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1993 (Res. 7)
Amended 1995 (Res. 53)
Revised 1997 (Res. 29)
Revised 2001 (Res. 35)
Revised 2006 (Res. 41,35)
Effective 10/01/06

ACR PRACTICE GUIDELINE FOR THE PERFORMANCE OF PERIPHERAL ARTERIAL ULTRASOUND USING COLOR AND PULSED DOPPLER

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 on 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 successful outcome. All that should be expected is that the 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 of this guideline (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.

These guidelines have been developed to assist practitioners performing noninvasive evaluation of the peripheral arteries using pulsed 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, Doppler waveforms, and continuous wave Doppler. 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 [ACR Practice Guideline for Performing and Interpreting Diagnostic Ultrasound Examinations](#).

III. INDICATIONS FOR PERIPHERAL ARTERIAL EXAMINATIONS

The initial examination for determining the presence of arterial occlusive disease remains the determination of the blood pressures in the extremities being studied. Blood pressure measurement at different levels should be reported as a ratio (e.g., ankle/brachial index) where appropriate. The sonographic examination consists of gray-scale imaging and the evaluation of the velocity waveforms in the corresponding arterial segments. Color Doppler should be used as an aid to the examination. The arterial segment(s) of interest should be interrogated. When indicated, the soft tissues contiguous to the arterial segment of interest should be carefully studied.

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

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, or 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, or stent placements.
4. The evaluation of suspected vascular and perivascular abnormalities, including such entities as masses, aneurysms, pseudoaneurysms, or various communications between arteries and veins.

5. Mapping of arteries prior to surgical interventions.

Additional uses of Doppler ultrasound can include preoperative mapping for dialysis access and postoperative follow-up (see the [ACR Practice Guideline for the Performance of Ultrasound Vascular Mapping for Preoperative Planning of Dialysis Access](#)).

IV. WRITTEN REQUEST FOR THE EXAMINATION

The written or electronic request for a peripheral arterial ultrasound examination should provide sufficient information to demonstrate the medical necessity of the examination and allow for the proper performance and interpretation of the examination.

Documentation that satisfies medical necessity includes 1) signs and symptoms and/or 2) relevant history (including known diagnoses). The provision of 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. 2006 (Res. 35)

V. SPECIFICATIONS OF THE EXAMINATION

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 stenosis 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 considerations apply. The full length of the arterial segment(s) of interest should be sampled with color and pulsed Doppler. The velocity waveforms obtained at all sites with hemodynamically significant stenoses and occlusions should be recorded. Measurements of abnormal arterial diameter should be routinely performed. A record should be made of the velocity waveforms in the

arterial segment situated 2 to 4 cm proximal (upstream) to the abnormality. The location and the length of any segment that was not visualized should be recorded. Every attempt should be made to acquire velocity waveforms with the angle between the direction of moving blood and the direction of the ultrasound beam kept at less than or equal to 60 degrees. Velocity estimates made with larger angles are less reliable.

An evaluation of the following arterial segments should generally be performed as indicated below. However, to answer specific questions, a limited exam may be appropriate.

1. Iliac arteries

For a unilateral examination, the common and external iliac arteries should be interrogated in their entirety. If the iliac arteries are examined bilaterally, the infrarenal abdominal aorta should also be imaged. A record should be made of the velocity profiles sampled in the selected artery or arteries.

2. Femoro-popliteal arteries

In general, the full length of the common femoral, superficial femoral, and popliteal arteries should be sampled. The origin of the profunda femoral artery should also be examined. A record of the velocity waveforms obtained of the common femoral, superficial femoral, and popliteal arteries should be kept.

3. Tibio-peroneal arteries

An attempt should be made to evaluate the full length of selected run-off vessels. A record should be made of the velocity profiles sampled in the selected artery or arteries.

4. Subclavian, axillary, and brachial arteries

An attempt should be made to evaluate the full length of these arterial segments. A record should be made of their velocity profiles.

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. Velocity measurements should be recorded in the artery proximal to the graft anastomosis, at the proximal anastomosis, every 10 to 20 cm along

the conduit of the graft, at the distal anastomosis, and in the artery distal to the anastomosis. 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. A record of these velocity waveforms should be kept.

D. Other

1. Suspected soft tissue abnormalities in proximity to arteries

The entire area of a suspected soft tissue abnormality should be imaged. Pulsed Doppler and color Doppler should be performed to determine the presence and nature of blood flow in the region of the suspected abnormality. Doppler velocity waveforms from within a visible lesion, adjacent arteries and veins, and any visible communicating channels should be recorded. The size of the lesion and the presence of thrombus within the lesion should be documented.

2. Confirmed presence of pseudoaneurysms

In case of therapeutic intervention, color Doppler or duplex sonography may be used as a guide to therapy and as a means of documenting therapeutic success.

3. Abnormal communication between artery and vein

Pulsed Doppler and color Doppler may be used to document the location of abnormal vascular communications. Velocity waveforms should be recorded from within vessels proximal to, in the area of, and distal to abnormal communications. Color Doppler 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 in 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 the side (right or left) of the anatomic site imaged. An official interpretation (final report) of the ultrasound findings should be in accordance with the [ACR Practice Guideline for Communication of Diagnostic Imaging Findings](#) and should be included in the patient's medical record, regardless of where the study is performed. Retention of the ultrasound examination should be consistent both with clinical need and with relevant legal and local healthcare facility requirements.

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. (Comment: 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 CONCERNS

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 Concerns appearing elsewhere in the ACR Practice Guidelines and Technical Standards book.

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 in the ACR Practice Guidelines and Technical Standards book by the Guidelines and Standards Committee of the Ultrasound Commission in

collaboration with the American Institute of Ultrasound in Medicine (AIUM).

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