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# Carotid Duplex

Molly Zaccardi RVT, MHA

D.E. Strandness Vascular Laboratory  
Technical Director

# Strandness Criteria

DIAMETER REDUCTION (ICA STENOSIS)	INTERNAL CAROTID ARTERY VELOCITIES AND DOPPLER WAVEFORM FEATURES	B-MODE IMAGE FINDINGS
0% (Normal)	PSV <125 cm/sec No spectral broadening (large systolic “window” present) Flow separation present in the bulb (proximal ICA)	No evidence of wall thickening or plaque
1-15%	PSV <125 cm/sec Minimal spectral broadening	Wall thickening or minimal plaque
16-49%	PSV <125 cm/sec Marked spectral broadening (throughout systole)	Plaque visualized
50-79%	PSV ≥125 cm/sec End diastolic velocity <140 cm/sec Marked spectral broadening	Plaque visualized
80-99%	PSV ≥125 cm/sec End diastolic velocity ≥140 cm/sec Marked spectral broadening	Plaque visualized
Total Occlusion (100%)	<b>No detectable Doppler flow in the ipsilateral ICA</b> <b>High resistance flow in the ipsilateral common carotid artery (compared to contralateral common carotid artery)</b> <b>ECA clearly identified</b>	Plaque visualized



# NASCET Criteria

Diameter Reduction (ICA Stenosis)	ICA Velocities and Doppler Waveform Features	B-mode Image Findings
<70%	ICA/CCA ratio <4.0 (or PSV <230 cm/sec if ratio not valid)	Plaque may be visualized
≥70%	ICA/CCA ratio ≥4.0 (or PSV ≥230 cm/sec if ratio not valid)	Plaque visualized

# Plaque Description

Focal	or	Diffuse
Smooth	or	Irregular
Homogeneous	or	Heterogeneous (Mixed Echogenicity)
Hypochoic (Sonolucent)	or	Hyperechoic
Calcified	or	Non-calcified



# Common Carotid Artery

Diameter Reduction	PSV or PSV Ratio	B-mode Image Findings
Normal	PSV $< \approx 125$	No evidence of wall thickening or plaque
$< 50\%$	PSV Ratio $< 2.0$ or PSV $< \approx 250$ cm/sec	Wall thickening or minimal plaque
$\geq 50\%$	PSV Ratio $\geq 2.0$ or PSV $\geq \approx 250$ cm/sec	Extensive plaque visualized
Total Occlusion	No detectable Doppler flow in the CCA	Plaque visualized



## External Carotid Artery

Diameter Reduction	PSV	B-mode Image Findings
Normal	$<\approx 150$ cm/sec	No evidence of wall thickening or plaque
$<50\%$	$\approx 150 - 200$ cm/sec	Wall thickening or minimal plaque
$\geq 50\%$	$\geq \approx 200$ cm/sec	Extensive plaque visualized
Total Occlusion	No detectable Doppler flow in the ECA ICA clearly identified	Plaque visualized



## Subclavian Artery

Diameter Reduction	Velocities and Doppler Waveform Features	B-mode Image and Other Findings
Normal	PSV $< \approx 200$ cm/sec Multiphasic flow pattern	Brachial systolic pressure gradient $< 15$ mmHg
$< 50\%$	PSV $< \approx 200$ cm/sec Monophasic flow pattern Post-stenotic turbulence	Wall thickening or minimal plaque Brachial systolic pressure gradient $< 15$ mmHg
$\geq 50\%$	PSV $\geq \approx 200$ cm/sec Monophasic dampened flow pattern Post-stenotic turbulence	Plaque visualized Brachial systolic pressure gradient $\geq 15$ mmHg
Total Occlusion	No detectable Doppler flow in the subclavian artery	Plaque visualized



## Vertebral Artery

Diameter Reduction	PSV and Doppler Waveform Features	B-mode Image Findings
Normal	PSV $< \approx 100$ cm/sec Antegrade flow direction Low resistance flow pattern Uniform velocities throughout the vessel segments evaluated	No evidence of wall thickening or plaque
<50%	Focal velocity increase with PSV $\approx 100-200$ cm/sec Antegrade flow direction Low resistance flow pattern	Wall thickening or minimal plaque
$\geq 50\%$ or other Abnormal Findings	Focal velocity increase with PSV $\geq \approx 200$ cm/sec and a post-stenotic flow pattern Retrograde flow direction (subclavian steal) or a “hesitant” or “to and fro” flow pattern (latent subclavian steal) High resistance flow pattern (distal obstruction)	Extensive plaque visualized
Total Occlusion	No detectable Doppler flow in the vertebral artery Adjacent vertebral vein clearly identified	Plaque visualized



## Follow-up After Internal Carotid Endarterectomy and Stenting Velocity and Stenosis Categories

Diameter Reduction (ICA Stenosis)	Internal Carotid Artery Velocities and Doppler Waveform Features	B-mode Image Findings
≥70%	PSV ≥300 cm/sec	Evidence of wall thickening, intimal hyperplasia or plaque





## B-Mode Optimization

Control	Description
Depth	Center the region of interest
Zoom	Enlarge ROI
Focus	Set just below ROI
Gain	Overgain....decrease until vessel is anechoic, bone is hyperechoic, tissue is hypoechoic
TGC	Amplify gain at selected depths with Time Gain Compensation
Penetration/ Resolution	Optimize balance and decrease sector to increase frame rate
Harmonics	Enhance borders



## Color Doppler Optimization

Control	Description
Gain	Adjust to fill the vessel
Color Velocity Scale	Set mean velocities at approximately $\frac{1}{2}$ of the typical peak systolic Doppler velocity for vessel (color changes will alert for high velocities and turbulence)
Color Box	Steer / angle box to vessel wall (linear transducer only) Decrease size to increase frame rate and line density
Wall filter	Keep low for low flow Increase only if necessary such as cardiac or respiratory movement causing color flash.



## Pulse Doppler Optimization

Control	Description
Gain	Decrease until noise outside the waveform envelope is eliminated
Sample Volume Size	Decrease for midstream sample Increase if tissue movement and unable to collect series of waveforms
Spectral Waveforms	Raise baseline to display venous flow below the baseline
Angle of Insonance	Angle to vessel wall at 60 degrees or less
Peak Velocity Scale	Increase scale to display the systolic peak
Wall Filter	Decrease for low flow, venous examinations, string sign etc. Increase if wall motion present



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**EXAMINATION:**

**CAROTID ARTERY DUPLEX**

Arterial duplex examination performed using B-mode, color flow, and Doppler spectral waveform assessment.

**INDICATION:**

This is a \_\_\_\_\_ year old \_\_\_\_\_ who presents with \_\_\_\_\_. A carotid duplex scan is requested.

**PREVIOUS EXAMINATIONS:**

None

**EQUIPMENT:**

**FINDINGS:**

-----RIGHT-----LEFT  
Brachial Systolic Blood Pressures- \_\_\_\_\_ mmHg----- \_\_\_\_\_ mmHg

**CAROTID ARTERY DUPLEX**

-----RIGHT-----LEFT  
Common Carotid Artery Proximal---- \_\_\_\_\_ cm/s---- \_\_\_\_\_ cm/s  
Common Carotid Artery Mid----- \_\_\_\_\_ cm/s---- \_\_\_\_\_ cm/s  
Common Carotid Artery Distal----- \_\_\_\_\_ cm/s---- \_\_\_\_\_ cm/s  
Plaque/Calcification-----N-----N

Internal Carotid Artery Proximal-- / \_\_\_\_\_ cm/s---- / \_\_\_\_\_ cm/s  
Internal Carotid Artery Mid----- / \_\_\_\_\_ cm/s---- / \_\_\_\_\_ cm/s  
Internal Carotid Artery Distal---- / \_\_\_\_\_ cm/s---- / \_\_\_\_\_ cm/s  
Carotid Bulb Flow Separation-----Y-----Y  
Plaque/Calcification-----N-----N  
ICA/CCA Ratio----- \_\_\_\_\_

External Carotid Artery----- \_\_\_\_\_ cm/s---- \_\_\_\_\_ cm/s  
Plaque/Calcification-----N-----N

Vertebral Artery----- \_\_\_\_\_ cm/s---- \_\_\_\_\_ cm/s  
Waveform-----antegrade----antegrade

Subclavian Artery----- \_\_\_\_\_ cm/s---- \_\_\_\_\_ cm/s  
Plaque/Calcification-----N-----N

Comments: Y=Yes, N=No

The diagnostic criteria used to interpret this carotid duplex examination include parameters that compare the site of stenosis to the normal distal internal carotid artery diameter, as described in the NASCET study.

\_\_\_\_\_ was contacted today at \_\_\_\_\_ and the preliminary results of this examination were discussed.

**PRELIMINARY TECHNOLOGIST IMPRESSION:**

**RIGHT CAROTID**

- 1-15% diameter reduction of the right internal carotid artery.
- Common carotid artery is normal.
- External carotid artery is normal.
- Vertebral artery has normal antegrade flow.
- Subclavian artery is normal.
- There is a XX mmHg brachial systolic pressure gradient (lower on the XX side).

**LEFT CAROTID**

- 1-15% diameter reduction of the left internal carotid artery.
- Common carotid artery is normal.
- External carotid artery is normal.
- Vertebral artery has normal antegrade flow.
- Subclavian artery is normal.
- There is a XX mmHg brachial systolic pressure gradient (lower on the XX side).



