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VASCULAR TECHNOLOGY

PROFESSIONAL PERFORMANCE GUIDELINES

Renal Artery Duplex Imaging

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Society for Vascular Ultrasound

4601 Presidents Drive, Suite 260 Lanham, MD 20706-4831

Tel.: 301-459-7550

Fax: 301-459-5651

E-mail: svuinfo@svunet.org

Internet: www.svunet.org

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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 diseases of the renal arteries.

APPROPRIATE INDICATIONS

Common indications for renal artery duplex exam include, but are not limited to:

- 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

Contraindications and limitations may include the following:

- Fresh surgical incisions/drains
- Ostomy bags
- Rapid breathing or on respirator
- Inability to hold breath
- Bowel gas
- Obesity
- Inability to change position
- Patient 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.
- If medications cannot be withheld until after the exam, the patient may take morning medications 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 sonographer or examiner should:

- Introduce themselves, explain the reason for the examination and indicate how much time the examination might take.
- Verify the patient's name and date of birth or utilize facility-specific patient identifiers.
- 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 breathing 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

A patient assessment must be performed before the exam. This includes an assessment of the patient's ability to tolerate the procedure and an evaluation of any contraindications to the procedure. The sonographer or examiner should obtain a complete, pertinent history by interview of the patient or their representative and a review the patient's medical record, when available.

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
- History of fibromuscular dysplasia
- History of cardiac disease
- 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 arteries. The distal renal arteries, renal veins, intrarenal 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

Utilize appropriate duplex instrumentation with the appropriate frequencies for the vessels being examined:

- Typically, a 2-6 MHz curvilinear or phased array transducer
 - Utilize multiple transducers, if available, to visualize anteriorly and through the intercostal rib spaces
- Display of two-dimensional structures and motion in real-time
 - Doppler ultrasonic signal documentation
 - Spectral analysis with color and/or power Doppler imaging
- Digital storage of ultrasound images

EXAM PROTOCOL

Sonographers should follow a standard imaging protocol. A complete evaluation includes B-mode imaging, spectral Doppler analysis, and color Doppler imaging of all accessible portions of the renal arteries. Bilateral evaluations are essential for a complete evaluation; however, studies may be unilateral based on laboratory-specific protocols.

Throughout each examination, the sonographer or examiner should:

- Observe sonographic characteristics of normal and abnormal tissues, structures, and blood flow, allowing 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 clinical status

- Analyze sonographic findings to ensure that sufficient data is provided to the physician to direct patient management and render a final diagnosis
- Accurately annotate B-mode, color and spectral Doppler images

Complete Renal Artery Duplex Exam

A complete renal artery duplex exam includes evaluation of the abdominal aorta, main renal arteries, renal veins, parenchymal arteries and the kidneys.

B-mode imaging should be performed in longitudinal and transverse planes. Optimize the gain to depict vessel walls, plaque and any other abnormalities. Color Doppler may be used to depict areas of abnormal flow or significant stenosis. Power Doppler is useful to confirm areas of possible vessel occlusion or low flow states.

B-Mode images should include the following:

- Maximum diameter of the abdominal aorta should be obtained in longitudinal and transverse planes
- Longitudinal length measurements of the kidneys
 - Obtain three length measurements per kidney to increase accuracy
 - Cysts, masses and hydronephrosis should be documented
- Renal Cortex thickness measurements should be obtained in the transverse plane if required by facility protocol
- Renal arteries (if adequately seen in B-Mode)
- Renal veins

Color Doppler images should include the following:

- Renal arteries
- Renal veins
- Segmental and parenchymal arteries within the kidney

Velocity measurements should be obtained from a longitudinal plane at an angle of 60° parallel to the direction of the blood flow/vessel walls. Maintain a Doppler angle between 45° and 60° whenever possible. Angles greater than 60° must be avoided. Doppler angles less than 45° may be necessary due to patient anatomy. To obtain peak velocity, utilize color Doppler to note areas of concern and “walk” the spectral Doppler cursor throughout these areas. Post-stenotic turbulence should be documented when present.

Spectral Doppler waveforms and velocity measurements must include the:

- Mid aorta at the level of the renal arteries
- Origin, proximal, mid and distal portions of the main renal arteries

- Accessory renal arteries (when present)
- Renal artery stents (when present)
- Segmental arteries at the upper, mid and lower poles
 - Used to obtain the resistive index (RI)
- Renal veins for patency (does not require velocity measurements)
- Inferior vena cava (does not require velocity measurements)

Indirect Testing of the Renal Arteries

Indirect testing of the renal arteries includes spectral Doppler analysis of the parenchymal arteries in order to infer main renal artery stenosis.

B-Mode images should include:

- Longitudinal length measurements of the kidneys
 - Should obtain multiple length measurements to increase accuracy
 - Cysts, masses and hydronephrosis should be documented
- Renal Cortex thickness measurements should be obtained in the transverse plane if required by facility protocol

Color Doppler images should include the following:

- Segmental and parenchymal arteries within the kidney

Spectral Doppler waveforms and velocity measurements should include:

- Segmental, interlobar or arcuate arteries in the upper, mid and lower poles
 - Obtain the pulsatility index (PI), resistive index (RI) and the acceleration time or acceleration index from the parenchymal vessels as per facility protocol
 - Typically, angle correction is not used to obtain renal parenchymal velocity measurements.

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 the residual lumen, the presence of an obstruction/restenosis and incorrect stent location or migration of the stent.
- Angle corrected Doppler spectral waveforms obtained proximal to the stent, within the stent and distal to the stent (45 to 60 degrees and parallel with the vessel wall, 60 degrees is optimal)

- 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.

REVIEW OF THE DIAGNOSTIC EXAM FINDINGS

The sonographer or 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 sonographer or examiner should:

- Provide preliminary results when necessary as provided for by laboratory-specific guidelines.
- Present record of diagnostic images, data, explanations, and technical worksheet to the interpreting physician. Interpretation must be available within two business days.
- The sonographer's and interpreting physician's names must appear on the final report. The finalized/signed report should be available within four business days.
- Alert the vascular laboratory medical director or appropriate healthcare provider when immediate medical attention is indicated based on departmental guidelines and procedures.

EXAM TIME RECOMMENDATIONS

High quality, accurate results are fundamental elements of the renal artery duplex examination. A combination of indirect and direct exam components is the foundation for maximizing exam quality and accuracy.

- Indirect exam components include:
 - Pre-exam activities: obtaining previous exam data, initiating exam worksheet and paperwork, equipment and exam room preparation, patient assessment and positioning, and patient communication
 - Post-exam activities: exam room cleanup, compiling and processing exam data for preliminary and/or formal interpretation, and exam billing activities.
- Direct exam components include:
 - Equipment optimization and the actual hands-on, examination process
- While study times may vary depending on testing protocols, patient condition, and clinical complexity of the evaluation being performed, these are the times necessary to provide a quality diagnostic evaluation. Listed are the recommended examination times for performing each CPT related to this guideline, which were derived from the direct time inputs from the Resource Based Relative Value Scale (RBRVS).
 - 93975 92 minutes
 - 93976 53 minutes

REFERENCES

- Pellerito, J, Pollak, JF. *Introduction to Vascular Ultrasonography*, 6th Edition, Elsevier, 2012.
- Kupinski, AM. *Diagnostic Medical Sonography: The Vascular System*. Philadelphia: Wolters Kluwer/Lippincott Williams & Wilkins, 2013.
- Rumwell, C, McPharlin M. *Vascular Technology: An Illustrated Review*. Fourth Edition Davies Publishing 2009.
- Society for Vascular Ultrasound. Professional Performance Video Series: “Renal Artery and Mesenteric/Splanchnic Artery Duplex Imaging.
- Neumyer M. Duplex scanning after renal artery stenting. *J Vasc Ultrasound* 2003; 27(3): 177-183.
- Granata A, Fiorini F, Andrulli S, et al. Doppler ultrasound and renal artery stenosis: an overview. *J Ultrasound* 2009;12:133-143. DOI: [10.1016/j.jus.2009.09.006](https://doi.org/10.1016/j.jus.2009.09.006)
- Poe PA. Color duplex ultrasound evaluation of renal and mesenteric arteries. *J Vasc Ultrasound* 2005;29(3): 149-155.
- Gerhard-Herman, Gardin JM, Jaff M, et al. Guidelines for noninvasive vascular laboratory testing: a report from the American Society of Echocardiography and the Society of Vascular Medicine and Biology. *J Am Soc Echocardiogr*. 2006; 11(8): 955-972.
DOI: [10.1177/1358863x06070516](https://doi.org/10.1177/1358863x06070516)
- IAC Standards and Guidelines for Vascular Testing. Intersocietal Accreditation Commission Web Site. Retrieved from <https://www.intersocietal.org/vascular/standards/IACVascularTestingStandards2018.pdf>