Ultrasound – Arterial Duplex, Upper Extremity

PURPOSE:

Duplex examinations are performed to provide evaluation of the upper extremity arteries to assess areas of stenosis, 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 (claudication), rest pain, ulceration, gangrene, digit and upper extremity discoloration or cold sensitivity
- Assessment of patients with documented arterial disease and/or wound healing potential
- 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
- 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.
- Note on tech report if there is a high bifurcation of the radial and ulnar arteries.
- 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:

- Long axis gray scale and color Doppler images must be obtained from:
    - Subclavian Artery
    - Axillary Artery
    - Brachial Artery
    - Radial Artery
    - Ulnar Artery
    - Innominate (when appropriate)
    - Bypass grafts when present, including anastomoses
    - Stents when present, including proximal and distal ends

- Spectral Doppler waveforms and velocity measurements must be documented from:
    - Subclavian Artery (proximal and distal)
    - Axillary Artery
    - Brachial Artery (proximal, mid, distal)
    - Radial Artery (distal) – If distal waveform abnormal, include proximal and mid Doppler
    - Ulnar Artery (distal) – If distal waveform abnormal, include proximal and mid Doppler
    - Innominate (when appropriate)
    - Bypass grafts when present, including anastomoses
    - Stents when present, including native artery at proximal and distal stent ends, and proximal, mid, and distal stent

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

Anatomy	*Grey Scale	*Color Doppler	*Waveform	*PSV	EDV
Subclavian artery (proximal & distal)	x	x	x	x	
Axillary artery	x	x	x	x	
Brachial artery (proximal, mid, distal)	x	x	x	x	
Radial artery distal	x	x	x	x	
Ulnar artery distal	x	x	x	x	
*Image in longitudinal view					
PSV = peak systolic velocity EDV = end diastolic velocity					

- **DATA PAGE(S)**

PROCESSING:

- Review examination images and data
- Export all images to Sectra
- UTSW: Confirm data in Imorgon and complete Imorgon worksheet
- Document relevant history and any study limitations

REFERENCES:

http://www.asecho.org/wordpress/wp-content/uploads/2013/05/Noninvasive-Vascular-Lab-Testing.pdf

APPENDIX:

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Table 15 Diagnostic criteria for peripheral arterial diameter reduction

	Diameter reduction	Waveform	Spectral broadening	PSV distal/PSV proximal
Normal	0	Triphasic	Absent	+++ No change
Mild	1%-19%	Triphasic	Present	< 2:1
Moderate	20%-49%	Biphasic	Present	< 2:1
Severe	50%-99%	Monophasic	Present	> 2:1*

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:

STATUS	NAME & TITLE	DATE	BRIEF SUMMARY
Submission	Mark Reddick, MD	**6/9/2016**	Submitted
Approval	David Fetzer, MD, Director	**6/20/2016**	Approved
Review	Eddie Hyatt	12-15-2018	Reviewed
Revisions	Monica Morgan, RDMS, RVT, Ultrasound Technical Supervisor	**6/21/2020**	Revised
Revisions	Thoa Bui, RDMS, RVT, R.T.(S)(ARRT)	**10/17/2024**	Revised/Updated