

Vascular Lab and other imaging

If you have any questions or special requests, please contact Deb Hand in vascular lab directly by phone x26631 or email, dhand@bwh.harvard.edu.

PVR/SDP/ABI: also known as Pulse Volume Recording/ Segmental Doppler Pressures. These tests also come with multiple level ABI's when ordered via EPIC

EPIC order: US Lower Extremity Arteries Physio (bilateral) Please note that this test is not be ordered unilaterally

Please give correct indication: (pick from the following)

- Claudication
- Rest Pain
- Dependent Rubor
- Ulceration
- Gangrene

DO NOT order "ABI" via EPIC (this is an order for the floor nurse to perform these tests at the bedside, not in vascular lab)

Interpretation:

ABI .9-1 normal

ABI 0.6-0.9 claudication

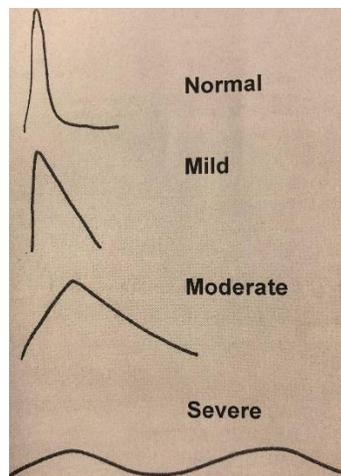
ABI: 0.4-0.6 rest pain

ABI: <0.4 tissue loss

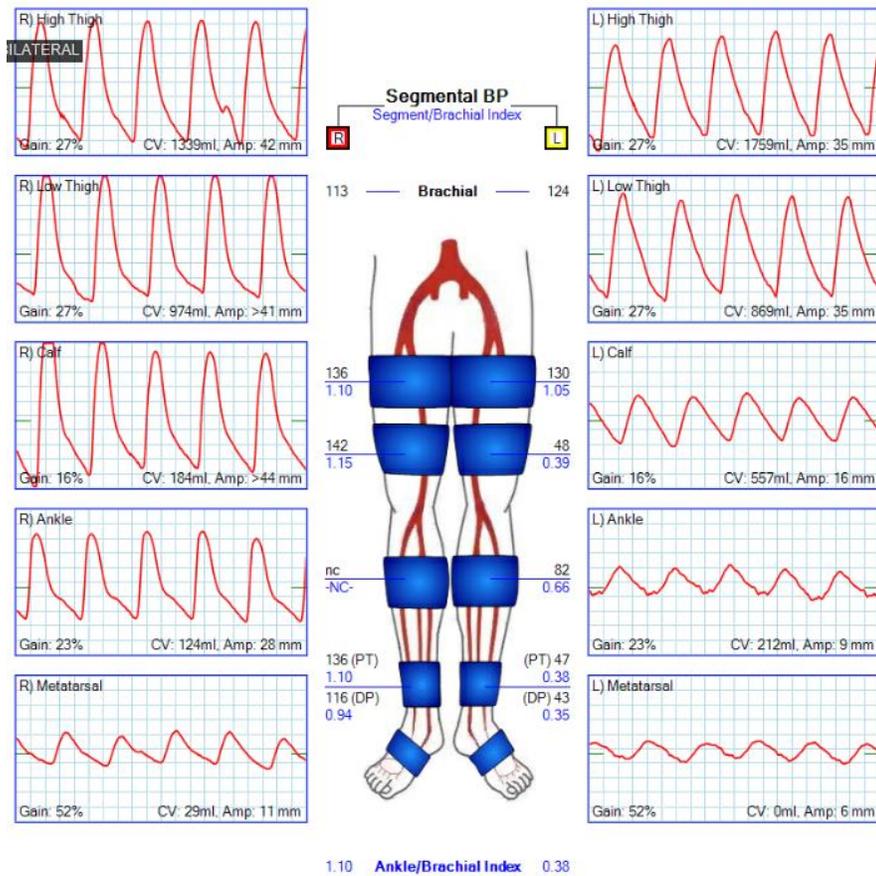
ABI:>1.3 indicates that the tibial vessels are so severely calcified that they cannot be compressed to calculate an ABI. You will see this pattern of disease typically in diabetic patients. You may order a TBI (toe brachial index) to get an idea of distal perfusion (toe vessels usually spared). You can order a TBI by placing request in the comments section of the ABI order. TBI of at least 0.3 is required to heal an amputation at the toe level

OR

You can look at the actual waveforms and assess their quality to determine severity of PAD.



PVR/SDP



PVR/SDP will give you an idea of the level of the arterial stenosis or occlusion. Here is an example of the 4 cuff technique.

If the systolic blood pressure can be determined accurately, a difference of 20 mm or greater between segments indicates stenosis.

High thigh pressure less than highest arm pressure is consistent with iliofemoral stenosis.

If both high thigh pressures are less than highest arm pressure it can also signify distal aortic stenosis.

If the leg arm ratio is greater than 1.3, the systolic pressure in the leg is likely artefactually elevated by vascular calcification artifact.

Arm pressures should not differ by 20 mm or more. A difference suggests brachiocephalic, subclavian or axillary stenosis on the side of the lower arm pressure.

Lower Extremity Non compressible: proximal cal
SDP PVR Right

PULSE VOLUME RECORDING
 Proximal thigh: normal
 Distal thigh: normal
 Proximal calf: normal
 Ankle: normal
 Metatarsal: normal

Lower Extremity PULSE VOLUME RECORDING
SDP PVR Left

Proximal thigh: diminished
 Distal thigh: diminished
 Proximal calf: diminished
 Ankle: diminished
 Metatarsal: diminished

Right Pressures

Arm	113 mmHg
Prox Thigh	113 mmHg
Prox Thigh Index	0.91
Dist Thigh	142 mmHg
Dist Thigh Index	1.15
Posterior Tibial	136 mmHg
Posterior Tibial Index	1.1
Dorsalis Pedis	116 mmHg
Dorsalis Pedis Index	0.94

Left Pressures

Arm	124 mmHg
Prox Thigh	130 mmHg
Prox Thigh Index	1.05
Dist Thigh	48 mmHg
Dist Thigh Index	0.39
Prox Calf	82 mmHg
Prox Calf Index	0.66
Posterior Tibial	47 mmHg
Posterior Tibial Index	0.38
Dorsalis Pedis	43 mmHg
Dorsalis Pedis Index	0.35

An ABI is calculated by dividing the highest ankle pressure from each limb by the highest brachial pressure. In the above example:

Right ABI: $136 \text{ mmHg} / 124 \text{ mmHg} = 1.1$

Left ABI: $47 \text{ mmHg} / 124 \text{ mmHg} = 0.38$

Graft/Stent Duplex: to check the patency of LE graft or stent, you will also get single level ABI's Arterial duplex check for the presence of intimal hyperplasia which can occur between 3-18 months post intervention.

EPIC order: US Lower Extremity Graft Scan – may be ordered bilateral or unilateral

Interpretation: Look for velocities jump from low to high of at least 3:1 or 4:1 which indicates a stenosis of graft or stent.

There is no evidence of stenosis within the graft if velocities are above 40 cm/sec and do not double during the length of the graft. Velocities less than 40 cm/sec are associated with an increased likelihood of graft failure. Velocities are compared from proximal to distal along the length of the graft. A doubling of the peak systolic velocity indicates 50% stenosis, tripling indicates 50 to 75% stenosis and quadrupling equals greater than 75% stenosis. At the distal anastomosis, the velocity must triple before distal anastomosis stenosis can be diagnosed. Velocities less than 125 cm/ sec in the proximal and distal native vessels are considered normal.

Example normal stent velocities (cm/sec)

104 Proximal stent (SFA-origin)
124 Proximal Stent-proximal thigh
104 Stent-prox./mid-thigh
84 Stent-mid thigh
73 Stent-mid/distal thigh
53 Stent-distal thigh
79 Distal to stent/distal thigh

Example of in-stent stenosis velocities (cm/sec)

(Distal SFA-above graft-stent)
*28 Proximal stent
*444 Mid stent (String Sign with very tight lumen)
*434 Distal stent (String Sign with very tight lumen)

PSA studies: A pseudoaneurysm is a break between the two outer layers of the arterial wall, the media and adventitia which results in extravasations of blood, which is then ‘supported’ by the surrounding soft tissues. This is present when an extravascular collection of blood with Doppler evidence of flow is present. The neck is the connection between the native artery and the extravasated blood. The neck is identified by a “to and fro” pattern of the Doppler waveform that is pathognomonic for pseudoaneurysm.

EPIC order: Lower extremity arterial duplex, in comments section “assess for PSA”

Please give correct indication: (pick from the following):

- pulsatile mass
- hematoma
- swelling
- pain

Carotid Arterial Duplex:

EPIC order: carotid US duplex bilateral

Interpretation:

		Primary criteria	Secondary criteria	Additional criteria
% Stenosis	Plaque present?	Peak Systolic Velocity (cm/sec)	End Diastolic Velocity (cm/sec)	ICA/CCA PSV Ratio
0	No	<150		
1-49	Yes	<150		
50-69		<u>150-249</u>		
70-89		≥250	<135	4.0-4.9
90-99		≥250	≥135	≥5.0
100		No flow. Reverse flow proximal to occlusion		

Interpreting ICA Stenosis Severity:

Peak systolic velocity (PSV) is the most important criterion.
End diastolic velocity (EDV) is only useful when the ICA PSV is ≥ 250 .

Common Carotid Artery Stenosis:

2x increase in Peak Systolic Velocity from the lowest to highest equates to $\geq 50\%$ stenosis. 3x increase in Peak Systolic Velocity from the lowest to highest equates to $\geq 75\%$ stenosis.

External Carotid Artery Stenosis:

A Peak Systolic Velocity of ≥ 200 cm/sec equates to $\geq 50\%$ stenosis.

Vertebral Artery Stenosis:

A Peak Systolic Velocity of ≥ 100 cm/sec equates to $\geq 50\%$ stenosis.

Right Peak Systolic Velocities

Prox CCA	89 cm/sec
Mid CCA	70 cm/sec
Dist CCA	40 cm/sec
Prox ICA	317 cm/sec
Mid ICA	108 cm/sec
Dist ICA	72 cm/sec
ECA	76 cm/sec



Left Peak Systolic Velocities

Prox CCA	104 cm/sec
Mid CCA	86 cm/sec
Dist CCA	55 cm/sec
Prox ICA	54 cm/sec
Mid ICA	69 cm/sec
Dist ICA	108 cm/sec
ECA	58 cm/sec

Interpretation Summary

There is 70-89% right internal carotid artery stenosis.
No evidence of 50% or greater stenosis in the left internal carotid artery.
Vertebral artery flow is antegrade (normal) bilaterally.

LE Venous Duplex: evaluation for DVT

EPIC order: US Lower extremity veins duplex

Please give correct indication: (pick from the following):

- pain
- swelling
- SOB

Vein Mapping: used to establish conduit for planned bypass procedure. Always order LE first then UE. Please give information in the comments section regarding previous vein harvest so technologist in vascular lab does not search for veins which no longer exist.

EPIC order: US Lower Extremity Vein Mapping – may be ordered bilateral or unilateral
US Upper Extremity Vein Mapping

if UE veins are being considered for conduit, please instruct nursing do NOT allow PIV nor blood draws from the arm. You may draw labs or establish PIV's in the hand. UE veins should not be harvested in patients with ESRD.

Interpretation: vein diameter of at least 2-3cm and suitable length for bypass required in order to use vein for conduit

Vein preference:

- contralateral GSV or SSV
- ipsilateral GSV or SSV
- Cephalic vein
- Basilic vein

Other Imaging

MRA: non-invasive means to look at arterial supply

Limitations: stents will appear black on imaging, any patient with GFR<30 is at high risk for systemic, nephrogenic fibrosis (NSF) which irreversible adverse reaction to the dye used for MRA.

EPIC order: MRAAbd/Pelvis w/Femoral Runoff

CTA: non-invasive means to look at arterial supply

Limitations: CKD, can cause AKI or worsening of CKD. AKI can be avoided with appropriate fluid pre and post CTA. CTA not optimal study to visualize the arteries below the knee especially if they are heavily calcified.

EPIC order: CT Angio Abdominal Aorta and Bilateral Lower Extremity Runoff (CTAAA)

Angiogram: gold standard for visualizes arterial supply

Please reference cath lab how to for further instructions on ordering this procedure