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VASCULAR TECHNOLOGY PROFESSIONAL PERFORMANCE GUIDELINES

Upper Extremity Arterial Segmental Physiologic Evaluation (Arterial, TOS, Cold)

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Upper Extremity Arterial Segmental Physiologic Evaluation

PURPOSE

Arterial segmental pressure and waveform evaluations are performed to evaluate the upper extremity arteries to determine the presence, severity, and location of arterial occlusive disease or absence of pathology.

COMMON INDICATIONS

Some of the more common indications for performance of arterial segmental pressures and waveforms include, but are not limited to:

- Arterial insufficiency
- Thoracic Outlet Syndrome (TOS)
- Raynaud's Disease
- Ischemic ulcer
- Limb ischemia/ Digital ischemia

Upper extremity arterial segmental pressure and waveform evaluations are also performed as follow-up of patients with known peripheral artery disease or an arterial intervention of the upper extremity.

CONTRAINDICATIONS AND LIMITATIONS

- Functioning dialysis access graft
- Patients with suspected or known acute deep venous thrombosis (DVT)
- Recent surgery, ulcers, casts or bandages on the upper extremity that cannot or should not be compressed by pressure cuffs
- Patients with incompressible vessels
- Patients who are post upper extremity interventional procedure, i.e., dialysis access graft, stent, arterial bypass graft, segmental pressures may be contraindicated.

GUIDELINE 1: PATIENT COMMUNICATIONS AND POSITIONING

The technologist/sonographer/examiner should:

- 1.1 Introduce self and explain why the Upper Extremity Arterial Segmental Physiologic Evaluation is being performed and indicate how long it will take.
- 1.2 Explain the procedure to the patient, taking care to ensure that the patient or an accompanying adult comprehends the necessity for each aspect of the evaluation.
- 1.3 Respond to questions and concerns about any aspect of the Upper Extremity Arterial Segmental Physiologic Evaluation.
- 1.4 Educate patient about risk factors for, and symptoms of, peripheral arterial disease.
- 1.5 Inform patient about necessary life style changes due to peripheral arterial disease. Refers specific questions regarding diagnosis, treatment or prognosis to the patient's physician.
- 1.6 The patient should have rested for at least 15 minutes before beginning exam.
- 1.7 Patients should be examined in the supine position for segmental pressures and Doppler waveforms.

GUIDELINE 2: PATIENT ASSESSMENT

Patient assessment must be performed before the Upper Extremity Arterial Segmental Physiologic Evaluation is performed. This includes assessment of the patient's ability to tolerate the procedure and an evaluation of any contraindications to the procedure.

The technologist/sonographer/examiner should:

- 2.1 Obtain a complete, pertinent history by interview of the patient or patient's representative and review of the patient's medical record. A pertinent history includes:
 - a. Current medical status
 - b. Previous vascular/cardiovascular surgeries
 - c. Current medications or therapies
 - d. Family history or presence of any risk factors for arterial disease: diabetes; hypertension; peripheral vascular disease; coronary artery disease; age; smoking; type of job/hobby (especially if examination is for TOS or arm/hand trauma); sclerodermal condition.
 - e. Presence of any symptoms of peripheral arterial disease: limb ischemia; skin changes; bruits.
- 2.2 When directed, perform adjunctive procedures: auscultation of bruits (carotid, orbital, subclavian); palpation of pulses (brachial, radial, carotid, facial); Allen's Test.
- 2.3 Verify that the requested procedure correlates with the patient's clinical presentation.

GUIDELINE 3: EXAMINATION GUIDELINES

Throughout each exam, characteristics of normal and abnormal waveform and segmental pressures must be observed so that the testing technique can be adjusted as necessary. The patient's physical and mental status is assessed and monitored during the examination, with modifications made to the procedure plan according to changes in the patient's clinical status during the procedure. Also, segmental pressure and waveform findings are analyzed throughout the course of the examination to ensure that sufficient data is provided to the physician to direct patient management and render a final diagnosis.

- 3.1 Use appropriate instrumentation, which includes measurement of segmental pressures and a display of the Doppler or plethysmographic waveforms:
 - a. Waveform output and display capabilities
 - b. Minimum of Doppler carrier frequency from 5.0 MHz
 - c. Blood pressure cuffs (arm and digital) of appropriate width and length are utilized to eliminate cuff pressure artifacts.
 - d. Permanent hardcopy paper, film or digital storage capabilities
- 3.2 Follow a standard exam protocol for each upper extremity. Physiological waveform analysis is typically Doppler or air plethysmography in origin. Segmental waveform and pressure information is used to identify the presence, absence, location and the severity of disease.
 - a. Bilateral upper arm and forearm systolic pressures should be taken with the patient supine, using appropriate cuffs for the limb diameter. This is usually performed with CW Doppler, monitoring the radial artery at the wrist. Pressures should be within 20mmHg of each other both from right to left and from above to below antecubital fossa.
 - b. Doppler Waveforms: Doppler waveforms are recorded from the brachial, radial and ulnar arteries, at an angle which optimizes the audible signal. Three representative waveforms should be obtained at each level. Gain settings should be optimized.
 - c. Audio interpretation of the signals should attempt to classify the signals as triphasic, biphasic (unidirectional or bidirectional), or monophasic. Obstructive (tardus parvus) waveforms, when present, prohibit immersion of hands in ice water without consulting with the patient's physician.
 - d. Photoplethysmography Waveforms: At least three representative waveforms must be obtained, with the sensor placed on the pad of each finger. Gain settings and chart speed should be standardized (suggest 2/3 height compared to the chart paper and 5mm/sec. trace speed).
 - e. Volume pulse recording (VPR) waveforms, standardized inflation pressures must be used. Gain settings should be optimized to facilitate clear signals for interpretation. Systolic segmental pressures should be recorded at the brachial, radial and ulnar arteries, bilaterally.
 - f. If waveforms from the brachial level are abnormal, Doppler waveforms from the subclavian level are recommended.
- 3.3 Additional pressures and waveforms may be obtained from the digital vessels, particularly if proximal abnormality is present or symptoms are not uniform.
- 3.4 When testing for Thoracic Outlet Syndrome (See SVU Guideline for TOS) perform maneuvers as described. If symptoms include the hand or digits, evaluation of these segments may be necessary (see 3.2 d and e above)

- 3.5 When testing for Vasospastic Disease, PPG waveforms, or VPR (volume) waveforms and/or digital surface temperatures are obtained from all (1-5) digits, bilaterally.
- Apply sensors (PPG) to digits 2 and 5 and temperature monitoring device to the pad of the digit (2nd and 5th), to monitor during exam. Record a baseline PPG tracing post-cold immersion (at the times noted in 3.5.c.), standardizing the trace height and speed as noted in 3.5. c and d. below. Waveform shape should have a rapid systolic onset to peak, with downslope straight down or in slightly towards the baseline. It may exhibit a “peaked” waveform (an anacrotic notch), with vasospasm. Record a digital temperature simultaneously with the PPG waveform, if performed within each laboratory protocol.
 - Place hands in large rubber gloves to prevent them from becoming wet during immersion into ice water bath. Photoplethysmograph and temperature sensors can be placed in water and can be monitored during and following hand immersion in iced water (for 30 seconds to one minute).
 - Repeat documentation of pulse shape and temperature measurements are recorded immediately, at 2 minutes, 5 minutes, 7 minutes and 10 minutes, unless recovery occurs sooner. Normal digital temperature ranges from 30 to 33 degrees centigrade, and pulse size/shape should start to return to pre-immersion levels, within 10 minutes.
 - Volume plethysmographic cuffs can be used instead and also be immersed in water, but care must be taken to prevent any water from entering the bladder. Cuffs and gloves are applied as above and waveform and/or pressures are taken. Gloves should be applied as noted in 3.5. b above.
 - Pulse change and recovery time is monitored during and following immersion into the ice water bath, recording the shape seen. Pressure measurements may be requested by ordering physician. Follow-up waveforms/pressures are recorded at times shown in 3.5.c. above.
 - Recovery times in either method should return to baseline waveform, temperature and/or pressures within 5 minutes. 10 minutes or longer is considered a positive exam for cold sensitivity.
- 3.6 To determine any change in follow-up studies, review previous exam documentation so that the current evaluation can document a change in status. The examination protocol may need to be modified to address previous findings and current physical needs.

GUIDELINE 4: REVIEW OF THE DIAGNOSTIC ULTRASOUND EXAM FINDINGS

The technologist/sonographer/examiner should:

- Review data acquired during the Upper Extremity Arterial Segmental Physiologic Evaluation to ensure that a complete and comprehensive evaluation has been performed and documented.
- Explain and document any exceptions to the routine Upper Extremity Arterial Segmental Physiologic Evaluation protocol (i.e., study limitations, omissions or revisions).
- Record all technical findings required to complete the final diagnosis in a worksheet, logbook or digital format so that the measurements can be classified according to the laboratory diagnostic criteria (based on published or internally validated data).
- Document exam date, clinical indication(s), technologist performing the evaluation and exam summary in a laboratory logbook or other appropriate method, i.e. computer software.
- Alert the vascular laboratory Medical Director or ordering medical provider when immediate medical attention is indicated based on the Upper Extremity Arterial Segmental Physiologic Evaluation findings.

GUIDELINE 5: PRESENTATION OF EXAM FINDINGS

The technologist/sonographer/examiner should:

- 5.1 Provide preliminary results when necessary as provided for by internal guidelines based on the Upper Extremity Arterial Physiologic Evaluation findings.
- 5.2 Present record of data, explanations, and technical worksheet to the interpreting physician for use in rendering a diagnosis and for archival purposes.

GUIDELINE 6: EXAM TIME RECOMMENDATIONS

Reproducible, high quality and accurate results are fundamental elements of the Upper Extremity Arterial Segmental Physiologic Evaluation. A combination of indirect and direct exam components is the foundation for maximizing exam quality and accuracy.

- 6.1 Indirect exam components which include pre-exam procedures: including obtaining previous exam data; completing pre -exam paperwork; exam room and equipment preparatory activities; patient assessment and positioning (Guideline 1 and 2); patient communication (Guideline 2); post-exam activities: exam room cleanup; compiling, reviewing and processing exam data for preliminary and/or formal interpretation (Guidelines 4-5); and, patient charge and billing activities. Recommended time allotment is 30 minutes.
- 6.2 Direct exam components include equipment optimization and the actual hands-on, examination process (Guideline 3). Recommended time allotment is 30-35 minutes.

GUIDELINE 7: CONTINUING PROFESSIONAL EDUCATION

Credentialing is considered the standard of practice in vascular technology. It demonstrates an individual's competence to perform vascular technology at the entry level. After achieving certification, all Registered Vascular Technologists (RVTs), Registered Vascular Specialists (RVS), or Radiologic Technologists (RT-V) must keep current with:

- 7.1 Advances in diagnosis and treatment of peripheral arterial disease.
- 7.2 Changes in Upper Extremity Arterial Segmental Physiologic Evaluation protocols or published laboratory diagnostic criteria.
- 7.3 Advances in ultrasound technology used for the Peripheral Arterial Evaluation.
- 7.4 Advances in other technology used for the Peripheral Arterial Evaluation.

APPENDIX

It is recommended that published or internally generated diagnostic criteria should be validated for each ultrasound system used. When validating ultrasound diagnostic criteria, it is important to realize that equipment, operator and interpretation variability is inherent to this process.

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