



VASCULAR TECHNOLOGY PROFESSIONAL PERFORMANCE GUIDELINES

Renal Artery Duplex Imaging

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Renal Artery Duplex Imaging

PURPOSE

Duplex imaging of the renal arteries is performed to determine the absence or presence, type, location, extent and severity of stenosis, aneurysm, or other disease of the renal arteries.

APPROPRIATE INDICATIONS

Common indications for performance of renal arterial duplex imaging include, but are not limited to:

- Evaluation of the native renal arteries and kidneys for evidence of renal artery disease or renal parenchymal disease
- Presence of epigastric or flank bruit in a hypertensive patient
- New onset of hypertension or hypertension refractory to medical management
- Screening for renal artery stenosis prior to medical management with ACE inhibitors
- Presence of elevated creatinine or BUN Monitoring of known renal artery stenosis
- Suspected renal vein occlusion
- F/U renal artery bypass graft
- Renal artery embolus
- Fibromuscular Dysplasia (known, suspected or family history)
- Suspected renal artery aneurysm
- F/U angioplasty and/or stent
- Suspected arteriovenous fistula
- Presence of a thrill or bruit following renal biopsy
- Evaluation of renal transplant dysfunction
- Presence of bruit in region of renal transplant

CONTRAINDICATIONS AND LIMITATIONS

Limitations may include

- Fresh surgical incisions/drains
- Ostomy bags
- Rapid breathing or on respirator
- Inability to hold breath
- Bowel gas
- Obesity
- Ability to change position
- Cooperation

PATIENT PREPARATION

- The patient should have no food by mouth for 8 hours prior to the procedure when possible
- Studies should be performed early in the day to minimize bowel gas interference.
- The patient may take morning medications if medications cannot be withheld until after the exam with a small sip of water
- The patient should not chew gum or smoke the morning of the exam as this may increase swallowing of air.

PATIENT COMMUNICATION

The technologist/sonographer/examiner should:

- Introduce self and explain the reason for the examination and indicate how much time the examination might take.
- Explain the procedure to the patient, taking into consideration the age and mental status of the patient and to ensure that the patient understands the necessity for each aspect of the evaluation.
- Explain to the patient that they may be asked to hold their breath at times during the exam. Demonstrate the technique with the patient to ensure compliance, either suspended breathing technique or breath in without letting air out.
- Respond to questions and concerns about any aspect of the examination.
- Refer specific diagnostic, treatment or prognosis questions to the patient's physician

PATIENT ASSESSMENT

Patient assessment must be performed before evaluation is performed. This includes assessment of the patient's ability to tolerate the procedure and an evaluation of any contra-indications to the procedure.

The technologist/sonographer/examiner should:

Obtain a complete and pertinent history by interviewing the patient or their representative and/or review of the patient's medical record, when available and according to lab protocol. A pertinent history includes:

- Current medical status, especially regarding known arterial disease or poorly controlled hypertension.
- Current kidney function and/or other renal abnormality
- Laboratory values, particularly BUN and serum Creatinine when available, according to individual laboratory protocols
- Signs or symptoms of peripheral vascular disease: claudication, rest pain, ulceration, gangrene, ischemia, hair loss, coolness, pallor, dependent rubor, cervical, or abdominal bruit (if noted by referring physician); known peripheral arterial disease
- History of fibromuscular dysplasia
- Current medications or therapies
- Results of prior vascular studies and other imaging modalities when available

PATIENT POSITIONING:

Initiate the exam with the patient lying in a supine position for examination of the aorta, renal ostium and proximal to mid renal artery. The distal renal artery, renal vein, intra renal flow and kidney measurements may be better accessed with the patient lying in a lateral decubitus position. Utilize any position necessary to acquire all data.

INSTRUMENTATION:

- Use appropriate duplex instrumentation which includes display of both two-dimensional structure and motion in real time and Doppler ultrasonic signal documentation.
- Utilize appropriate frequencies for the vessels being examined, typically 2-5 MHz curvilinear or phased array transducer.
- Utilize multiple transducers if available to visualize anteriorly and through the intercostal rib spaces
- Digital storage of static images and/or cineloop is required.
- Duplex instrumentation with pulsed wave Doppler and color Doppler is required

EXAM PROTOCOL:

Throughout each examination the technologist/sonographer/examiner should:

- Observe the sonographic characteristics of normal and abnormal tissues, structures, and blood flow to allow necessary adjustments to optimize exam quality
- Assess and monitor the patient's physical and mental status, allowing modifications to the procedure plan according to the patient's clinic status.
- Analyze sonographic findings to ensure that sufficient data is provided to the physician to direct patient management and render a final diagnosis.

Follow a standard, facility- specific imaging protocol including, but not limited to the following:

Abdominal Aorta:

- Evaluate in transverse and sagittal planes from the diaphragm, to the aortic bifurcation and into the right and left common iliac arteries utilizing B-mode and color Doppler imaging.
- Documentation of the aortic diameter, the presence and location of atherosclerotic plaque and evidence of disordered flow patterns.
- Angle corrected Doppler spectral waveforms should be obtained (to 60 degrees or less parallel with the vessel wall)
- Record peak systolic velocity of aorta at level of renal arteries for calculation of the renal to aortic ratio
- Identify and document flow in the Inferior Vena Cava\

Renal Artery and Kidney:

Direct testing of the renal artery

- Kidney length is measured in the longest sagittal dimension. Multiple length measurements are performed to ensure accuracy
- Renal Cortex thickness measurements should be obtained in the transverse plane
- Evaluate the renal artery (RA) with color Doppler to identify color flow changes that may indicate actual flow change, variation in residual lumen and the presence of plaque.
- Evaluation should encompass each RA from the ostium to the renal hilum
- Angle corrected Doppler spectral waveforms are obtained at the ostium, proximal, mid and distal segments of each RA obtained (60 degrees or less parallel with the vessel wall)
- Real time spectral trace obtained throughout suspected regions of stenosis.
- Identification of accessory and/or multiple renal arteries may be facilitated by the use of color flow imaging. Velocities should be obtained in any accessory vessels identified.
- Identify and document flow in the renal veins
- Renal parenchymal pathology, such as cysts, masses, hydronephrosis, etc, should be documented

Indirect testing of the renal artery

- Decubitus views are optimal for indirect Doppler, with no liver or spleen between the transducer and the kidney
- Increase Doppler gate size
- Angle correction is not necessary, however, parenchymal arterial signals interrogated should be within 30 degrees of perpendicular (becomes degraded when greater than 30 degrees)
- Doppler spectral waveforms are obtained from the segmental, interlobar or arcuate arteries as per facility protocol.
- The upper and distal poles of the renal parenchyma should be evaluated. This is to ensure that there is no difference in flow to the upper pole or lower pole. This is also an indirect evaluation to prove that multiple renal arteries are not present.
- Calculate the pulsatility index (PI), resistive index (RI) and the acceleration time or acceleration index from the parenchymal vessels as per facility protocol

Renal artery stents:

- Evaluate with B-mode imaging to visualize the stent.
- Evaluate with color Doppler to identify color flow changes that may indicate actual flow change, variation in residual lumen, the presence of an obstruction/restenosis and incorrect stent location.
- Angle corrected Doppler spectral waveforms obtained proximal to the stent, within the stent and distal to the stent (60 degrees or less parallel with the vessel wall)

Note: The diameter of the stented segment of the renal artery may be slightly larger than the native renal artery. This diameter change can result in increased peak systolic velocity as the blood moves from a larger diameter to the smaller diameter of the non stented artery.

- The stent should be evaluated for correct placement within the renal artery. If there is a distinct flow disturbance within the aorta, at the level of the renal artery, this may be an indication that the stent is protruding into the lumen of the aorta.

Pulsed Wave Doppler Assessment of arterial flow may include:

- Peak systolic velocity
- End diastolic velocity
- Systolic upstroke/acceleration time
- Pulsatility or resistive indices
- Flow direction
- Identification of spectral broadening and/or turbulence
- At a minimum, Doppler spectral waveforms should be obtained throughout the entire vessel including proximal to flow disturbances, within flow disturbances and distal to a flow disturbance

Based on the published data, the following cautions are included:

- Aorta peak systolic velocities less than 40 cm/s and greater than 100 cm/s should not be utilized for the renal to aortic ratio calculation
- Use the same Doppler angles for follow up exams as compared to previous exams
- Caution should be exercised when comparing estimated velocities of the same location with two different angles of insonation.
- Non-visualization of a renal artery does not document or confirm complete occlusion of an artery.

REVIEW OF THE DIAGNOSTIC ULTRASOUND EXAM FINDINGS

The technologist/sonographer/examiner should:

- Review data acquired during the evaluation to ensure that a complete and comprehensive evaluation has been performed and documented.
- Explain and document any exceptions to the evaluation protocol (i.e., study limitations, omissions or revisions).
- Record all technical findings required to complete the final diagnosis in the patients' medical record
- Document exam date, clinical indication(s), technologist performing the evaluation and exam summary in the patients' medical record.
- Review previous exam documentation and compare to the current exam to document and compare any change.

PRESENTATION OF EXAM FINDINGS

The technologist/sonographer/examiner should:

- Provide preliminary results when necessary as provided for by internal guidelines.
- Present record of exam data, explanations, and technical worksheet to the interpreting physician for use in rendering a diagnosis and for archival purposes.
- Alert vascular laboratory Medical Director or appropriate health care provider when immediate medical attention is indicated.

EXAM TIME RECOMMENDATIONS

High quality, accurate results are fundamental elements of the Renal Artery Duplex Examination. A combination of direct and indirect exam components is the foundation for maximizing exam quality and accuracy.

- Indirect exam components include pre-exam procedures: review of previous exam data; completion of pre-exam paperwork; exam room and equipment preparation; patient assessment, history, and positioning; patient communication; post exam activities: exam room clean up; compiling, reviewing and processing exam data for preliminary and/or formal interpretation; exam charge and billing activities. Recommended time is 30 minutes.
- Direct exam components include equipment optimization, patient positioning throughout the exam, and the hands-on examination process. Recommended time is 50 minutes.

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