.
- Noncompressible, distended lumen of 2mm or greater (excluding segments with appendicoliths).
- Single wall thickness 3mm or greater.
- Periappendiceal fluid/ edema/ inflammatory change/abscess.

Clinical Protocol

Renal Arteries

1. Aorta: Long images of aorta with measurements (prox, mid, and dist).
2. Common Iliac Arteries: Image right and left common iliac arteries in long and transverse with single trans (largest) diameter measurement.
3. IVC: Long image.
   - Include AP measurement if over 3.75 cm.
   - If IVC filter or catheter seen, localize with respect to hepatic/renal veins.
4. Bladder: Image long and trans.
   - Measure wall if thickened.
   - Demonstrate ureteral jets if hydronephrosis seen in either kidney or if suspected ureteral stone.
   - If requested, pre- and post-void residual volumes.
5. Kidneys: Long images (medial, mid, lateral) and trans images (upper, mid, lower) of both kidneys.
   - Record max measurement (long and trans) of kidneys.
   - Image comparison to adjacent liver/spleen.
   - Single color Doppler image of kidneys.
   - If absence of kidney, image renal fossa.
   - If hydronephrosis seen, also show ureteral jets.
   - If stones present, measure largest dimension of largest stone.
6. Prostate: Image and measure, if seen.
7. Spectral waveform to measure peak systolic velocity in aorta at level of renal arteries.
8. Assess and image entire extra-renal renal arteries in long axis using color/power Doppler. Record limitations of visualization.
9. Angle corrected* spectral Doppler waveforms with peak systolic blood flow velocities and resistive index of all renal arteries prox (origin), mid, and dist. If significant stenosis, Doppler spectrum should be recorded within stenosis and distal to each stenosis.
10. Search for accessory renal arteries with evaluation as above. If renal artery (main or accessory) comes off iliac artery, calculate ratio to iliac artery velocity.
11. Spectral waveforms with acceleration times should be recorded from segmental arteries at upper, mid, and lower kidney – near hilum, at level of interlobar and segmental arteries (NOT at arcuate arteries). Lowest angle of insonation should be used (usually < 20 degrees).
12. Evaluate renal veins for patency.

* For angle correction:

Angle θ is Doppler angle between direction of flowing blood in vessel and applied Doppler ultrasound signal. Should not exceed 60 degrees. (The lower the angle, the better.) Angle θ should not be preset!

Renal Arteries Worksheet

SONOGRAPHER NOTES

INDICATIONS	DATE/TIME	
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AORTA PSV (cm/s)	Right Renal Vein Patent?	Left Renal Vein Patent?
	❑ Yes ❑ No	❑ Yes ❑ No

RIGHT				LEFT		
EXTRARENAL	**PSV (cm/s)**	**RI**	**Renal Artery (RA) PSV and Resistive Index (RI)**	**EXTRARENAL**	**PSV (cm/s)**	**RI**
Prox				Prox		
Mid				Mid		
Dist				Dist		

RA PSV / Aortic PSV = R/A Ratio	**R/A Ratio**	RA PSV / Aortic PSV = R/A Ratio
_____ / _____ = _____		_____ / _____ = _____

INTRARENAL	**AT (sec)**	**Acceleration Time (AT)**	**INTRARENAL**	**AT (sec)**
Upper			Upper	
Mid			Mid	
Lower			Lower	

Interpretation Criteria

Normal R/A Ratio < 3.5. Abnormal R/A Ratio > 3.5 (indicates 60% or greater diameter reduction).
AT > 0.070 sec consistent with RAS. RI < 0.5 suggests RAS.
If unable to rely on aortic PSV due to aortic stenosis or other aortic pathology, RAS then indicated by RA PSV of 180-200 cm/s or greater.

Findings/Limitations/Comments

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MFP SFP Other

US Renal Arteries Worksheet

Name / MR # / Label