

GUNDERSEN/LUTHERAN ULTRASOUND DEPARTMENT
POLICY AND PROCEDURE MANUAL

SUBJECT: Renal Artery Ultrasound
SECTION: Vascular Ultrasound
ORIGINATOR: Kraig Schuster
DATE: Oct 15, 2015

APPROVED BY: _____
Jody Riherd MD

Dave Clayton RDMS RVT

Scheduling: Early Am, one-hour time slot

Prep: NPO 10 hours

Patient Position: Supine, right and left lateral decubitus

Equipment: Color flow duplex ultrasound unit with two or three MHz sector or curved array transducer.

Purpose: Evaluation of patients with significant hypertension or renal insufficiency for significant renal artery stenosis.

Indications:

1. Young patients with severe hypertension.
2. Patients with rapidly accelerating hypertension.
3. Patients with malignant hypertension or flash pulmonary edema.
4. Patients whose blood pressure is particularly difficult to control.
5. Patients with concomitant hypertension and renal insufficiency.
6. Serial follow up after surgical or transcatheterization intervention.

Exam Protocol: The renal artery exam consists of four major components:

1. Renal and aorta gray scale imaging.
 2. Aorta spectral evaluation.
 3. Renal artery spectral evaluation.
 4. Segmental renal artery spectral evaluation.
- *** All spectral images are taken with a Doppler angle of 60 degrees or less, with the sample gate parallel to the vessel wall, NOT the flow jet.
 - ***Procedure should be performed at the lowest possible power settings.

Renal and Aorta Gray Scale Imaging: Bilateral kidneys and the abdominal aorta are evaluated for size and structural abnormalities. The maximum length of each kidney is documented. A thorough evaluation of each kidney is performed to include the following images in addition to renal length: longitudinal medial, mid, and lateral views; transverse upper, mid, and lower pole views. The maximum diameter of the abdominal aorta is also documented. Any aneurysm is evaluated for location in relation to the renal artery origin.

Aorta Spectral Evaluation: The patient is placed in a supine position with a midline approach. The abdominal aorta is scanned in a longitudinal plane. The abdominal aorta's PSV measurement is obtained with color and angle corrected spectral Doppler just distal to the SMA at the level of the renal arteries.

Renal Artery Spectral Evaluation: The patient is placed in a supine position with a midline transverse approach. The left renal vein crossing the aorta is a landmark for identifying the location of the renal arteries, which typically originate directly posterior to the left renal vein. The origins of the renal arteries typically arise from the lateral aspects of the aorta. The origin of the right renal artery is slightly more anterior than that of the left, and the right renal artery crosses posterior to the IVC. Multiple renal arteries are present in up to 20 percent of kidneys. After identifying the origin of the renal arteries with colorflow, spectral Doppler velocity waveforms are taken from multiple sites in both main renal arteries and any accessory renal arteries. The origin, proximal, mid, and distal renal artery spectral Doppler velocities are documented. The patient may need to roll to a left or right lateral decubitus position to enable scanning of the renal arteries.

Segmental Renal Artery Evaluation: Examination of the segmental renal arteries is performed from a posterolateral approach. Spectral Doppler waveform is obtained in an upper, middle, and lower area within the renal sinus and from the renal hilum. The spectral display sweep speed is adjusted to allow just two or three systolic pulses to be displayed on the same screen. The peak velocity scale is adjusted so that the Doppler waveform filled as much of the scale as possible without aliasing. Spectral tracings are evaluated for early systolic peak and the early systolic acceleration index is measured. The resistive index should also be measured.

Spectral Doppler Criteria

Classification & Features

- >60 % Renal Artery Stenosis
 - Renal artery to Aorta Ratio (RAR) $>3.5^{**2}$
 - and peak systolic velocity (PSV) > 200 cm/sec¹
 - Acceleration Index <3 m/sec²³
- <60 % Renal Artery Stenosis
 - Renal Artery PSV > 200 cm/sec but RAR < 3.5
- >80 % Renal Artery Stenosis
 - End diastolic Velocity >150 cm/sec¹
- Occluded Renal Artery

- Absence of flow signal in renal artery and low-amplitude parenchymal signal (<10 cm/sec)
- Small kidney < 9 cm⁵

**RAR not valid if AAA or aorta PSV < 40 cm/sec or >100 cm/sec⁶

****The RAR should be calculated for each exam and written on the renal artery worksheet so it can be included in the radiologist's report.

Imaging Protocol:

- ****Additional images may be necessary to adequately demonstrate anatomy and pathology.
- Any stenotic area should have spectral readings taken before (if possible), after, and at the area of stenosis.
- ****Please note that the Doppler angle for the segmental arteries should be at 20 degrees or less.
- Long distal aorta with AP measurement
- Aorta at level of renal arteries with color and angle corrected spectral Doppler and velocity measurement
- Long right kidney with measurement of kidney size and measurement of cortical thickness
- Long views of the right kidney to include medial, mid, and lateral images
- Transverse views of the right kidney to include upper, mid, and lower poles
- Right renal artery (RRA) origin with color and angle corrected spectral Doppler and velocity measurement
- RRA proximal with color and angle corrected spectral Doppler and velocity measurement
- RRA mid with color and angle corrected spectral Doppler and velocity measurement
- RRA distal with color and angle corrected spectral Doppler and velocity measurement
- RRV with color and spectral Doppler (this image may be obtained wherever the RRV is best seen)
- Right upper segmental artery with color and angle corrected spectral Doppler, with Acceleration Index and Resistive Index measured
- Right mid segmental artery with color and angle corrected spectral Doppler, with Acceleration Index and Resistive Index measured
- Right lower segmental artery with color and angle corrected spectral Doppler, with Acceleration Index and Resistive Index measured
- Long left kidney with measurement of kidney size and measurement of cortical thickness
- Long views of the left kidney to include medial, mid, and lateral images
- Transverse views of the left kidney to include upper, mid, and lower pole images
- Left renal artery (LRA) origin with color and angle corrected spectral Doppler and velocity measurement

- LRA proximal with color and angle corrected spectral Doppler and velocity measurement
- LRA mid with color and angle corrected spectral Doppler and velocity measurement
- LRA distal with color and angle corrected spectral Doppler and velocity measurement
- LRV with color and spectral Doppler (this image may be obtained wherever the LRV is best seen)
- Left upper segmental artery with color and angle corrected spectral Doppler, with Acceleration Index and Resistive Index measured
- Left mid segmental artery with color and angle corrected spectral Doppler, with Acceleration Index and Resistive Index measured
- Left lower segmental artery with color and angle corrected spectral Doppler, with Acceleration Index and Resistive Index measured

References:

1. Olin JW, Piedmonte MR, Young JR, et al. The utility of duplex ultrasound scanning of the renal arteries for diagnosing significant renal artery stenosis. *Ann Intern Med.* 1995;122: 833-838.
2. Strandness DE Jr. Duplex scanning in diagnosis of renovascular hypertension. *Surg Clin North Am.* 1990;70:109-117.
3. Stavros AT, Parker SH, Yakes WF, et al. Segmental stenosis of the renal artery: Pattern recognition of tardus and parvus abnormalities with duplex sonography. *Radiology* 184:487-492, 1992
4. Strandness DE Jr., Van Breda A. Duplex Scanning In Vascular Diseases: Surgical and Interventional Therapy 1994; pp. 188-189.
5. Isaacson JA, Zierler RE, Spittell PC. Noninvasive Screening for Renal Artery Stenosis: Comparison of Renal Artery and Renal Hilar Duplex Scanning. *JVT* 19(3):105-110, 1995.
6. Olin JW Cleveland Clinic Vascular Laboratory Guidelines for Renal Artery Duplex Reporting, Sept. 1995.

Gundersen Health System

Renal Artery Duplex Ultrasound

Name: _____

Date: _____

Clinic #: _____

Ordering MD: _____

Exam #: _____ Pt. Age: _____

Prior Surgery: Yes _____ No _____

Reason for Exam:

Procedure Performed:

_____ HTN BP: _____ / _____

_____ Renal Insufficiency Creatinine: _____

_____ CKD _____ Bruit

_____ ASD _____ F/U Post Op

_____ Other : _____

		Right	Left
Renal Size (cm)			
Cortical Thickness			
Segmental Art (acceleration index cm/s)	Upper		
	Mid		
	Lower		

Aorta	PSV cm/s	Size
Doppler Criteria	**RAR invalid if AAA or Aortic PSV<40 or >100 cm/sec**	
Renal <60% Stenosis	PSV>200cm/sec and RAR <3.5*	
Renal > 60% Stenosis	PSV > 200cm/sec and RAR >3.5* AI<3 m/sec ²	
Renal >80%	EDV > 150 cm/sec	

	Main Renal Artery					
	Right			Left		
	PSV	RAR	Turb?	PSV	RAR	Turb?
Origin						
Prox						
Mid						
Distal						

	Accessory Renal Artery					
	Right			Left		
	PSV	RAR	Turb?	PSV	RAR	Turb?
Origin						
Prox						
Mid						
Distal						

Real Time Impression: _____

Doppler Impression: _____

Sonographer: _____

Radiologist: _____