

# RadMIS Inc. ULTRASOUND PROTOCOLS

## Table of Contents

<a href="#"><u>General Comments</u></a>	3
<a href="#"><u>Abdomen Ultrasound Complete</u></a>	4
<a href="#"><u>Abdominal Complete/Aorta,IVC,Iliac Doppler (pre renal transplant evaluation)...</u></a>	5,6
<a href="#"><u>RUQ Ultrasound</u></a>	7
<a href="#"><u>Renal Ultrasound</u></a>	8
<a href="#"><u>Pelvic Ultrasound (Standard, Non-Pregnancy)</u></a>	9
<a href="#"><u>Pelvic Ultrasound (1st Trimester Pregnancy)</u></a>	10
<a href="#"><u>Pelvic Ultrasound (2<sup>nd</sup> and 3rd Trimester: Basic Exam)</u></a>	11
<a href="#"><u>Pelvic Ultrasound (2<sup>nd</sup> and 3rd Trimester: Level II Anatomic Survey)</u></a>	12,13
<a href="#"><u>Sonohysterogram</u></a>	14
<a href="#"><u>Scrotal Ultrasound</u></a>	15
<a href="#"><u>Thyroid Ultrasound</u></a>	16
<a href="#"><u>Renal Doppler Native</u></a>	17
<a href="#"><u>Renal Doppler Transplant</u></a>	18,19
<a href="#"><u>Abdominal Doppler: Hepatic</u></a>	20
<a href="#"><u>Abdominal Doppler: Mesenteric</u></a>	21
<a href="#"><u>Groin Doppler: Evaluate for Pseudoaneurysm/AV Fistula</u></a>	22
<a href="#"><u>Lower Extremity Venous Duplex</u></a>	23
<a href="#"><u>Upper Extremity Venous Duplex</u></a>	24

## General Comments

### DOCUMENTATION:

1. Requisition as well as Prescription to be scanned into PACS for every patient.
2. **Technologist to document clinical information (ie. Indication, signs/symptoms, patient history) on the preliminary worksheet and/or on the demographics screen for each study. Demographics screen should be sent to PACS. Be as specific as possible with signs and symptoms (ie. site and duration of pain).**
3. Technologist worksheet to be scanned into PACS at the discretion of the site director.

### IMAGING:

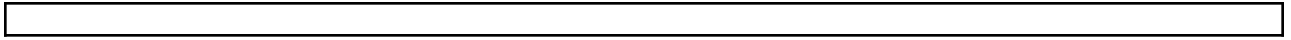
1. Document required images as detailed in this document.
2. Additional images can be taken at the discretion of the technologist/radiologist to document incidentally noted findings or to evaluate palpable abnormalities/patient site of concern.
3. If a patient is status post surgical resection of an organ (ie. cholecystectomy, nephrectomy, oophorectomy), document the operative bed.
4. Any image taken with a measurement should be taken with and without calipers.
5. In the outpatient setting and in instances when the case cannot be immediately checked by a radiologist, CINE CLIPS should be used to document pathology or questioned pathology in an organ of interest.

### STATEMENT ON USE OF COLOR DOPPLER IN PREGNANCY:

1. **Color Doppler should only be used when clinically necessary during pregnancy.** It should be safe to use color Doppler to assess for placental flow, hemorrhage, torsion, fibroid degeneration, etc. Pulsed Doppler may be used to assess for ovarian torsion during pregnancy. The focused Doppler beam should only be used in the ovary and never over the embryo. Pulsed Doppler may also be helpful to distinguish an empty sac (anembryonic pregnancy) vs a pseudogestational sac. **There is never a reason to expose a normal embryo to pulsed Doppler.**

## Abdomen Ultrasound Complete

<b>Time of Exam:</b>	30 minutes
<b>Preparation:</b>	Fast 4-6 hrs. If patient has eaten may still perform exam understanding that the study may be limited.
<b>Transducer:</b>	<ul style="list-style-type: none"> <li>• 2.5 to 5.0 MHz curved transducer</li> <li>• High frequency linear transducer for liver surface if history of hepatitis</li> </ul>
<b>General Comments:</b>	
<b>Required Images:</b>	
<b>AORTA:</b> Longitudinal image of the abdominal aorta	
<b>IVC:</b> Longitudinal image of the inferior vena cava	
<b>LIVER:</b> Longitudinal images of the left lobe to include (1) the inferior left lobe margin and aorta & (2) the diaphragm and caudate  Longitudinal images of the right lobe to include (1) the IVC where it passes through the liver, (2) the main lobar fissure, GB portal vein, (3) the right kidney for parenchymal comparison, & (4) the dome and adjacent right pleural space  Transverse image of the left lobe to include (1) its lateral margin & (2) the ligamentum teres  Transverse image of the right lobe to include (1) the hepatic veins, (2) the right and left branches of the portal vein, (3) the right lateral inferior lobe and (4) included the dome and adjacent pleural space	
<b>GALLBLADDER / BILIARY TREE:</b> Positioning: (must scan in at least 2 positions): supine/left lateral decubitus with erect views as indicated  Longitudinal image of the gallbladder  Transverse image of the gallbladder  Longitudinal image of the common hepatic duct  Longitudinal image of the common hepatic duct with measurements	
<b>PANCREAS:</b> Long axis image of the pancreas to include (1) as much of the head, uncinata, neck, body and tail as possible & (2) uncinata process and common bile duct	
<b>KIDNEYS:</b> Longitudinal image of the each kidney with and without measurements  Transverse images of the each kidney at the upper, middle, and lower poles	
<b>SPLEEN:</b> Longitudinal image of the spleen (1) with and without measurements, (2) to include adjacent pleural space, (3) to include left kidney for parenchymal comparison  Transverse image of the spleen to include anterior and posterior margins	



**Abdomen Ultrasound Complete  
Aorta/IVC/Iliac Doppler  
(Pre Renal Transplant Evaluation)**

<b>Time of Exam:</b>	45 minutes
<b>Preparation:</b>	Fast 4-6 hrs. If patient has eaten may still perform exam understanding that the study may be limited.
<b>Transducer:</b>	<ul style="list-style-type: none"> <li>• 2.5 to 5.0 MHz curved transducer</li> <li>• High frequency linear transducer for liver surface if history of hepatitis</li> </ul>
<b>General Comments:</b>	
<b>Required Images:</b>	
<p><b>LIVER:</b>            Longitudinal images of the left lobe to include (1) the inferior left lobe margin and aorta &amp; (2) the diaphragm and caudate</p> <p>Longitudinal images of the right lobe to include (1) the IVC where it passes through the liver, (2) the main lobar fissure, GB portal vein, (3) the right kidney for parenchymal comparison, &amp; (4) the dome and adjacent right pleural space</p> <p>Transverse image of the left lobe to include (1) its lateral margin &amp; (2) the ligamentum teres</p> <p>Transverse image of the right lobe to include (1) the hepatic veins, (2) the right and left branches of the portal vein, (3) the right lateral inferior lobe and (4) the dome and adjacent pleural space</p>	
<p><b>GALLBLADDER / BILIARY TREE:</b>            Positioning: (must scan in at least 2 positions): supine/left lateral decubitus with erect views as indicated</p> <p>Longitudinal image of the gallbladder</p> <p>Transverse image of the gallbladder</p> <p>Longitudinal image of the common hepatic duct</p> <p>Longitudinal image of the common hepatic duct with measurements</p>	
<p><b>PANCREAS:</b>            Long axis image of the pancreas to include (1) as much of the head, uncinata, neck, body and tail as possible &amp; (2) uncinata process and common bile duct</p>	
<p><b>KIDNEYS:</b>            Longitudinal image of the each kidney with and without measurements</p> <p>Transverse images of the each kidney at the upper, middle, and lower poles</p>	
<p><b>SPLEEN:</b>            Longitudinal image of the spleen (1) with and without measurements, (2) to include adjacent pleural space, (3) to include left kidney for parenchymal comparison</p>	

Transverse image of the spleen to include anterior and posterior margins

**VASCULATURE:**

**Aorta:**

Evaluate for aneurysm

Sagittal and Transverse images with measurements of the proximal, mid and distal portions

Color and Spectral waveforms at mid aorta and any area of dilatation.

**Bilateral Common Iliac Arteries:**

Sagittal and Transverse images with measurements in Transverse (Sagittal if possible)

Color and Spectral waveforms

**Bilateral Common Iliac Veins:**

Color and Spectral waveforms

**Bilateral External Iliac Arteries:**

Sagittal and Transverse images with measurements in Transverse (Sagittal if possible)

Color and Spectral waveforms

**Bilateral External Iliac Veins:**

Color and spectral waveform

**IVC:**

Check for patency

Color and spectral waveform

## RUQ Ultrasound

<b>Time of Exam:</b>	30 minutes
<b>Preparation:</b>	Fast 4-6 hrs. If patient has eaten still perform exam
<b>Transducer:</b>	<ul style="list-style-type: none"> <li>• 2.5 to 5.0 MHz curved transducer</li> </ul>
<b>General Comments:</b>	
<b>Required Images:</b>	
<b>IVC:</b> Longitudinal image of the inferior vena cava	
<b>LIVER:</b> Longitudinal images of the left lobe to include (1) the inferior left lobe margin and aorta & (2) the diaphragm and caudate  Longitudinal images of the right lobe to include (1) the IVC where it passes through the liver, (2) the main lobar fissure, GB portal vein, (3) the right kidney for parenchymal comparison, & (4) the dome and adjacent right pleural space  Transverse image of the left lobe to include (1) its lateral margin & (2) the ligamentum teres  Transverse image of the right lobe to include (1) the hepatic veins, (2) the right and left branches of the portal vein, (3) the right lateral inferior lobe and (4) included the dome and adjacent pleural space	
<b>GALLBLADDER / BILIARY TREE:</b> Positioning: (must scan in at least 2 positions): supine/left lateral decubitus with erect views as indicated  Longitudinal image of the gallbladder  Transverse image of the gallbladder  Longitudinal image of the common hepatic duct  Longitudinal image of the common bile duct with measurements	
<b>PANCREAS:</b> Long axis image of the pancreas to include (1) as much of the head, uncinate, neck, body and tail as possible & (2) uncinate process and common bile duct	
<b>RIGHT KIDNEY:</b>  Longitudinal image of the each kidney with and without measurements  Transverse images of the each kidney at the upper, middle, and lower poles	



## Renal Ultrasound

<b>Time of Exam:</b>	30 minutes
<b>Preparation:</b>	None
<b>Transducer:</b>	2.5 to 5.0 MHz curved transducer
<b>General Comments:</b>	All renal masses should be evaluated with color Doppler
<b>Required Images:</b>	
<b>RIGHT KIDNEY:</b>	
Sagittal Plane Anterior Approach Long Axis (with and without superior to inferior measurement)	
Longitudinal image medial to long axis	
Longitudinal image lateral to long axis	
Longitudinal image lateral to long axis (to include part of liver for parenchymal comparison)	
Transverse superior pole	
Transverse interpolar kidney (with and without anterior to posterior measurement)	
Transverse inferior pole	
<b>LEFT KIDNEY:</b>	
Left Lateral Approach Long Axis (with and without superior to inferior measurement)	
Longitudinal image anterior to long axis	
Longitudinal image posterior to long axis	
Transverse superior pole	
Transverse interpolar kidney (with and without anterior to posterior measurement)	
Transverse inferior pole	
<b>BLADDER:</b>	
Longitudinal image distended bladder	
Transverse image distended bladder	
Bladder lumen or wall abnormalities should be noted. Dilatation or other distal ureteral abnormalities should be documented	
Optional: Transverse and longitudinal scans may be used to demonstrate any post void residual if the bladder is markedly distended or patient presenting with Urinary Tract Infection, Urinary Retention	

### Pelvic Ultrasound (Non-Pregnancy)

<b>Time of Exam:</b>	30 minutes
<b>Preparation:</b>	None
<b>Transducer:</b>	<ul style="list-style-type: none"> <li>• 2.5 to 5.0 MHz curved transducer</li> <li>• Intracavitary Probe</li> </ul>
<b>General Comments:</b>	<ul style="list-style-type: none"> <li>• If only transvaginal examination ordered: perform transvaginal only. Perform trans-abdominal subsequently if limited transvaginal evaluation of organs</li> <li>• If both transabdominal and transvaginal examinations ordered, perform both</li> <li>• Document LMP, relevant clinical history including pelvic surgeries</li> <li>• Color Doppler may be used to evaluate focal ovarian pathology (corpus luteum, complex cyst)</li> <li>• Spectral Doppler of ovaries only in cases of r/o torsion or to prove ovarian tissue.</li> </ul>
<b>Required Images:</b>	
<p><b>UTERUS:</b></p> <p><i>Transabdominal:</i>            Longitudinal image of the uterus in the mid sagittal plane with and without measurements            Longitudinal image of uterus focused on the endometrial stripe with and without measurements            Longitudinal image of uterus (right and left lateral) to include any fibroids            Transverse image of the uterine body with and without measurements</p> <p><i>Endovaginal:</i>            As above, but to also include            Longitudinal image of the uterine body/cervix to include the endometrial cavity            Transverse images of the cervix</p> <p><b>OVARIES:</b></p> <p><i>Transabdominal:</i>            Long axis image of each ovary with and without measurements            Transverse image of each ovary with and without measurements</p> <p><i>Endovaginal:</i>            As above</p>	



### Pelvic Ultrasound 1<sup>st</sup> Trimester Pregnancy

<b>Time of Exam:</b>	30 minutes
<b>Preparation:</b>	20 oz water prior to transabdominal imaging; stop drinking 1 hr prior to appointment (required if transabdominal imaging only)
<b>Transducer:</b>	<ul style="list-style-type: none"> <li>• 2.5 to 5.0 MHz curved transducer</li> <li>• Intracavitary Probe</li> </ul>
<b>General Comments:</b>	<ul style="list-style-type: none"> <li>• Document LMP, prior sonographic EDC, BHCG if known, history of recent prior US</li> </ul>
<b>Required Images:</b>	
<p><b>UTERUS:</b></p> <p><i>Transabdominal:</i>            Longitudinal image of the uterus in the mid sagittal plane with and without measurements            Longitudinal image of uterus focused on the endometrial stripe with and without measurements            Longitudinal image of uterus (right and left lateral) to include any fibroids            Transverse image of the uterine body with and without measurements</p> <p><i>Endovaginal:</i>            As above, but to also include            Longitudinal image of the uterine body/cervix to include the endometrial cavity            Transverse images of the cervix</p> <p>*Must document cervix, fetal heart rate, presence/absence of subchorionic hemorrhage, mean gestation sac diameter (early), CRL (late), yolk sac</p> <p><b>OVARIES:</b></p> <p><i>Transabdominal:</i>            Long axis image of each ovary with and without measurements            Transverse image of each ovary with and without measurements</p> <p><i>Endovaginal:</i>            As above</p>	

## Pelvic Ultrasound 2<sup>nd</sup> and 3<sup>rd</sup> Trimester Pregnancy

### Basic Exam:

Emergency Department scan, growth evaluation, follow up for placental localization, etc.

<b>Time of Exam:</b>	30 minutes
<b>Preparation:</b>	20 oz water prior to transabdominal imaging; stop drinking 1 hr prior to appointment
<b>Transducer:</b>	<ul style="list-style-type: none"> <li>• 2.5 to 5.0 MHz curved transducer</li> </ul>
<b>General Comments:</b>	<ul style="list-style-type: none"> <li>• Document LMP, history of recent prior US and EDC based on LMP or prior US</li> <li>• The sonographer should perform a brief survey of fetal anatomy although documentation is not necessary. Additional images of any unusual finding may be obtained. Patients with suspected placenta previa should be re-examined with a partially distended bladder or with transvaginal technique.</li> </ul>
<b>Required Images:</b>	
<p>Documentation of fetal lie after 28 weeks.</p> <p>Placenta including relationship to the cervix.</p> <p>Cervical length</p> <p>Fetal biometry: BPD, HC, FL, AC</p> <p>Fetal Heart Rate</p> <p>Any Fetal anatomy not well seen on prior study</p> <p><b>ALL FLUID FILLED STRUCTURES SHOULD BE IMAGED AT EACH SCAN:</b>  Ventricles, Heart (4ch, outflow tracts), Stomach, Kidneys, Bladder. &lt;28 weeks- MVP for Amniotic fluid;  &gt;28 weeks 4 quad AFI.</p>	

Pelvic Ultrasound 2<sup>nd</sup> and 3<sup>rd</sup> Trimester Pregnancy

Level II Anatomic Survey (usually performed at 18-22 weeks)

<b>Time of Exam:</b>	30 minutes
<b>Preparation:</b>	20 oz water prior to transabdominal imaging; stop drinking 1 hr prior to appointment
<b>Transducer:</b>	<ul style="list-style-type: none"> <li>• 2.5 to 5.0 MHz curved transducer</li> </ul>
<b>General Comments:</b>	<ul style="list-style-type: none"> <li>• Document LMP, history of recent prior US</li> <li>• Examination may be modified for a more advanced pregnancy. For instance the fetal limbs are usually incompletely visualized after 27-28 weeks. The posterior fossa is not well visualized in the late third trimester. Some anatomy may be better visualized with transvaginal approach. If the fetal position does not allow visualization of an anatomic feature, the patient may be re-examined after emptying her bladder or walking around the department for several minutes. In some cases, it may be necessary to reschedule the patient.</li> </ul>
<b>Required Images:</b>	
<p>Documentation of fetal lie after 28 weeks.</p> <p>Placenta including relationship to the cervix.</p> <p>Cervical length</p> <p>Assessment of amniotic fluid volume (AFI) (&gt;28 weeks AFI; &lt; 28 wks, MVP)</p> <p>Fetal biometry: BPD, HC, FL, AC</p> <p>Fetal Heart Rate</p> <p>Fetal anatomy:</p> <p>Brain: Lateral ventricles with choroid and measurement of width at the level of the atria Cavum septum pellucidum (CSP) Falx</p> <p>Posterior Fossa: transverse cerebellum, cisterna magna with measurement of depth</p> <p>Face: semicoronal view of nose and lips; lenses of the eyes (best to view orbits axially), Profile to show Nasal Bone</p> <p>Nuchal Fold thickness: measured on a view demonstrating CSP, thalami, and cerebellum (Not performed after 22 weeks!)</p>	

Heart: situs; 4-chamber, right ventricular outlet, and left ventricular outlet views

Abdomen: Stomach with situs, kidneys (axial AP diameter measurement  $\geq$  4mm, must get coronal or sag plane to evaluate calyces), urinary bladder, abdominal cord insertion (grey scale), 2 UAs on axial color image draping the bladder)

Spine: axial views (most important) at cervical, thoracic, lumbar, and sacral levels to include sacrum with the iliac wings, sagittal views +/- coronal.

Extremities: documentation of all 4 extremities including hands and feet, radius/ulna, tib/fib bilaterally. Documenting placental cord insertion should be attempted.

### Sonohysterogram

<b>Time of Exam:</b>	45 minutes
<b>Preparation:</b>	None
<b>Timing of Examination</b>	Exam should be performed 7-10 days after the start of the last menstrual period
<b>Transducer:</b>	Intracavitary Probe
<b>Contrast Agent</b>	Sterile Saline
<b>General Comments:</b>	<ul style="list-style-type: none"> <li>• If adnexal tenderness or pain suspicious for active pelvic infection is found prior to fluid infusion, the examination should be deferred until after an appropriate course of treatment.</li> <li>• Hydrosalpinx depicted on pre procedural imaging should prompt a discussion with the referring physician with regard to the use of prophylactic antibiotic treatment</li> <li>• Documented negative pregnancy test or patient waiver is required</li> </ul>
<b>Required Images:</b>	
<p><b>Uterus:</b>                      Longitudinal image of the uterus in the mid sagittal plane with and without measurements                      Longitudinal image of uterus focused on the endometrial stripe with and without measurements                      Longitudinal image of the uterine fundus to include the endometrial cavity                      Longitudinal image of the uterine body/cervix to include the endometrial cavity                      Longitudinal image of uterus (right and left lateral) to include any fibroids                      Transverse images of the uterine fundus, body (with and without measurements), and cervix</p> <p><b>Ovaries:</b>                      Long axis image of each ovary with and without measurements                      Transverse image of each ovary with and without measurements</p> <p><b>Procedure:</b>                      Once the uterine cavity is filled with fluid, a complete survey of the uterine cavity should be performed and representative images obtained to document normal and abnormal findings. If a balloon catheter is used for the examination, images should be obtained at the end of the procedure with the balloon deflated to fully evaluate the endometrial cavity, particularly the cervical canal and lower portion of the endometrial cavity</p>	



## Scrotal Ultrasound

<b>Time of Exam:</b>	30 minutes
<b>Preparation:</b>	None
<b>Transducer:</b>	<ul style="list-style-type: none"> <li>• 12 MHz linear transducer preferred</li> <li>• 2.5 to 5.0 MHz curved transducer or 7 MHz linear transducer may be used to obtain an image including both testicles for direct comparison as well as to evaluate large scrotal abnormalities not covered in the FOV of the high frequency transducer</li> </ul>
<b>General Comments:</b>	<ul style="list-style-type: none"> <li>• If a palpable abnormality is the indication for the sonogram, this area should be directly imaged</li> <li>• Pediatric patients; be sure to image the spermatic cord bilaterally. Use clips as needed.</li> </ul>
<b>Required Images:</b>	
<p><b>Testicles (Right and Left):</b></p> <p>Transverse images superior, mid and inferior portions (with and without measurement of mid portion)</p> <p>Longitudinal images centrally, medial and lateral (with and without measurement of central portion)</p> <p>Doppler sonography (spectral and color/power Doppler imaging) should be used with identical Doppler settings to evaluate symmetry of flow. Low-flow detection settings should be used to document testicular blood flow. If flow cannot be demonstrated on color Doppler, power Doppler, if available, should be used to increase flow sensitivity. Both arterial and venous waveforms should be obtained as technically feasible.</p> <p>Comparative image of the testes including grayscale and color Doppler imaging; best accomplished with a side-by-side transverse image (consider using curved transducer to obtain this image)</p> <p><b>Spermatic cord:</b></p> <p>Color Doppler imaging of the spermatic cord is required in pediatric cases for “r/o torsion”</p> <p><b>Epididymis (Right and Left):</b></p> <p>Respective images of head, body (tail when technically feasible)</p> <p><b>Venous plexus:</b></p> <p>Images of the bilateral venous plexus with and without valsalva to evaluate for varicocele</p> <p><b>Relevant extra testicular structures:</b></p>	

Document any hydrocele, extra testicular finding

## Thyroid Ultrasound

<b>Time of Exam:</b>	30 minutes
<b>Preparation:</b>	None
<b>Transducer:</b>	High frequency linear transducer (12 mHz)
<b>General Comments:</b>	<ul style="list-style-type: none"> <li>• Exam should be performed with neck in hyperextension</li> <li>• Color or power Doppler examination can be used to supplement the grayscale evaluation of either diffuse or focal abnormalities of the thyroid</li> <li>• The location, size, number, and character of significant abnormalities, including measurements of nodules and focal abnormalities in three dimensions.</li> <li>• In patients who have undergone complete or partial thyroidectomy, the thyroid bed should be imaged in transverse and longitudinal planes. Any masses or cysts in the region of the bed should be measured and reported. Additionally, the lateral neck should be evaluated</li> </ul>
<b>Required Images:</b>	
<p><b>Right and Left Lobes:</b></p> <p>Longitudinal mid lobe (with and without measurement)                  Transverse upper, mid and lower portions (with and without measurement of mid gland)</p> <p><b>Isthmus:</b></p> <p>Transverse image (with and without measurement of thickness)</p> <p><b>Cervical Nodes:</b></p> <p>Scan the lateral compartment of the neck. Document the presence and size of any abnormal lymph node</p> <p>***see attached weblink for nodal stations:</p> <p><a href="http://headneckbrainspine.com/web_flash/newmodules/neck%20ct%20cervical%20lymph%20node%20levels.swf">http://headneckbrainspine.com/web_flash/newmodules/neck%20ct%20cervical%20lymph%20node%20levels.swf</a></p>	

## Renal Doppler Native

<b>Time of Exam:</b>	60 minutes
<b>Preparation:</b>	Fast 6-8 hours
<b>Transducer:</b>	2.5 to 5.0 MHz curved transducer
<b>General Comments:</b>	Optimize color Doppler parameters: Use an appropriate sample volume size. Optimize the velocity scale for the size of the waveform to avoid aliasing (this may require adjusting the scale, baseline, or frequency, or selecting a lower frequency transducer), and using the lowest feasible angle of insonation. Angle correction is essential for determining blood-flow velocity. The angle between the direction of flowing blood and the applied Doppler ultrasound signal should not exceed 60 degrees.
<b>Required Images:</b>	
<p><i>Grayscale images:</i>  Longitudinal image of each kidney with and without measurements  Longitudinal and Transverse images of distended bladder  Look for abnormalities: masses, hydronephrosis</p> <p><i>Color and Spectral Doppler Evaluation:</i>  <b>Aorta:</b>  An appropriate angle-corrected spectral waveform from the abdominal aorta at the level of the renal arteries should be recorded.  Look for abnormalities: plaque, dissection, aneurysm</p> <p><b>Main Renal Artery:</b></p> <p>The entire main renal artery should be scanned along its long axis using optimized color Doppler parameters. Occasionally, power Doppler or grayscale imaging may be necessary to localize a portion of the artery. Look for duplicated renal arteries.</p> <p>Spectral Doppler should be performed along the vessel's length from the origin to the hilum at the lowest feasible angle of insonation.</p> <p>The greatest peak systolic velocities should be recorded at: (1) origin (2) proximal portion, (3) mid aspect, (4) distal, (5) near the hilum. A peak systolic velocity should also be recorded at any site of color aliasing or suspected stenosis.</p> <p>Renal artery stent evaluation should include recording a peak systolic velocity in the proximal renal artery (if possible), within the stent, and distal to the stent (if possible)</p> <p><b>Intrarenal Evaluation:</b></p> <p>Spectral waveforms should be recorded from segmental arteries in the upper and lower poles and the interpolar region (mid-portion) of each kidney. Optimize waveform size. Angle correction not necessary. Resistive indexes should be documented.</p>	

## Renal Doppler Transplant

<b>Time of Exam:</b>	45 minutes
<b>Preparation:</b>	6-8 hours
<b>Transducer:</b>	<ul style="list-style-type: none"> <li>● 9 MHz linear transducer</li> <li>● 2.5 to 5.0 MHz curved transducer</li> </ul>
<b>General Comments:</b>	<ul style="list-style-type: none"> <li>● Discuss anatomy with surgeon if possible for 1<sup>st</sup> post operative scan.</li> <li>● Imaging of native kidneys is not required unless specifically requested</li> <li>● Optimize color Doppler parameters: Use an appropriate sample volume size. Optimize the velocity scale for the size of the waveform to avoid aliasing (this may require adjusting the scale, baseline, or frequency, or selecting a lower frequency transducer), and using the lowest feasible angle of insonation. Angle correction is essential for determining blood-flow velocity. The angle between the direction of flowing blood and the applied Doppler ultrasound signal should not exceed 60 degrees.</li> </ul>
<b>Required Images:</b>	
<p><i>Grayscale images:</i>                      Longitudinal image of the transplant with and without measurements                      Transverse images of the transplant upper, mid and lower portions                      Document hydronephrosis, renal mass, perinephric collections                      Longitudinal and Transverse images of distended bladder</p> <p><i>Color and Spectral Doppler Evaluation:</i>  <b>Kidney:</b>                      Color/Power Doppler of entire kidney to assess transplant perfusion</p> <p><b>External Iliac Artery:</b>                      An appropriate angle-corrected spectral waveform from the iliac artery (1) proximal, (2) at the level of the renal anastomosis and (3) distal to the anastomosis should be recorded.</p> <p><b>Main Renal Artery:</b>                      The entire main renal artery should be scanned along its long axis using optimized color Doppler parameters. Occasionally, power Doppler or grayscale imaging may be necessary to localize a portion of the artery.</p>	

Spectral Doppler should be performed along the vessel's length from the anastomosis to the hilum at the lowest feasible angle of insonation.

The peak systolic velocities should be recorded at: (1) anastomosis (2) proximal, (3) mid, (4) distal, (5) hilum. Peak systolic velocity should also be recorded at any site of color aliasing or suspected stenosis.

**Intrarenal evaluation:**

Spectral waveforms should be recorded from segmental, interlobar and arcuate arteries in the upper and lower poles and the interpolar region of each kidney. Resistive indexes should be documented.

**Renal Veins:**

Color and Spectral Doppler should be performed of the main renal vein as well as segmental veins in the upper pole, interpolar region and lower pole.

### Abdominal Doppler: Hepatic

<b>Time of Exam:</b>	30 minutes
<b>Preparation:</b>	Fast 6-8 hrs;
<b>Transducer:</b>	2.5 to 5.0 MHz curved transducer
<b>General Comments:</b>	<ul style="list-style-type: none"> <li>• If no recent full abdominal ultrasound or cross sectional imaging, consider full abdominal examination (call referring MD)</li> <li>• Use power Doppler as necessary in cases of suspected low/slow flow</li> <li>• Document collateral venous pathways (ie patent paraumbilical vein)</li> <li>• Document presence/absence of ascites</li> <li>• Optimize color Doppler parameters: Use an appropriate sample volume size. Optimize the velocity scale for the size of the waveform to avoid aliasing (this may require adjusting the scale, baseline, or frequency, or selecting a lower frequency transducer), and using the lowest feasible angle of insonation. Angle correction is essential for determining blood-flow velocity. The angle between the direction of flowing blood and the applied Doppler ultrasound signal should not exceed 60 degrees.</li> </ul>
<b>Required Images:</b>	
<p>Grayscale, Color, Spectral Doppler Waveforms:</p> <p>IVC  Hepatic Veins: Right, Middle, Left  Portal Veins: Main, Right (Main, Anterior, Posterior) Left (Main, Medial, Lateral)  Splenic Vein: at the midline and at the splenic hilum  Hepatic Artery (one sample in porta hepatis)</p> <p>If TIPS present:</p> <p>Spectral Doppler should be performed along the stent length at the lowest feasible angle of insonation. Obtain velocities in the proximal, mid and distal portions of the stent. Include images of the main portal vein and draining hepatic vein.</p>	

### Abdominal Doppler: Mesenteric

<b>Time of Exam:</b>	30 minutes
<b>Preparation:</b>	Fast 8-12 hrs;
<b>Transducer:</b>	2.5 to 5.0 MHz curved transducer
<b>General Comments:</b>	<ul style="list-style-type: none"> <li>Optimize color Doppler parameters: Use an appropriate sample volume size. Optimize the velocity scale for the size of the waveform to avoid aliasing (this may require adjusting the scale, baseline, or frequency, or selecting a lower frequency transducer), and using the lowest feasible angle of insonation. Angle correction is essential for determining blood-flow velocity. The angle between the direction of flowing blood and the applied Doppler ultrasound signal should not exceed 60 degrees.</li> </ul>
<b>Required Images:</b>	
<p>Grayscale, Color, Spectral Doppler Waveforms:</p> <p>Check for plaque or aneurysm.</p> <p>Aorta: Proximal, Mid, Distal          Celiac Axis: Proximal, Mid, Distal.</p> <ul style="list-style-type: none"> <li>Interrogate Vessel in inspiration and expiration</li> </ul> <p>SMA: Origin and Proximal          IMA</p>	



Groin Doppler: Evaluate for Pseudoaneurysm/AV Fistula

<b>Time of Exam:</b>	30 minutes
<b>Preparation:</b>	None
<b>Transducer:</b>	<ul style="list-style-type: none"> <li>• 2.5 to 5.0 MHz curved transducer</li> <li>• High frequency linear transducer 7MHz, 9MHz</li> </ul>
<b>General Comments:</b>	<ul style="list-style-type: none"> <li>• In the acute setting be sure to image the entire area of clinically apparent hematoma. Look specifically over site of puncture</li> <li>• Most puncture sites are at the level of the femoral head, however, be sure to image above the level of the femoral head as well</li> </ul>
<b>Required Images:</b>	
<p>Curved transducer:</p> <p>Large field of view grayscale images of the groin to evaluate for hematoma or collection outside of “typical” field of view. Interrogate any suspected abnormality with color and Spectral Doppler imaging as well as with a linear high frequency transducer.</p> <p>Linear High frequency transducer:</p> <p>Focused imaging of any collection with grayscale, color and spectral Doppler.</p> <p>Spectral waveforms should be recorded from the femoral artery and femoral vein with attention to pseudoaneurysm (PSA) or AV fistula (AVF).</p> <p>If PSA present, document the length of the neck, obtaining spectral waveforms within the neck.</p>	

## Lower Extremity Deep Venous Duplex

<b>Time of Exam:</b>	30 minutes
<b>Preparation:</b>	None
<b>Transducer:</b>	High frequency linear transducer (7 MHz or greater)
<b>General Comments:</b>	<ul style="list-style-type: none"> <li>• All images should be performed and documented with and without compression. Venous compression is applied in the transverse plane with adequate pressure on the skin to completely obliterate the normal vein lumen.</li> <li>• All spectral Doppler should be obtained from the long axis</li> <li>• Symptomatic areas such as the calf generally require additional evaluation and additional images if the cause of the symptoms is not readily elucidated by the standard examination (ie. evaluate for popliteal fossa cysts, calf fluid collections, edema)</li> <li>• The extent and location of sites where the veins fail to compress completely should be clearly recorded and generally require additional images. Long axis views without compression may be helpful to characterize the abnormal vein.</li> </ul>
<b>Required Images:</b>	
<p>Common femoral vein</p> <p>Common femoral vein at GSV junction</p> <p>Femoral Vein; proximal, mid, distal</p> <p>Deep Femoral Vein at bifurcation</p> <p>Popliteal vein</p> <p>Tibioperoneal trunk</p> <p>Proximal posterior tibial and peroneal veins</p> <p><i>Color and Spectral Doppler waveforms:</i></p> <p>Common femoral vein (both on the side of interest as well as on the contralateral side to evaluate for symmetry). Images should be documented with and without augmentation. Consider using Valsalva when obtaining the spectral waveform without compression to accentuate phasicity.</p>	

Popliteal vein

Lower Extremity Venous Insufficiency Duplex

<b>Time of Exam:</b>	45 minutes
<b>Preparation:</b>	standing or reverse trendelenburg position
<b>Transducer:</b>	High frequency linear transducer (7 mHz or greater)
<b>General Comments:</b>	<ul style="list-style-type: none"> <li>• All images should be performed and documented without compression. Use ample gel.</li> <li>• All spectral Doppler should be obtained from the long axis</li> <li>• Complete Lower Extremity Deep Venous Duplex</li> <li>• Scan the great saphenous and small saphenous veins, documenting the largest diameter, location of perforators and varicose veins.</li> <li>• Check for reflux in GSV, SFV and perforators</li> <li>• Complete diagram to include location of perforators, reflux and any additional large superficial veins such as Giacomini</li> </ul>
<b>Required Images:</b>	
<p><b>XS greyscale</b> Great saphenous vein at CFV junction</p> <p>Great saphenous vein; proximal, mid, distal thigh; proximal, mid, distal leg Small saphenous vein at popliteal junction.</p> <p>Popliteal vein Great saphenous vein; proximal, mid, distal</p> <p>Varicose veins and perforators.</p> <p><b>Sag Duplex,</b> GSV and SFV in long grayscale GSV and SFV in long color without provocative maneuver. GSV and SFV in long PW doppler without provocative maneuver. GSV and SFV in long color with provocative maneuver. GSV and SFV in long PW doppler without provocative maneuver.</p> <p>Images should be documented with and without augmentation. Consider using Valsalva when obtaining the spectral waveform without compression to accentuate phasicity.</p> <p>Diagram to include level of perforators, varicose veins and any additional large veins such as Giacomini, accessory saphenous or inter-sapheous vein , etc.</p>	

## Upper Extremity Venous Duplex

<b>Time of Exam:</b>	30 minutes
<b>Preparation:</b>	None
<b>Transducer:</b>	High frequency linear transducer (7 MHz or greater)
General Comments:	<ul style="list-style-type: none"> <li>• All images should be performed and documented with and without compression. Venous compression is applied in the transverse plane with adequate pressure on the skin to completely obliterate the normal vein lumen.</li> <li>• All spectral Doppler should be obtained from the long axis</li> <li>• Symptomatic areas, such as the forearm, may require additional evaluation, if the cause of the symptoms is not already elucidated by the standard examination.</li> <li>• The extent and location of sites where the veins fail to compress completely should be clearly recorded and generally require additional images. Long axis views without compression may be helpful to characterize the abnormal vein.</li> </ul>
<b>REQUIRED IMAGES:</b>	
<p><i>Grayscale images:</i></p> <p>Internal jugular vein                  Innominate vein (best possible)                  Subclavian vein                  Axillary vein                  Brachial vein in the arm                  Basilic vein in the arm                  Cephalic vein in the arm                  Focal symptomatic areas, if present</p> <p><i>Color and Spectral Doppler images:</i></p> <p>Internal jugular vein</p> <p>Subclavian vein (both on the side of interest as well as on the contralateral side to evaluate for symmetry)</p> <p>Axillary vein</p> <p>Innominate vein (if seen) should be recorded with color Doppler</p>	

