Ultrasound – Arterial Duplex, Upper Extremity

PURPOSE:
Duplex examinations are performed to provide evaluation of the upper extremity arteries to assess for plaque morphology location and severity.

SCOPE:
Applies to all ultrasound arterial Duplex studies of the upper extremity performed in:
- UT Southwestern Zale-Lipshy University Hospital, William P. Clements Jr. University Hospital, and all University Hospital-based Clinics Imaging Services (UTSW)
- Parkland Health and Hospital System Department of Radiology (PHHS)

INDICATIONS:
- Evaluation or follow-up of patients with exercise induced pain, rest pain, ulceration
- Assessment of patients with documented arterial disease
- Pre-procedure assessment for planning of intervention
- Follow-up to determine technical adequacy of intervention (i.e., post angioplasty/stent)
- Follow-up of bypass grafts to detect intrinsic stenosis or progression of disease
- Evaluation of aneurysm, pseudoaneurysm and arterial-venous fistula
- Evaluation of arterial trauma

CONTRAINDICATIONS:
Contraindications for upper extremity arterial duplex are few; however, some limitations exist and may include the following:
- Presence of ulcers, casts, or bandages
- Obesity
- IV or catheters that limit access to or visualization of arterial structures
- Patients’ inability to cooperate with or tolerate the examination

EQUIPMENT:
- Duplex ultrasound with color flow Doppler with transducer frequencies ranging from 3.5-10 MHz

PATIENT PREPARATION:
- Introduce yourself to patient
- Verify patient identity according to hospital procedure
- Explain the test
- Obtain patient history including symptoms
- Place the patient in a supine position

GENERAL GUIDELINES:
- A complete examination includes evaluation of the entire course of the accessible portions of each vessel
- Bilateral testing is considered an integral part of a complete examination
- Limited examinations for recurring indications may be performed as noted
- Variations in technique during the assessment of peripheral vascular interventions (i.e., stents), must be documented in tech notes
TECHNICAL CONSIDERATIONS:
• Equipment gain and display settings will be optimized while imaging vessels with respect to depth, dynamic range and focal zones.
• Color-flow Doppler will be added to supplement B-mode images with proper color scale to demonstrate areas of high flow and color aliasing.
• Power Doppler will be used to validate low flow states or occlusions.
• Cursor sample size will be small and positioned parallel to the vessel wall and/or direction of blood flow.
• A spectral Doppler angle of 60 degrees or less will be used to measure velocities.
• Spectral Doppler gains will be set to allow a spectral window and optimized to reduce artifact.
• Areas of suspected stenosis or obstruction will include spectral Doppler waveforms and velocity measurements recorded at and distal to the stenosis or obstruction.
• Sites of intervention (i.e., stents) will include spectral Doppler waveforms and velocity measurements from the proximal, mid and distal sites.
• Plaque should be assessed and characterized.

DOCUMENTATION:
• Duplex evaluation is performed bilaterally starting with the right side

• Long axis gray scale and color Doppler images must be obtained from:
  o Subclavian Artery
  o Axillary Artery
  o Brachial Artery
  o Radial Artery
  o Ulnar Artery

• Spectral Doppler waveforms and velocity measurements must be documented from:
  o Subclavian Artery (proximal and distal)
  o Axillary Artery
  o Brachial Artery (proximal, mid, distal)
  o Radial Artery (distal) – If distal waveform abnormal, include proximal and mid Doppler
  o Ulnar Artery (distal) – If distal waveform abnormal, include proximal and mid Doppler
  o Superficial palmar arch, interdigital and digital arteries as indicated

• If you identify a stenosis (obvious narrowing on gray scale, PSV > 180 cm/sec, focal spectral broadening/turbulent flow), document the following in addition:
  o At the site of stenosis
    ▪ Grayscale diameter
    ▪ Doppler waveform
    ▪ Peak systolic velocity (PSV)
  o At a site 2 cm proximal to the stenosis (or relatively normal segment of proximal vessel)
    ▪ Grayscale diameter
    ▪ Doppler waveform
    ▪ PSV

PROCESSING:
• Review examination data and process for final interpretation
• Note study limitations

REFERENCES:
APPENDIX:

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Table 15 Diagnostic criteria for peripheral arterial diameter reduction

<table>
<thead>
<tr>
<th>Diameter reduction</th>
<th>Waveform</th>
<th>Spectral broadening</th>
<th>PSV distal/PSV proximal</th>
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<tr>
<td>Normal</td>
<td>Triphasic</td>
<td>Absent</td>
<td>+++ No change</td>
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<tr>
<td>Mild</td>
<td>Triphasic</td>
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<td>&lt; 2:1</td>
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<tr>
<td>Moderate</td>
<td>Biphasic</td>
<td>Present</td>
<td>&lt; 2:1</td>
</tr>
<tr>
<td>Severe</td>
<td>Monophasic</td>
<td>Present</td>
<td>&gt; 2:1*</td>
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PSV, Peak systolic velocity.

* >4:1 suggests >75% stenosis, >7:1 suggests >90% stenosis.

Table 17 Diagnostic criteria for vein graft lesions using peak systolic velocity

- Minimal stenosis <20% with PSV ratio < 1.4 and < 125 cm/s
- Moderate stenosis of 20% to 50% with PSV ratio 1.5 to 2.4 and a PSV <180 cm/s
- Severe stenosis 50% to 75% with PSV ratio 2.5 to 4 and a PSV >180 cm/s
- High-grade stenosis > 75% with PSV ratio > 4 and PSV >300 cm/s

PSV, Peak systolic velocity.

Table 18 Interpretation criteria for arterial stenosis after percutaneous revascularization

- PSV >180 cm/s
- PSV ratios >2 indicate significant stenosis
- Changes in waveform shape and velocity measurements on serial examinations warrant close interval follow-up

PSV, Peak systolic velocity.
CHANGE HISTORY:

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<td>6/9/2016</td>
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<tr>
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<td>David Fetzer, MD, Director</td>
<td>6/20/2016</td>
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<td>Eddie Hyatt</td>
<td>12-15-2018</td>
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<td>Revisions</td>
<td>Monica Morgan, RDMS, RVT, Ultrasound Technical Supervisor</td>
<td>6/21/2020</td>
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