AIUM Practice Parameter for the Performance of

Native Renal Artery Duplex Sonography

Parameter developed in conjunction with the American College of Radiology (ACR), the Society for Pediatric Radiology (SPR), and the Society of Radiologists in Ultrasound (SRU).

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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 parameters, and accreditation. To promote this mission, the AIUM is pleased to publish, in conjunction with the American College of Radiology (ACR), the Society for Pediatric Radiology (SPR), and the Society of Radiologists in Ultrasound (SRU), this AIUM Practice Parameter for the Performance of Native 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 parameters of the AIUM are intended to provide the medical ultrasound community with parameters for the performance and recording of high-quality ultrasound examinations. The parameters 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 parameters with recognition that deviations from these parameters will be needed in some cases, depending on patient needs and available equipment. Practices are encouraged to go beyond the parameters to provide additional service and information as needed.
I. Introduction

The clinical aspects contained in specific sections of this parameter (Introduction, Indications, Specifications of the Examination, and Equipment Specifications) were revised collaboratively by the American Institute of Ultrasound in Medicine (AIUM), the American College of Radiology (ACR), the Society for Pediatric Radiology (SPR), and the Society of Radiologists in Ultrasound (SRU). Recommendations for personnel requirements, written request for the examination, procedure documentation, and quality control vary among the organizations and are addressed by each separately.

Sonography using grayscale imaging, Doppler spectral 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. While it is not possible to detect every abnormality, adherence to the following parameters 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 (e.g., uncontrolled hypertension despite optimal therapy, hypertension with a progressive decline in renal function, a progressive decline in renal function associated with angiotensin-converting enzyme inhibition therapy, and abrupt onset of hypertension);
2. Follow-up of patients with known renovascular disease who have undergone renal artery stent placement or other renal artery interventions or have known unilateral stenosis with concern for stenosis in the contralateral kidney;
3. Evaluation of an abdominal or flank bruit;
4. Evaluation of a suspected vascular abnormality such as an aneurysm, pseudoaneurysm, arteriovenous malformation, or arteriovenous fistula;
5. Evaluation of renal insufficiency in a patient at risk for renovascular disease;
6. Evaluation of renal artery blood flow in patients with known aortic dissection, trauma, or other abnormalities that may compromise blood flow to the kidneys;
7. Evaluation of discrepant renal size; and
8. Concern for an aortic or renal artery orifice thrombus in infants who have or have had an aortic catheter, such as an umbilical artery catheter.

There are no absolute contraindications to performing this examination.
III. Qualifications and Responsibilities of Personnel


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 the provider’s 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 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 (eg, evaluation of a renal stent or known solitary kidney).

The study consists of grayscale imaging of the kidneys with spectral and color Doppler imaging of the extrarenal and intrarenal 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 complete renal ultrasound examination may be considered. See the *AIUM Practice Parameter for the Performance of an Ultrasound Examination of the Abdomen and/or Retroperitoneum*.

B. Spectral and Color Doppler Evaluation

   Analysis of main renal artery and intrarenal arterial waveforms should be used to evaluate for renal artery stenosis.

   Careful attention to technique is important to ensure accurate examination results, including selecting a transducer that is appropriate for the patient’s body habitus, optimizing color Doppler parameters, using an appropriate sample volume, optimizing the velocity scale for the size of the waveform to avoid aliasing (this may require adjusting the scale, baseline, or frequency or selecting a lower-frequency transducer), and using 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 should not exceed 60°.
1. Main Renal Artery Evaluation

The entire main renal artery should be scanned along its long axis using optimized color Doppler guidelines. Occasionally, power Doppler or grayscale imaging may be necessary to localize a portion of the artery. Inability to visualize the entire or part (especially the origin) of the main renal artery should be reported.

Spectral Doppler imaging should be performed along the vessel’s length from the origin to the hilum at the lowest feasible angle of insonation.

The greatest peak systolic velocities should be recorded at the origin/proximal portion, at the mid aspect, and near the hilum. A peak systolic velocity should also be recorded at any site of color aliasing or suspected stenosis. If there is significant stenosis, a Doppler waveform should be recorded within the stenosis and distal to the stenosis.

An effort should also be made to search for accessory renal arteries. When visualized, peak systolic velocities should be recorded as described above.

An appropriate angle-corrected spectral waveform from the abdominal aorta at the level of the renal arteries should be recorded. The aortic peak systolic velocity is used to calculate the ratio of the peak systolic velocity in the renal artery to the aorta.

Renal artery stent evaluation should include recording a peak systolic velocity in the proximal renal artery (if possible), within the stent, and distal to the stent (if possible).

In infants who have developed an aortic thrombus after catheterization, the relationship of the clot to the renal arterial orifices and the flow around the thrombus should be documented. If the thrombus is located near a renal artery orifice, renal arterial and intraparenchymal waveforms should be obtained to assess renal perfusion.

2. Intrarenal Evaluation

Spectral waveforms should be recorded from segmental arteries in the upper and lower poles and the interpolar region (midportion) of each kidney. It is important to use a fast sweep speed and optimize the velocity scale to ensure accurate results.

If acceleration index measurements are used in the assessment, angle correction is needed; the angle of insonation should be as low as possible, usually 20° or less.

Intrarenal analysis consists of quantitative and/or qualitative evaluation of the Doppler waveforms. Quantitative evaluation may include acceleration times, acceleration indices, or resistive indices. For qualitative analysis, the morphology of the waveform should be assessed for a normal systolic upstroke or tardus parvus changes.
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 Parameter for Documentation of an Ultrasound Examination.

VII. Equipment Specifications

Duplex and color Doppler sonography of the renal arteries should be performed in real time using transducer frequencies based on body habitus. For adults, mean frequencies between 2 and 5 MHz are most commonly used. In neonates, frequencies of 7 to 15 MHz are typically used.

VIII. Quality Control and Improvement, Safety, Infection Control, and Patient Education

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.

IX. ALARA Principle

The potential benefits and risks of each examination should be considered. The ALARA (as low as reasonably achievable) principle should be observed when adjusting controls that affect the acoustic output and by considering transducer dwell times. Further details on ALARA may be found in the AIUM publication Medical Ultrasound Safety, Third Edition.
Acknowledgments

This parameter was revised by the AIUM in collaboration with the American College of Radiology (ACR), the Society for Pediatric Radiology (SPR), and the Society of Radiologists in Ultrasound (SRU) according to the process described in the AIUM Clinical Standards Committee Manual.

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References


