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.

COMMON INDICATIONS
Some of the common indications for performance of renal arterial duplex imaging include:
- 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 over region of renal transplant

CONTRAINDICATIONS AND LIMITATIONS
Limitations may include
- Fresh surgical incisions/drains
- Rapid breathing or on respirator
- Bowel gas
- Obesity
- Patient positioning and cooperation.

PATIENT PREPARATION
The patient should have no food by mouth after midnight to minimize bowel gas and studies should be performed early in the day, if possible. Bowel prep is usually not necessary. The patient should take morning medications with sips of water only and abstain from dairy products or citrus juices as they may cause abdominal gas. The patient should not chew gum or smoke the morning of the exam as this may increase swallowing of air. Consideration should be given to patients who need to eat in order to take medications, i.e., those with diabetes. If necessary to schedule later in the am, a light early breakfast of toast and one protein may be allowed for diabetics.
GUIDELINE 1: PATIENT COMMUNICATIONS AND POSITIONING

The technologist/sonographer/examiner should:

1.1 Introduce self and explain why the examination is being performed and indicate how much time the examination might take.

1.2 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.

1.3 Explain to the patient that they may be asked to hold their breath at times during the exam.

1.4 Respond to questions and concerns about any aspect of the examination.

1.5 Refer specific diagnostic, treatment or prognosis questions to the patient's physician.

1.6 Initiate the examination with the patient lying in a supine position for examination of the aorta, renal ostium and proximal-to-med renal artery. It is helpful to obtain all information possible with the patient supine, prior to rotation, as this may cause gas to move more. The distal renal artery, renal vein, intrarenal flow and kidney measurements may be better accessed with the patient lying in a lateral decubitus position. All positions should be used, as necessary, to acquire all the data desired.

GUIDELINE 2: 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:

2.1 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, according to individual lab protocol.
- 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.
- Relevant risk factors for peripheral vascular disease: diabetes; hypertension; age; smoking, obesity, cerebrovascular disease; coronary artery disease; hyperlipidemia: family history of cerebrovascular disease, coronary artery, or peripheral vascular disease; family history of diabetes or hypertension.
- History of other related disorders such as fibromuscular dysplasia.
- Laboratory values, particularly BUN and serum Creatinine when available, according to individual laboratory protocols.
- Current medications or therapies.
- Results of prior vascular studies, when available.

2.2 Complete a limited or focused physical exam, noting surgical or traumatic scars or incisions, on the abdomen or flank.

GUIDELINE 3: EXAMINATION GUIDELINES

Throughout each exam, sonographic characteristics of normal and abnormal tissues, structures, and blood flow must be observed so that scanning technique can be adjusted as necessary to optimize image quality and spectral waveform characteristics. The patient’s physical and mental status is assessed and monitored during the examination and modifications are made to the procedure plan according to changes in the patient’s clinical condition during the procedure. Sonographic findings are analyzed throughout the course of the examination to ensure that sufficient data...
is provided to the physician to direct patient management and render a final diagnosis. Diagnostic criteria must include application of published criteria or internally generated criteria.

**INSTRUMENTATION:**

3.1 Use appropriate duplex instrumentation, which includes display of both two-dimensional structure and motion in real time and Doppler ultrasonic signal documentation with:

a. Identification and examination of the aorta includes:
   i. Evaluation 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 flow imaging.
   ii. Documentation of the aortic diameter, the presence and location of atherosclerotic plaque and evidence of disordered flow patterns.
   iii. Angle corrected (to 60 degrees or less) Doppler spectral waveforms obtained from the aorta at the level of the celiac axis and superior mesenteric artery (SMA).
   iv. Record of the peak systolic aortic velocity is kept for comparison with the renal artery velocities.

b. Identification and examination of the renal arteries include:
   i. Evaluation with color Doppler to identify color flow changes that may indicate actual flow change, variation in residual lumen and the presence of plaque.
   ii. Evaluation should encompass each renal artery from the ostium to the renal hilum if possible.
   iii. Angle corrected (to 60 degrees or less) Doppler spectral waveforms obtained at the ostium, proximal, mid and distal segments of each renal artery.
   iv. Doppler spectral waveforms (without the use of angle correction) obtained at the renal hilum and the segmental arteries in the upper, mid and distal poles of the renal parenchyma.
   v. Real time spectral trace obtained throughout suspected regions of stenosis.

c. Identification of accessory and/or multiple renal arteries may be facilitated by the use of color flow imaging.

d. Identification and patency of the renal veins can be confirmed with proper optimization of color Doppler and the use of power Doppler.

e. Kidney length is measured in the longest sagittal dimension. Multiple length measurements are performed to ensure accuracy. An atypically small kidney should be re-examined to rule out technical error.

f. Renal parenchymal pathology, such as cysts, masses, hydronephrosis, stones, etc, should be documented with B-mode images.

g. Although the renal artery duplex scan evaluation of the kidneys is directed toward identification of vascular abnormalities, it is helpful to have a basic understanding of other renal pathology that may be incidentally noted while assessing the vasculature. Correlative imaging may be requested as clinically indicated and/or appropriate.

3.2 Follow a standard exam protocol for renal artery duplex imaging in follow-up of stent placement. The standard exam will require multiple acoustic windows and patient positioning techniques.

a. Identification and examination of a renal artery stent includes:
   i. Evaluation with B-mode imaging to distinguish the stent.
   ii. Evaluation 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.
   iii. Angle corrected (to 60 degrees or less) Doppler spectral waveforms obtained proximal to the stent, within the stent and distal to the stent.

b. 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 an increase in peak systolic velocity as the blood moves from a larger diameter (stent) to a smaller diameter (native artery).
c. 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, then this may be an indication that the stent is protruding too far into the lumen of the aorta.

3.3 All diagnostic criteria must be internally validated.
   a. Gray scale and color flow imaging are generally used to identify and follow the selected vessel segments and to note the presence or absence of any disease process within the vessel lumen.
   b. Doppler spectral waveform analysis is used to quantify disease severity and should include assessment for presence or absence of flow. Assessment of present flow may include:
      - Peak systolic velocity
      - End diastolic velocity
      - Systolic upstroke/acceleration
      - Pulsatility or resistive indices
      - Flow direction
      - Identification of spectral broadening and/or turbulence
   c. At a minimum, Doppler spectral waveforms should be obtained throughout all vessel segments, including proximal to, within and distal to any region of disordered flow.

Based on the published data, the following cautions are included:
   - It is important to use the same range of Doppler angles in the proximal, mid and distal renal artery
   - 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.

GUIDELINE 4: REVIEW OF THE DIAGNOSTIC ULTRASOUND EXAM FINDINGS
The technologist/sonographer/examiner should:
4.1 Review data acquired during the evaluation to ensure that a complete and comprehensive evaluation has been performed and documented.
4.2 Explain and document any exceptions to the evaluation protocol (i.e., study limitations, omissions or revisions).
4.3 Record all technical findings required to complete the final diagnosis on a worksheet, logbook or other appropriate form so that the measurements can be classified according to the laboratory diagnostic criteria (based on published or internally validated data).
4.4 Document exam date, clinical indication(s), technologist performing the evaluation and exam summary in a laboratory logbook or other appropriate medium, i.e. computer software.
4.5 To determine any change in follow up studies, review previous exam documentation so that the current evaluation can document a change in status. The examination protocol may need to be modified to address previous findings and current physical needs.

GUIDELINE 5: PRESENTATION OF EXAM FINDINGS
The technologist/sonographer/examiner should:
5.1 Provide preliminary results when necessary as provided for by internal guidelines.
5.2 Present record of exam data, explanations, and technical worksheet to the interpreting physician for use in rendering a diagnosis and for archival purposes.
5.3 Alert vascular laboratory Medical Director or appropriate health care provider when immediate medical attention is indicated.

GUIDELINE 6: 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.

6.1 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 (Guideline 1); patient communication (Guideline 2); post exam activities: exam room clean up; compiling, reviewing and processing exam data for preliminary and/or formal interpretation (Guidelines 3 and 4); patient communication (Guideline 5); exam charge and billing activities. Recommended time is 30 minutes.

6.2 Direct exam components include equipment optimization, patient positioning throughout the exam, and the actual hands-on examination process. (Guideline 2) Recommended time is 50 minutes.

GUIDELINE 7: CONTINUING PROFESSIONAL EDUCATION

Certification is considered the Guideline of practice in vascular technology. It demonstrates an individual’s competence to perform vascular technical examinations at the entry level. After achieving certification from either ARDMS (RVT credential), CCI (RVS credential), or AART-RT (VS) an individual must keep current with:

7.1 Advances in diagnosis and treatment of peripheral and renal vascular disease.

7.2 Renal Artery Duplex Examination protocols and published laboratory diagnostic criteria.

7.3 Advances in duplex ultrasound technology and other correlative imaging techniques used for the evaluation of renal arteries and kidneys.
REFERENCES

- SVU Professional Performance DVD – “Renal Artery and Mesenteric / Splanchnic Artery Duplex Imaging
- Renal Duplex Examination” CD Produced by GE Healthcare and SVU. Narration and Comments by Owen C., and Zang W.