AIUM Practice Guideline for the Performance of Peripheral Arterial Ultrasound Examinations Using Color and Spectral Doppler Imaging

Guideline developed in collaboration with the American College of Radiology and the Society of Radiologists in Ultrasound.
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) and the Society of Radiologists in Ultrasound (SRU) this AIUM Practice Guideline for the Performance of Peripheral Arterial Ultrasound Examinations Using Color and Spectral Doppler Imaging.

The AIUM represents the entire range of clinical and basic science interests in medical diagnostic ultrasound, and, with hundreds of volunteers, this multidisciplinary organization 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, Specifications of the Examination, and Equipment Specifications) were developed collaboratively by the American Institute of Ultrasound in Medicine (AIUM), the American College of Radiology (ACR), and the Society of Radiologists in Ultrasound (SRU). Recommendations for physician requirements, written request for the examination, procedure documentation, and quality control vary among the three organizations and are addressed by each separately.

These guidelines are intended to assist practitioners performing noninvasive evaluation of the peripheral arteries using color and spectral Doppler ultrasound. The sonographic examination of patients with peripheral vascular disease will, in general, complement the use of other physiologic tests, such as pressure measurements, pulse volume recordings, and continuous wave Doppler ultrasound. In selected cases a tailored examination is used to answer a specific diagnostic question. While it is not possible to detect every abnormality, adherence to the following guidelines will maximize the probability of detecting most of the abnormalities that occur in the extremity arteries.

II. Qualifications and Responsibilities of the Physician

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.

III. Indications

The indications for peripheral arterial ultrasound examination include but are not limited to:

1. The detection of hemodynamically significant stenoses or occlusions in specified segment(s) of the peripheral arteries in symptomatic patients with suspected arterial occlusive disease. These patients could present with recognized clinical indicators, including claudication, rest pain, ischemic tissue loss, and suspected arterial embolizations.

2. The monitoring of sites of previous surgical interventions, including sites of previous bypass surgery with either synthetic or autologous vein grafts.

3. The monitoring of sites of various percutaneous interventions, including angioplasty, thrombolysis/thrombectomy, atherectomy, and stent placements.

4. The evaluation of suspected vascular and perivascular abnormalities, including such entities as masses, aneurysms, pseudoaneurysms, and arteriovenous fistulas.

5. Mapping of arteries before surgical interventions.

6. Clarifying or confirming the presence of significant arterial abnormalities identified by other imaging modalities.


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 relevant legal and local health care facility requirements.

V. Specifications of the Examination

The initial examination for determining the presence of arterial occlusive disease remains the determination of blood pressures in the extremities being studied. Blood pressure measurement at different levels should be reported as a ratio (eg, ankle/brachial index) where appropriate. The sonographic examination consists of gray scale imaging and the evaluation of the spectral Doppler waveforms in the corresponding arterial segments. Color Doppler ultrasound should be used to improve detection of arterial lesions and guide placement of the sample volume for spectral Doppler assessment.

A. Appropriate Techniques and Diagnostic Criteria
Specific sonographic techniques must be tailored to the different arterial segments studied and to the specific pathology being evaluated. Established imaging, Doppler, and pressure criteria may be used to identify arterial stenoses and occlusions, identify graft abnormalities, detect abnormal arteriovenous communications, and evaluate suspected soft tissue abnormalities in proximity to an artery.

B. Arterial Occlusive Disease

For arterial occlusive disease, the following general considerations apply. The full length of the arterial segment(s) of interest should be evaluated with color Doppler ultrasound. Suspected abnormalities should also be imaged with gray scale ultrasound. Representative spectral Doppler waveforms with velocity measurements should be obtained and documented along the length of the arterial segment(s) and at any area of color or gray scale abnormality. A spectral Doppler waveform with velocity measurements in the arterial segment 2 to 4 cm proximal to (upstream of) any stenosis should be documented. The location and the length of any diseased or nonvisualized segment(s) should also be documented. Every attempt should be made to acquire spectral Doppler waveforms with velocity measurements with the angle between the direction of moving blood and the direction of the ultrasound beam kept at less than or equal to 60°. Velocity estimates made with larger angles are less reliable.

An evaluation of the following arterial segments should generally be performed as indicated below. However, a focused or limited examination may be appropriate in certain clinical situations. At a minimum, an angle-corrected spectral Doppler waveform with velocity measurements should be obtained from the following sites:

1. Lower extremity:
   a. Common femoral artery;
   b. Proximal superficial femoral artery;
   c. Mid superficial femoral artery;
   d. Distal superficial femoral artery;
   e. Popliteal artery.

If clinically appropriate, imaging of the iliac, deep femoral, tibioperoneal, and dorsalis pedis arteries can be performed.

2. Upper extremity:
   a. Subclavian artery;
   b. Axillary artery;
   c. Brachial artery.

If clinically appropriate, imaging of the innominate, radial, and ulnar arteries and/or the palmar arch can be performed.

C. Evaluation of Surgical and Percutaneous Interventions

1. Bypass grafts:

An attempt should be made to sample the full length of any bypass graft whenever possible with color Doppler ultrasound. Suspected abnormalities should also be imaged with gray scale ultrasound. Spectral Doppler waveforms and velocity measurements should be documented in the native artery proximal to the graft anastomosis, at the proximal anastomosis, at representative sites along the graft, at the distal anastomosis, and in the native artery distal to the anastomosis. Angle-corrected spectral Doppler waveforms and velocity measurements should also be obtained in regions of suspected flow abnormalities noted on gray scale or color Doppler imaging.

2. Sites having undergone percutaneous interventions:

An attempt should be made to sample the site of selective arterial interventions as well as the segment immediately proximal (upstream) and distal (downstream) to the site of intervention. Spectral Doppler waveforms and velocity measurements should be documented.

D. Other

1. Suspected soft tissue abnormalities in proximity to arteries:

The entire area of a suspected soft tissue abnormality should be imaged. If appropriate, spectral and color Doppler examinations may be performed to determine the presence and nature of blood flow in the region of the suspected abnormality.

2. Pseudoaneurysms:

The size of the pseudoaneurysm, the residual lumen, and the length and width of the communicating channel should be documented. Spectral Doppler waveforms should be obtained in the communicating channel to demonstrate “to-and-fro” flow. In cases of therapeutic intervention, color and/or spectral Doppler ultrasound may be used as a guide to therapy and as a means of documenting therapeutic success.12, 16-18
3. Abnormal communication between artery and vein:
Color and spectral color Doppler ultrasound may be used to document the location of abnormal vascular communications. Angle-corrected spectral Doppler waveforms should be documented from within vessels proximal to, in the area of, and distal to abnormal communications. Color Doppler ultrasound is particularly useful for identifying the level of such communications and resultant transmitted soft tissue vibrations secondary to the flow disturbances produced by abnormal vascular communications.

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
Peripheral arterial sonography should be performed with a real-time scanner with a linear array or curved array transducer equipped with pulsed Doppler and color Doppler capability. (Power or energy Doppler may be used if needed.) The transducer should operate at the highest clinically appropriate frequency, recognizing that there is a trade-off between resolution and penetration. This should usually be at a frequency of 3.5 MHz or greater, with the occasional need for a lower-frequency transducer. Evaluation of the flow signals originating from within the lumen of the vessel should be conducted with a carrier frequency of 2.5 MHz or greater.

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, Second Edition.

Acknowledgments
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Collaborative Committee
ACR
Michelle L. Robbin, MD, Chair
John S. Pellerito, MD
Joseph F. Polak, MD, MPH

AIUM
M. Robert De Jong, RDMS, RVT
Laurence Needleman, MD
Leslie M. Scoutt, MD

SRU
Edward G. Grant, MD
Janis G. Letourneau, MD
AIUM Clinical Standards Committee
David M. Paustner, MD, Chair
Leslie M. Scoutt, MD, Vice Chair
Susan Ackerman, MD
Lisa Allen, BS, RDMS, RDCS, RVT
Mert Ozan Bahtiyar, MD
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Lin Diacon, MD, RDMS, RPVI
Judy Estroff, MD
Kimberly Gregory, MD, MPH
Charlotte Henningsen, MS, RT, RDMS, RVT
Charles Hyde, MD
Christopher Moore, MD, RDMS, RDCS
Olga Rasmussen, RDMS
Carl C. Reading, MD
Daniel Skupski, MD
Jay Smith, MD
Joseph Wax, MD

References

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