Vascular Interpretation Criteria

AAA Study

- Ectasia – Dilated vessel whose diameter is enlarged, but not sufficiently large enough to classify it as an aneurysm
- Aortic ectasia is a dilatation of less than 1.5x the suprarenal size and less than 3.0 cm (Typically ectasia is 2.5 cm – 3.0 cm)
- Aortic aneurysm is dilatation of the artery of 1.5x the suprarenal size or greater than 3.0 cm.
- Iliac Ectasia is dilatation of 1.5-1.9 cm
- Iliac Aneurysm is dilatation of 2.0 cm or greater
- Aneurysm Shape
    - Fusiform – Circumferential involvement
    - Saccular – Only a portion of the wall is involved. Bag-like protrusion with a channel or opening connecting the aorta to the sac.
    - Bilobed – "Dumbbell" shaped.

Peripheral Arteries and Bypass Grafts

Peripheral Arterial STENOSIS CRITERIA

Category	Peak Systolic Velocity	Velocity Ratio
<50%	<200 cm/sec	<2.0
50-75%	200-400 cm/sec	>2.0 and <4.0
75-99%	>400 cm/sec	>4.0
Near Occlusion	Trickle Flow	
Occlusion	No Flow	0

Peripheral Arterial Aneurysm Criteria

1. Ectasia – Dilatation of the artery measuring < 2 cm or less than 2x normal segment
2. Aneurysm – Dilatation of artery >2 cm or 2x size of normal segment
3. Pseudoaneurysm – Anastamotic or iatrogenic, which does not involve all 3 layers of artery wall. Visible intraluminal swirling/whirlwind with color flow. Visible jet, tract, communication or neck to native artery. If thrombosed may have the appearance of a hematoma.
4. Thrombus may or may not be present
5. Note any compression of adjacent structures, patency of vessel, intimal flap, dissection or AVF

Bypass Graft STENOSIS CRITERIA

Category	Peak Systolic Velocity	Velocity Ratio
<50%	<200 cm/sec	<2.0
50-75%	200-400 cm/sec	>2.0 and <4.0
75-99%	>400 cm/sec	>4.0
Near Occlusion	Trickle Flow	
Occlusion	No Flow	0

Carotid Artery Doppler

DOPPLER SPECTRAL ANALYSIS

	ICA PSV	ICA EDV	ICA/CCA PSV Ratio	Plaque
Normal	<180 cm/s	<40 cm/s	<2.0	none
<50%	<180 cm/s	<40 cm/s	<2.0	<50% diameter reduction
50-69%	180-230 cm/s	40-100 cm/s	2.0-4.0	≥50% diameter reduction
≥70%-near occlusion	>230 cm/s	>100 cm/s	>4.0	≥50% diameter reduction
Near occlusion	low or not detectable	variable	variable	visible
Total occlusion	not detectable	n/a	n/a	visible, no lumen

WNL may be used for post endarterectomy studies and/or studies in young patients with normal Doppler analysis and no intimal thickening or plaque visualized. In general normal is rarely used and patients are classified as Less than 50% stenosis with no plaque visualized.

Secondary Abnormal Criteria

ICA

1. Turbulence and spectral broadening will occur with stenosis.
2. Very low amplitude and high resistant signal can be seen with severe intracranial internal carotid artery disease.
3. Elevated velocities in a normal ICA can be seen with contralateral ICA occlusion. Entire contralateral carotid system will have elevated velocities.
4. Low amplitude or poor quality ICA and/or CCA signal can be seen in an ipsilateral proximal high grade stenosis making it difficult to accurately assess ICA stenosis by velocity criteria. Estimates may be taken in gray scale using diameter reduction, but are not considered accurate.
5. Abnormal color flow pattern or no color flow
6. Plaque seen in gray scale

ECA

- Velocity and ratio criteria have not been established for ECA stenosis.
- ECA stenosis is identified by focal increase in velocity with post stenotic turbulence and is stated as stenosis noted without assigning a stenosis category
- Normally an ECA waveform is high resistant, but may become low resistant when ECA becomes a collateral for ICA occlusion
- No Doppler signal
- Abnormal color flow pattern or no color flow
- Plaque seen by gray scale
- Edit 3-26-2026: There are Many Proposed Criteria. I use PSV > or = 200 cm/sec combined with Color Aliasing for >50% ECA stenosis. Reference: Kronick M. Development of Duplex Ultrasound Criteria for External Carotid Artery Stenosis. Strandness Symposium.

CCA

- CCA stenosis is identified by focal velocity increase with post stenotic turbulence. CCA stenosis may be classified as less than 50% stenosis if CCA/CCA ratio (proximal segment to stenotic segment) is less than 2.0 and greater than 50% stenosis if CCA/CCA ratio is greater than 2.0.
- Dampened, low amplitude waveform with lower diastolic component indicates proximal disease. Compare right to left. If both sides are significantly dampened bilateral proximal disease vs. low cardiac output may not be distinguishable.
- No Doppler signal
- Abnormal color flow pattern or no color flow
- Plaque seen in gray scale

SUBCLAVIAN

1. Monophasic signal indicates proximal or distal disease

2. Subclavian stenosis is identified by focal velocity increase with post stenotic waveform. PSV over 400 cm/s is suggestive of stenosis greater than 75%.
3. Low resistant waveform pattern
4. Significant differences in velocities from right to left
5. No Doppler signal
6. Abnormal color flow pattern or no color flow
7. Plaque seen in gray scale
8. Edit 10-1-2026: our lab policy is to state “elevated subclavian artery velocity” if greater than 200 cm/sec. … there are multiple papers about this. For example: 200 - 305 cm per second for 50-69% stenosis; >305 cm/sec for >70% stenosis. Reference: Zhang L, Dong Y, Wang J, et al. Color Duplex Ultrasonography for the Evaluation of Innominate, Subclavian, and Common Carotid Artery Stenosis. *J Ultrasound Med*. 2024;43(5):829-839. doi:10.1002/jum.16492

9. I personally use 2024 ESC Guideline for Peripheral Arterial and Aortic Diseases: greater than 230 for Moderate 50-69%, greater than 340 for severe 70% or greater. That guideline also incorporates a peak velocity ratio, which our lab does not do (2.2 cutoff for moderate, 3.0 cutoff for severe)

VERTEBRAL

- Retrograde flow with asymmetrical brachial systolic pressures indicates subclavian steal
- A stenosis is identified by focal velocity increase with post stenotic turbulence, and occurs most frequently at origin
- Multiphasic (to and fro) signal indicates an incomplete subclavian steal
- The vertebral artery has a low resistant waveform pattern. No diastolic flow indicates distal resistance, which may be from distal occlusion or tissue necrosis.
- No Doppler signal
- Abnormal color flow pattern or no color flow
- Plaque seen in gray scale

Mesenteric Artery Study

Primary Doppler Criteria:

Hemodynamic Stenosis (>50%)

- Sharp increase in PSV and EDV
- Increased spectral broadening
- Post-stenotic turbulence
- Diastolic reversal in fasting SMA and IMA disappears

Celiac Artery

- >70% Diameter Reduction = PSV >200 cm/s with post-stenotic turbulence
- Low resistant signal (also seen in HA and SA)
- A compressed CA by the median arcuate ligament may cause elevated PSV in the absence of stenosis. This tends to fluctuate with respirations. Velocities will normalize with deep inspiration.

Superior Mesenteric Artery

- >70% Diameter Reduction = PSV >275 cm/s with post-stenotic turbulence
- Normal high resistant signal in fasting state

Post Prandial

- Dramatic change to low resistant signal. The SMA EDV should double within 30 minutes with maximal increase at 40 minutes.
- SMA PSV and EDV will increase
- The CA does not vary significantly
- IMA does not vary significantly

Renal Artery Doppler Study

Renal Artery Doppler

Primary Doppler Criteria:

RENAL DISEASE CATEGORIES & DOPPLER VELOCITY CRITERIA

	PSV cm/s	Post stenotic turbulence	Renal/Aorta Ratio
Normal	<180	Absent	<3.5
<60%	>180	Present	<3.5
>60%	>180	Present	>3.5
Occluded	0	**Kidney length is typically less than 9 cm**	

Some errors can be made in the interpretation of the renal/aortic ratio. If the aortic flow is too low or too high, disease within the renal artery may be misclassified. The RAR should not be used if aortic PSV is less than 40 cm/s or greater than 100 cm/s. Disease is then classified by whether a focal velocity increase is found with post stenotic turbulence.

Some patients may have PSV's exceeding 180 cm/s without post stenotic turbulence; this velocity maybe normal for this patient. The PSV's for the CA and SMA will also be equally elevated.

Secondary Abnormal Criteria

KIDNEY

- The average normal Pole to Pole length of the kidney is 9-12 cm. A kidney larger than 12 cm is expected in a tall, large framed individual. A kidney length of less than 9 cm should be stated on the report and may indicate atrophy. The length of the right and left kidneys are usually within one centimeter of one another.
- The parenchymal signals normally are low resistance. Increased renovascular resistance is identified by loss or reduction of diastolic flow and suggests that there may be intrinsic kidney disease. The diastolic ratio or 1-RI should be greater than 0.30 in a normal kidney. If the resistance is 0.20 – 0.30 it is consistent with borderline increase in renovascular resistance. If the resistance is equal to or less than 0.20 it is consistent with increased renovascular resistance.
- Edit 3-26-2026: The Resistive Index is (PSV - EDV) / PSV. Most literature I have seen uses Resistive Index rather than 1 - Resistive Index. So Normal would be less than 0.70. Abnormal is > 0.80

ABI:

2024 ACC PAD Guideline:

Less than or equal to 0.90 = abnormal

0.70 - 0.90 Mild PAD

0.40-0.69 Moderate

Less than 0.40 Severe

Greater than 1.40 noncompressible / calcified vessels

1.00-1.40 is normal