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The American College of Radiology will periodically define new practice guidelines and technical standards for radiologic practice to help advance the science of radiology and to improve the quality of service to patients throughout the United States. Existing practice guidelines and technical standards will be reviewed for revision or renewal, as appropriate, on their fifth anniversary or sooner, if indicated.

Each practice guideline and technical standard, representing a policy statement by the College, has undergone a thorough consensus process in which it has been subjected to extensive review, requiring the approval of the Commission on Quality and Safety as well as the ACR Board of Chancellors, the ACR Council Steering Committee, and the ACR Council. The practice guidelines and technical standards recognize that the safe and effective use of diagnostic and therapeutic radiology requires specific training, skills, and techniques, as described in each document. Reproduction or modification of the published practice guideline and technical standard by those entities not providing these services is not authorized.

2008 (Resolution 9)*

ACR–AIUM PRACTICE GUIDELINE FOR THE PERFORMANCE OF RENAL ARTERY DUPLEX SONOGRAPHY

PREAMBLE

These guidelines are an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. They are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care. For these reasons and those set forth below, the American College of Radiology cautions against the use of these guidelines in litigation in which the clinical decisions of a practitioner are called into question.

The ultimate judgment regarding the propriety of any specific procedure or course of action must be made by the physician or medical physicist in light of all the circumstances presented. Thus, an approach that differs from the guidelines, standing alone, does not necessarily imply that the approach was below the standard of care. To the contrary, a conscientious practitioner may responsibly adopt a course of action different from that set forth in the guidelines when, in the reasonable judgment of the practitioner, such course of action is indicated by the condition of the patient, limitations of available resources, or advances in knowledge or technology subsequent to publication of the guidelines. However, a practitioner who employs an approach substantially different from these guidelines is advised to document in the patient record information sufficient to explain the approach taken.

The practice of medicine involves not only the science, but also the art of dealing with the prevention, diagnosis, alleviation, and treatment of disease. The variety and complexity of human conditions make it impossible to always reach the most appropriate diagnosis or to predict with certainty a particular response to treatment.

Therefore, it should be recognized that adherence to these guidelines will not assure an accurate diagnosis or a practitioner will follow a reasonable course of action based on current knowledge, available resources, and the needs of the patient to deliver effective and safe medical care. The sole purpose of these guidelines is to assist practitioners in achieving this objective.

I. INTRODUCTION

The clinical aspects contained in specific sections of this guideline (Introduction, Indications, Specifications of the Examination, and Equipment Specifications) were developed collaboratively by the American College of Radiology (ACR) and the American Institute of Ultrasound in Medicine (AIUM). Recommendations for physician requirements, written request for the examination, procedure documentation, and quality control vary between the two organizations and are addressed by each separately.

Ultrasound using grayscale imaging, Doppler spectral analysis, and color Doppler imaging (CDI) is a proven and useful procedure for evaluating the renovascular system. Occasionally, an additional and/or specialized examination may be necessary. While it is not possible to detect every abnormality, adherence to the following guidelines will maximize the probability of detecting most renovascular abnormalities.

II. INDICATIONS/CONTRAINDICATIONS

Indications for renal artery duplex include, but are not limited to:

1. Evaluation of patients with hypertension, particularly when there is a moderate to high suspicion of renovascular hypertension.
2. Follow-up of patients with known renovascular disease who have had renal artery stents or renal artery surgical reconstruction, or who are under medical supervision.
3. Evaluation of abdominal bruit.
4. Evaluation of suspected vascular abnormality.
5. Evaluation of acute renal failure when there is a suspected vascular cause.
6. Evaluation of renal artery blood flow in patients with known aortic dissection or other aortic abnormalities that may compromise blood flow to the kidneys.
7. Evaluation of discrepant renal size in a patient with hypertension.
8. Evaluation of renal insufficiency in patients with a high likelihood of renal vascular disease.

There are no absolute contraindications to performing this examination.

III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

Each organization addresses this requirement individually. ACR language is as follows:

See the [ACR–SPR–SRU Practice Guideline for Performing and Interpreting Diagnostic Ultrasound Examinations](#).

IV. WRITTEN REQUEST FOR THE EXAMINATION

Each organization addresses this requirement individually. ACR language is as follows:

The written or electronic request for renal artery duplex sonography should provide sufficient information to demonstrate the medical necessity of the examination and allow for its proper performance and interpretation.

Documentation that satisfies medical necessity includes 1) signs and symptoms and/or 2) relevant history (including known diagnoses). Additional information regarding the specific reason for the examination or a provisional diagnosis would be helpful and may at times be needed to allow for the proper performance and interpretation of the examination.

The request for the examination must be originated by a physician or other appropriately licensed health care provider. The accompanying clinical information should be provided by a physician or other appropriately licensed health care provider familiar with the patient’s clinical problem or question and consistent with the state scope of

practice requirements. (ACR Resolution 35, adopted in 2006)

V. SPECIFICATIONS OF THE EXAMINATION

The study is generally performed for both kidneys. If not, the report should state the reason for a unilateral study (e.g., evaluation of renal stent, known solitary kidney).

The study consists of grayscale imaging of the kidney and spectral and color Doppler of the intrarenal and extrarenal vessels.

A. Grayscale Imaging

The longest renal length should be measured and reported. In patients who have not had recent cross-sectional imaging of the kidneys, a renal ultrasound examination is appropriate. See the [ACR–AIUM Practice Guideline for the Performance of an Ultrasound Examination of the Abdomen and/or Retroperitoneum](#).

B. Intrarenal Evaluation

Spectral waveforms are recorded from at least three locations: segmental arteries at the upper, mid, and lower kidney. Careful attention to technique is necessary to optimize the examination. An appropriate sample volume should be used. The size and height of the spectral waveforms should be increased, without producing aliasing, by adjusting the settings (e.g., scale, baseline, pulse repetition frequency [PRF]). The sweep speed may be adjusted to increase the width of the waveforms, e.g., for measurements that use time such as acceleration time or acceleration. The segmental arteries should be interrogated at the lowest feasible angle of insonation, which is usually 20 degrees or less.

The waveforms should be analyzed qualitatively and/or quantitatively. The waveforms may be analyzed quantitatively to determine resistive index, acceleration time, and/or acceleration. Angle correction is necessary if acceleration is measured. Qualitative analysis of each waveform for normal systolic upstroke, early systolic compliance peak, and/or tardus parvus waveform may be performed.

C. Extrarenal Evaluation

The entire extrarenal portion of the renal artery is assessed in the long axis (with respect to the artery) with guidance of color and/or power Doppler, though on occasion, guidance with grayscale imaging may be appropriate. Limitations with visualization should be reported.

Spectral Doppler measurements of blood-flow velocity should be sampled along accessible portions of the renal artery from its origin to the renal hilum. Spectral Doppler should be performed at 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 (angle θ , the Doppler angle) should not exceed 60 degrees.

Maximal peak systolic velocity should be recorded at the origin/proximal, mid, and distal renal artery at a minimum. If there are significant stenoses, the Doppler spectrum should be recorded within the stenosis and distal to each stenosis.

A spectral waveform should be obtained to measure systolic velocity in the abdominal aorta near the origin of the superior mesenteric artery. This is used for analyzing the ratio of peak systolic velocity in the renal artery to that in the aorta (renal-aortic ratio).

A search for accessory renal arteries should be performed by looking at both the aorta and the kidneys. When identified, accessory arteries should be evaluated in a manner similar to the evaluation of main renal arteries. Renal artery stent evaluations should include the peak systolic velocity measurements within the stent and in the unstented portion of the renal artery. Knowledge of stent location may be necessary for localization and evaluation for in-stent restenosis. Intrarenal waveform analysis may also aid in the detection of in-stent restenosis.

VI. DOCUMENTATION

Each organization addresses this requirement individually. ACR language is as follows:

Adequate documentation is essential for high-quality patient care. There should be a permanent record of the ultrasound examination and its interpretation. Comparison with prior relevant imaging studies may prove helpful. Images of all appropriate areas, both normal and abnormal, should be recorded. Variations from normal size should generally be accompanied by measurements. Images should include the patient identification, facility identification, examination date, and image orientation. An official interpretation (final report) of the ultrasound examination should be included in the patient's medical record. Retention of the ultrasound examination images should be consistent both with clinical need and with relevant legal and local health care facility requirements.

Reporting and communication efforts should be in accordance with the [ACR Practice Guideline for Communication of Diagnostic Imaging Findings](#).

VII. EQUIPMENT SPECIFICATIONS

Renal artery duplex sonograms should be conducted with real-time scanners, preferably using sector or linear (straight or curved) transducers. The scanner should have spectral and color Doppler capability. For grayscale examination, see the [ACR–AIUM Practice Guideline for the Performance of an Ultrasound Examination of the Abdomen and/or Retroperitoneum](#).

VIII. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION

Each organization addresses this requirement individually. ACR language is as follows:

Policies and procedures related to quality, patient education, infection control, and safety should be developed and implemented in accordance with the ACR Policy on Quality Control and Improvement, Safety, Infection Control, and Patient Education appearing under the heading *Position Statement on QC & Improvement, Safety, Infection Control, and Patient Education* on the ACR web page (<http://www.acr.org/guidelines>).

Equipment performance monitoring should be in accordance with the [ACR Technical Standard for Diagnostic Medical Physics Performance Monitoring of Real Time Ultrasound Equipment](#).

ACKNOWLEDGEMENTS

This guideline was revised according to the process described under the heading *The Process for Developing ACR Practice Guidelines and Technical Standards* on the ACR web page (<http://www.acr.org/guidelines>) by the Guidelines and Standards Committee of the Commission on Ultrasound in collaboration with the AIUM.

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Suggested Reading (Additional articles that are not cited in the document but that the committee recommends for further reading on this topic)

1. Bude RO, Forauer AR, Caoili EM, Nghiem HV. Is it necessary to study accessory arteries when screening the renal arteries for renovascular hypertension? *Radiology* 2003;226:411-416.
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7. Taylor DC, Kettler MD, Moneta GL, et al. Duplex ultrasound scanning in the diagnosis of renal artery stenosis: a prospective evaluation. *J Vasc Surg* 1988;7:363-369.
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*Guidelines and standards are published annually with an effective date of October 1 in the year in which amended, revised, or approved by the ACR Council. For guidelines and standards published before 1999, the effective date was January 1 following the year in which the guideline or standard was amended, revised, or approved by the ACR Council.

Development Chronology for this Guideline
2008 (Resolution 9)