

Ultrasound – Lower Extremity Arterial Evaluation: Duplex

PURPOSE:

Duplex examinations are performed to provide evaluation of the lower extremity arteries to assess for presence and location of, plaque morphology, and severity of stenosis.

SCOPE:

Applies to all ultrasound lower extremity arterial Duplex studies performed in:

- UT Southwestern Zale-Lipsky 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:

- Claudication
- Rest Pain
- Follow-up of known stenosis
- Ulceration
- Post-op or post-intervention
- Trauma

RELATIVE CONTRAINDICATIONS:

- Patients with ulcers, casts or bandages [relative, as open areas could still be examined]
- Obesity [relative and is dependent on image quality]
- 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.
- Curvilinear transducer may be appropriate for deep vessels and in obese patients

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 and documentation for assessment of peripheral vascular interventions (e.g., stents, presence of hemodialysis fistulae, ECMO catheters, LVADs), must be described.

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 must 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:

- Long axis grayscale and Color Doppler images must be obtained from:
 - Common Femoral Artery (CFA)
 - Profunda Femoris Artery (PFA)
 - Superficial Femoral Artery (SFA)
 - Popliteal Artery
 - PTA (dist)
 - Peroneal (dist)
 - Aorta, common and external iliac arteries and tibial arteries 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:
 - CFA
 - PFA
 - SFA (proximal, mid, distal)
 - Popliteal Artery
 - Posterior Tibial Artery (PTA) (distal) – If distal waveform abnormal, include prox and mid Doppler
 - Anterior Tibial Artery (ATA) (distal) – If distal waveform abnormal, include prox and mid Doppler
 - Dorsalis Pedis Artery (DPA)
 - Peroneal Artery (distal) – If distal waveform abnormal, include prox and mid Doppler
 - Aorta, common and external iliac arteries when appropriate
 - Bypass grafts when present, including anastomoses
 - Stents when present, including proximal and distal ends, and proximal, mid, and distal stent
- If you identify a stenosis (obvious narrowing on grayscale, PSV > 180 cm/sec, focal spectral broadening/turbulent flow), you will need to document the following:
 - At the site of stenosis and at a site 2 cm proximal to the stenosis (or relatively normal segment of proximal vessel)
 - Grayscale lumen diameter
 - Doppler waveform
 - Peak Systolic Velocity (PSV)

Anatomy	*Grey Scale	*Color Doppler	*Waveform	*PSV	EDV
Common femoral artery	x	x	x	x	
Profunda femoris artery (prox)	x	x	x	x	

Superficial femoral artery (proximal, mid, distal)	x	x	x	x	
Popliteal artery	x	x	x	x	
Posterior tibial artery distal	x	x	x	x	
Peroneal artery distal	x	x	x	x	
Anterior tibial artery distal	x	x	x	x	
Dorsalis pedis artery	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 iMorgan
- Document relevant history and any study limitations

REFERENCES: <https://accreditationsupport.acr.org/support/solutions/articles/11000084118-exam-requirements-vascular-ultrasound-revised-8-23-2024->
https://www.intersocietal.org/vascular/standards/html/2018/b_3.htm
<http://www.asecho.org/wordpress/wp-content/uploads/2013/05/Noninvasive-Vascular-Lab-Testing.pdf>

APPENDIX:

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)	03/31/2025	Revised; approved by Dr. De Silva & Dr. Kalva 04/03
	Skye Smola, RDMS, RVT	5/27/2025	Removed multi-level Pop Art eval, only single level needed; approved by Dr. da Silva