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## VASCULAR TECHNOLOGY PROFESSIONAL PERFORMANCE GUIDELINES

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# Upper Extremity Arterial Duplex Evaluation

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VASCULAR PROFESSIONAL PERFORMANCE GUIDELINE  
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## **PURPOSE**

Duplex sonography of the upper extremity arteries is performed to provide an overview of the location, extent, and severity of vascular disease. The ultrasound evaluation can be performed from the subclavian artery to the wrist to facilitate clinical management decisions.

## **APPROPRIATE INDICATIONS**

Common indications for performance of upper extremity arterial duplex imaging include:

- Known history of peripheral arterial disease
- Ischemic rest pain
- Arterial ulceration or gangrene
- Pre-procedure assessment for planning of intervention
- Follow up after surgical intervention, i.e., post angioplasty and/or stent placement
- Post-operative surveillance of arterial bypass grafts
- Evaluation of an aneurysm, pseudo-aneurysm and arterial-venous fistula
- Evaluation of arterial trauma
- Arterial Thoracic Outlet Syndrome (TOS)

## **CONTRAINDICATIONS AND LIMITATIONS**

- Presence of ulcers, casts, staples, or bandages
- Obesity may limit visualization of some structures
- IV or catheters that limit access /visualization of arterial structures
- Patient's inability to cooperate with or tolerate the examination

## **PATIENT COMMUNICATION**

Prior to beginning the exam, the sonographer or examiner should:

- Introduce themselves, explain why the examination is being performed and indicate how much time the examination will take.
- Verify the patient's name and date of birth or utilize facility-specific patient identifiers.
- Explain the procedure, taking into consideration the age and mental status of the patient and ensuring that the necessity for each portion of the evaluation is understood.
- Respond to questions and concerns about any aspect of the evaluation.
- Educate the patient about risk factors for and symptoms of peripheral arterial disease.
- Refer specific diagnostic, treatment, or prognosis questions to the patient's physician.

## PATIENT ASSESSMENT

A patient assessment must be performed before the evaluation. This includes an assessment of the patient's ability to tolerate the procedure, an evaluation of any contraindications to the procedure, and a physical assessment of bilateral arms, hands, and fingers. The sonographer or examiner should obtain a complete, pertinent history and a review of the patient's medical record, if available. A pertinent history includes:

- Previous vascular/cardiovascular surgeries
- Current medications or therapies
- Risk factors for arterial disease:
  - Diabetes
  - Hypertension
  - Hyperlipidemia
  - Coronary artery disease
  - Age
  - Smoking history
  - Connective Tissue Disease such as Scleroderma, Systemic Lupus Erythematosus, and CREST syndrome.
- Type of job/hobby (especially if the examination is for TOS or arm/hand trauma).
- Physical assessment of the arms, hands, and fingers for symptoms of limb ischemia, skin changes (including duration, location, and whether it is persistent or episodic), gangrene, and/or ulcers.

A complete assessment should guide the sonographer to:

- Verify that the procedure ordered correlates with the patient's clinical presentation.
- Determine if upper extremity arterial physiological evaluation should be included in the examination.
- Perform adjunctive procedures according to the laboratory-specific protocol: auscultation of bruits, palpation of pulses and/or Allen's test.

## PATIENT POSITIONING

The optimal position and preparation for performing an upper extremity arterial evaluation includes:

- The exam is typically performed with the patient in supine position, head slightly elevated and arm externally rotated. When examining the axillary artery, a pledge position may be helpful. The arm can be placed on a pillow for patient comfort.
- The examiner should be close to the examined extremity as possible to allow for proper ergonomics.

## INSTRUMENTATION

Utilize appropriate duplex instrumentation with the appropriate frequencies for the vessels being examined.

- Typically, this is a high-frequency linear transducer with frequencies ranging from 8-15 MHz.
- Lower frequencies or a small footprint transducer may be utilized to access the origin of the subclavian arteries in the chest region.
- Display of both two-dimensional structure and motion in real-time
  - Doppler ultrasonic signal documentation
  - Spectral analysis with or without color Doppler imaging
- Digital storage of static images or cineloop is required.

## EXAM PROTOCOL

Sonographers should follow a standard imaging protocol. A complete evaluation includes B-mode, spectral Doppler analysis, and color Doppler imaging of all accessible portions of the upper extremity arteries. Bilateral evaluations are essential for a complete evaluation; however, studies may be unilateral or limited based on laboratory-specific protocols.

During each examination, the sonographer or examiner should:

- Observe the sonographic characteristics of normal and abnormal tissues, structures, and blood flow to allow the necessary adjustment for optimizing exam quality.
- Assess and monitor the patient's physical and mental status, allowing modifications to the procedure plan according to the patient's clinical status.
- Analyze sonographic findings to ensure that sufficient data are provided to the physician to direct patient management and render a final diagnosis.

If not contraindicated, bilateral systolic brachial pressures should be documented to assess symmetry.

B-Mode and color Doppler imaging of the upper extremity arteries should be performed in a longitudinal plane. Transverse imaging may be helpful. Longitudinal grayscale and color Doppler images should be documented for each normal arterial segment and in areas of stenosis, previous interventions, or other abnormalities. Color Doppler is used to localize areas of flow disturbance and stenosis. Power Doppler is useful to confirm possible vessel occlusion or low flow states.

Longitudinal **B-mode and/or color Doppler images** should include the following:

- Subclavian artery
- Axillary artery

- Brachial artery
- Radial and ulnar arteries
- Innominate artery (when indicated by facility protocol or based on findings)
- Areas of previous intervention (angioplasty, stenting)
- Bypass graft(s), when present, including anastomoses

Doppler spectral analysis is used to quantify disease severity. Spectral Doppler waveforms should be obtained in a longitudinal plane at an angle of 60° and parallel to the direction of the blood flow/vessel walls. Maintain Doppler angles between 45° to 60° whenever possible. Avoid angles greater than 60°.

Peak systolic velocities should be documented for each normal arterial segment and in areas of stenosis, previous intervention or other abnormality. Spectral Doppler waveforms and velocity measurements should be obtained 1 to 4 cm proximal to, within and distal to the suspected stenosis, obstruction, or in areas of previous intervention.

**Spectral Doppler waveforms** and velocity measures should include:

- Subclavian artery
- Axillary artery
- Brachial artery
- Radial and Ulnar arteries
- Innominate artery (when indicated by facility protocol or based on findings)
- Areas of previous intervention (angioplasty, stenting)
- Bypass graft(s) when present, should include the following:
  - Inflow and outflow arteries
  - Proximal and distal anastomosis
  - Proximal, mid, and distal graft

Abnormalities requiring further examination and additional images when present:

- Areas of stenosis: Pre-stenosis, at stenotic site, and post-stenotic turbulence. Peak systolic velocity ratio (VR) is used to determine if the lesion is hemodynamically significant. The PSV ratio is obtained by taking the PSV at the area of stenosis and dividing by the PSV in the normal segment proximal to the stenosis.
- Areas of an aneurysm: Obtain outer wall to outer wall diameter measurements and spectral Doppler velocities proximal to, within and distal to the aneurysm. Subclavian artery aneurysm may be difficult to obtain due to its proximity to the clavicle. Document when mural thrombus is present.
- In the presence of a brachial pressure difference greater than 20 mmHg: the ipsilateral vertebral artery should be evaluated for direction of flow when vertebral-to-subclavian

steal is suspected.

- In the presence of other surgical interventions (angioplasty or stents): evaluate the proximal inflow artery, endovascular segment and distal artery.

## REVIEW OF THE DIAGNOSTIC EXAM FINDINGS

The sonographer or examiner should:

- Review data acquired during the upper extremity arterial duplex examination to ensure that a complete and comprehensive evaluation has been performed and documented.
- Explain and document any exceptions to the protocol (i.e., study omissions or revisions).
- To determine any change in follow-up studies, review previous exam documentation to document any change in status; and/or duplicate prior imaging and Doppler parameters.
- Record the technical findings required to complete the final diagnosis on a worksheet or other appropriate method (e.g., computer software), so that the findings can be classified according to the laboratory diagnostic criteria
- Document the exam date, clinical indications, sonographer performing the evaluation, and exam summary in the patient's medical record.

## PRESENTATION OF FINDINGS

The sonographer or examiner should:

- Provide preliminary results when necessary as provided for by laboratory-specific guidelines.
- Present records of diagnostic images, data, explanations, and technical worksheets to the interpreting physician. Interpretation must be available within two business days.
- The sonographer's and interpreting physician's names must appear on the final report. The finalized/signed report should be available within four business days.
- Alert the vascular laboratory medical director or appropriate healthcare provider when immediate medical attention is needed, based on departmental guidelines and procedures.

## EXAM TIME RECOMMENDATIONS

High quality, accurate results are fundamental elements of the upper extremity arterial duplex evaluation. A combination of indirect and direct examination components is the foundation for maximizing exam quality and accuracy.

- Indirect exam components include:

- Pre-exam activities: obtaining previous exam data, initiating exam worksheet and paperwork, equipment and exam room preparation, patient assessment and positioning, and patient communication
- Post-exam activities: exam room cleanup, compiling and processing exam data for preliminary and/or formal interpretation, and exam billing activities.
- Direct exam components include:
  - Equipment optimization and the actual hands-on, examination process.
- While study times may vary depending on testing protocols, patient condition, and clinical complexity of the evaluation being performed, these are the times necessary to provide a quality diagnostic evaluation. Listed are the recommended examination times for performing each CPT related to this guideline, which were derived from the direct time inputs from the Resource Based Relative Value Scale (RBRVS).
  - 93930            76 minutes
  - 93931            51 minutes

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