AIUM Practice Guideline for the Performance of Renal Artery Duplex Sonography
The American Institute of Ultrasound in Medicine (AIUM) is a multidisciplinary association dedicated to advancing the safe and effective use of ultrasound in medicine through professional and public education, research, development of guidelines, and accreditation. To promote this mission, the AIUM is pleased to publish, in conjunction with the American College of Radiology (ACR), this AIUM Practice Guideline for the Performance of Renal Artery Duplex Sonography. We are indebted to the many volunteers who contributed their time, knowledge, and energy to bringing this document to completion.

The AIUM represents the entire range of clinical and basic science interests in medical diagnostic ultrasound, and, with hundreds of volunteers, the AIUM has promoted the safe and effective use of ultrasound in clinical medicine for more than 50 years. This document and others like it will continue to advance this mission.

Practice guidelines of the AIUM are intended to provide the medical ultrasound community with guidelines for the performance and recording of high-quality ultrasound examinations. The guidelines reflect what the AIUM considers the minimum criteria for a complete examination in each area but are not intended to establish a legal standard of care. AIUM-accredited practices are expected to generally follow the guidelines with recognition that deviations from these guidelines will be needed in some cases, depending on patient needs and available equipment. Practices are encouraged to go beyond the guidelines to provide additional service and information as needed.
I. Introduction

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

Sonography using gray scale imaging, spectral Doppler analysis, and color Doppler imaging is a proven and useful procedure for evaluating the renovascular system. Occasionally, an additional and/or specialized examination may be necessary. Although 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 sonography 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.
4. Evaluation of a 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.

There are no absolute contraindications to performing this examination.

III. Qualifications and Responsibilities of Personnel

See the AIUM Official Statement Training Guidelines for Physicians Who Evaluate and Interpret Diagnostic Ultrasound Examinations and the AIUM Standards and Guidelines for the Accreditation of Ultrasound Practices.

IV. Written Request for the Examination

The written or electronic request for an ultrasound examination should provide sufficient information to allow for the appropriate performance and interpretation of the examination.

The request for the examination must be originated by a physician or other appropriately licensed health care provider or under their direction. The accompanying clinical information should be provided by a physician or other appropriate health care provider familiar with the patient’s clinical situation and should be consistent with the relevant legal and local health care facility requirements.

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 a renal stent or known solitary kidney).

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

A. Gray Scale 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 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 3 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 (eg, scale, baseline, and pulse repetition frequency). The sweep speed may be adjusted to increase the width of the waveforms, eg, for measurements that use time such as acceleration time and acceleration. The segmental arteries should be interrogated at the lowest feasible angle of insonation, which is usually 20° or less.

The waveforms should be analyzed qualitatively and/or quantitatively. The waveforms may be analyzed quantitatively to determine the resistive index, acceleration time, and/or acceleration. Angle correction is necessary if acceleration is measured. Qualitative analysis of each waveform for the 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 imaging, although on occasion, guidance with gray scale 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 imaging 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°.

The 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 the systolic velocity in the abdominal aorta near the origin of the superior mesenteric artery. This is used for analyzing the ratio of the 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

Adequate documentation is essential for high-quality patient care. There should be a permanent record of the ultrasound examination and its interpretation. Images of all appropriate areas, both normal and abnormal, should be recorded. Variations from normal size should be accompanied by measurements. Images should be labeled with the patient identification, facility identification, examination date, and side (right or left) of the anatomic site imaged. An official interpretation (final report) of the ultrasound findings should be included in the patient's medical record. Retention of the ultrasound examination should be consistent both with clinical needs and with relevant legal and local health care facility requirements.

Reporting should be in accordance with the AIUM Practice Guideline for Documentation of an Ultrasound Examination.

VII. Equipment Specifications

Renal artery duplex sonography 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 gray scale examination, see the 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 Concerns

Policies and procedures related to quality control, patient education, infection control, and safety should be developed and implemented in accordance with the AIUM Standards and Guidelines for the Accreditation of Ultrasound Practices.

Equipment performance monitoring should be in accordance with the AIUM Standards and Guidelines for the Accreditation of Ultrasound Practices.
Acknowledgments
This guideline was developed by the American Institute of Ultrasound in Medicine (AIUM) in collaboration with the American College of Radiology (ACR), according to the process described in the AIUM Clinical Standards Committee Manual.

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