

## ***GUNDERSEN/LUTHERAN ULTRASOUND DEPARTMENT POLICY AND PROCEDURE MANUAL***

---

SUBJECT: Carotid Duplex Ultrasound

SECTION: Vascular Ultrasound

ORIGINATOR: Deborah L. Richert, BSVT, RDMS, RVT

DATE: October 15, 2015

APPROVED BY:

\_\_\_\_\_  
Jody Riherd MD

\_\_\_\_\_  
Dave Clayton RDMS RVT

**Scheduling:** 45-minute time slot.

**Prep:** None.

**Patient Position:** Supine, with patient head slightly hyper extended and rotated away from the side being examined.

**Equipment:** Color duplex ultrasound unit with 9 MHz Linear transducer. \*\*\*Procedure should be performed at the lowest possible power settings.

**Purpose:**

1. Screening for atherosclerotic occlusive disease in patients with hemispheric symptoms.
2. Evaluation of carotid bruits.
3. Monitoring progression of known atherosclerotic disease.
4. Follow-up after endarterectomy.
5. Evaluation before major surgery.
6. Evaluation after retinal artery emboli.
7. Carotid dissection.

**Exam Protocol:** Bilateral carotid arteries are always imaged. The carotid ultrasound exam consists of three major components:

1. Grayscale imaging
2. Color / Power Doppler imaging
3. Spectral Doppler analysis

***Grayscale Imaging:***

**Transverse:** Good quality transverse images allow the evaluation of plaque size and luminal compromise. Imaging is begun in the transverse plane at the most proximal portion obtainable of the CCA. The transducer is then advanced cephalad to image the

CCA, bifurcation, ECA, and ICA. Any plaque identified should be evaluated for smoothness, homogeneity, and calcification.

**Longitudinal:** Longitudinal imaging allows the evaluation of plaque and tortuous vessels. In general, a posterior lateral approach, utilizing the sternocleidomastoid muscle as an acoustic window provides the sharpest images. An anterior or lateral approach should be evaluated to determine the optimal approach. Imaging is begun in the longitudinal plane at the most proximal portion obtainable of the CCA. The transducer is then advanced cephalad to image the CCA, bifurcation, ECA, and ICA. Any plaque identified should be evaluated for smoothness, homogeneity, and calcification.

***Color Doppler Imaging:***

Color Doppler imaging is used to determine normalcy, determine areas of stenosis, locate vertebral arteries, differentiate ICA/ECA, image distal ICA, image tortuous vessels, presence of hypoechoic plaque, and occlusion. Color Doppler imaging is used in the longitudinal plane and each vessel is evaluated from proximal to distal. Transverse images in areas of stenosis may be helpful in evaluating luminal stenosis with eccentric plaque. Areas of narrowing, if necessary, may have transverse power angio images as follows: 1) before the maximum stenosis; 2) at the maximum stenosis; and 3) distal to the maximum stenosis where the vessel walls are parallel. The vertebral arteries are found coursing between the acoustic shadows produced by the cervical transverse processes.

***Spectral Doppler Analysis:***

Spectral Doppler analysis is used to evaluate waveforms and quantify the velocities in the carotid and vertebral arteries. Spectral Doppler is obtained in the longitudinal plane. The sample gate must be adjusted parallel to the vessel wall (NOT the flow jet), and the Doppler angle should be less than or equal to 60 degrees. Areas that have been identified by color Doppler as suspicious for stenosis are carefully evaluated with spectral Doppler to locate the area with the narrowest lumen or the highest velocity. Spectral readings should be obtained at the region of highest velocity and/or stenosis and just prior to and distal to the region. The peak systolic and peak end diastolic velocities are measured from the spectral waveform in each vessel. At a minimum, spectral Doppler readings should be obtained from the CCA, ECA, ICA (proximal, mid, and distal) and vertebral artery. Temporal taps may be performed on the ECA. The temporal artery is a branch of the ECA and tapping it will cause a reflected response on the ECA spectral analysis. If a temporal tap is performed on the ECA and a strong temporal tap is not seen on the ECA spectral analysis then a temporal tap may be performed on the ICA also. The ICA will not show a reflected response to temporal tapping. The ICA/CCA systolic ratio is measured from the highest peak systolic velocities obtained in the ICA and the peak systolic velocity obtained two to four cm from the distal end of the CCA.

**Consensus Panel Grayscale and Doppler US Criteria for Diagnosis of ICA Stenosis**  
(Society of Radiologists in Ultrasound Consensus Conference, 2003)

	<b><u>Primary Parameter</u></b>		<b><u>Additional Parameters</u></b>	
Degree of Stenosis %	ICA PSV, cm/s	Plaque Estimate %	ICA/CCA PSV Ratio	ICA EDV, cm/sec
Normal	<125	None	<2.0	<40
<50	<125	<50	<2.0	<40
50-69	125-230	≥50	2.0-4.0	40-100
≥ 70 but less than near occlusion	>230	>50	>4.0	>100
Near occlusion	High, low, or undetectable	Visible	Variable	Variable
Total occlusion	Undetectable	Visible, no detectable lumen	N/A	N/A

### **Imaging Protocol:**

- \*\*\* Additional images may be necessary to adequately demonstrate anatomy and pathology.
- \*\*\* Any areas of stenosis should have spectral readings obtained at the region of highest velocity and/or stenosis and just prior to and distal to the region.
- \*\*\*Image the RT side first, followed by the LT side.

### **Gray Scale**

- Transverse proximal CCA
- Transverse CCA
- Transverse ICA/ECA bifurcation
- Longitude proximal CCA
- Longitudinal CCA
- Longitudinal ECA
- Longitudinal ICA

### **Color / Power Images**

- Longitudinal Proximal CCA spectral Doppler with PSV/EDV measurement.
- Longitudinal distal CCA spectral Doppler with PSV/EDV measurement.
- Longitudinal proximal ECA spectral Doppler with PSV measurement and temporal taps (if necessary).
- Longitudinal proximal ICA spectral Doppler with PSV/EDV measurement and temporal taps only if necessary as described above.
- Longitudinal mid ICA spectral Doppler with PSV/EDV measurement.
- Longitudinal distal ICA spectral Doppler with PSV/EDV measurement.
- Longitudinal vertebral artery spectral Doppler with PSV measurement.

- Longitudinal ICA color or power Doppler image (whichever best demonstrates the vessel).
- Transverse power Doppler images of the bifurcation, proximal ICA, and mid ICA, with ICA labeled, as necessary for demonstration of plaque formation.

## **References:**

1. Zwiebel WJ (ed) Introduction to vascular Ultrasonography, 4th Ed WB Saunders 2000.
2. Bluth EI, Wetzner SM, Stavros AT, et al: Carotid duplex sonography: a multicenter recommendation for standardized imaging and Doppler criteria. Radiographics 8:487-506, 1988.
3. Gooding GAW: Carotid Ultrasound. The Radiologist Vol. 3, No. 1:27-36, 1996.
4. Erickson SJ, Mewissen MW, Foley WD, et al: Stenosis of the internal carotid artery: Assessment using color Doppler imaging compared with angiography. AJR 152:1299-1305, 1989.
5. Owen, C: Carotid Imaging. In Program Supplement US: the Basics in Vascular Ultrasound July 31 and August 19, 1997 pp 53-67. TIP-TV 1997, General Electric Company.
6. Grant, EG, Benson, CB, Moneta GL, et al. Carotid artery stenosis: gray-scale and Doppler US Diagnosis. Society of Radiologists in Ultrasound Consensus Conference. Radiology 2003; 229: 340-346.

# GUNDERSEN HEALTH

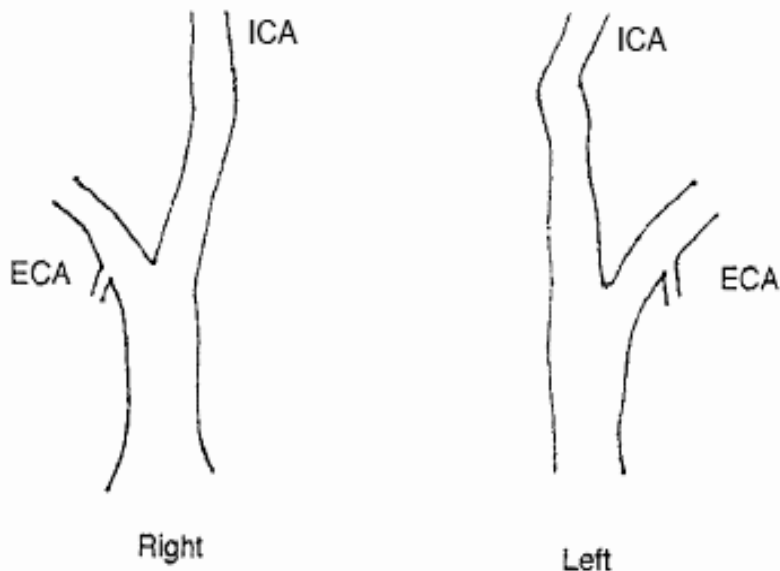
## Carotid Ultrasound Worksheet

Patient Name: \_\_\_\_\_ Exam Date: \_\_\_\_\_

Patient ID: \_\_\_\_\_ Indication: \_\_\_\_\_

Prior Carotid Surgery? Y N Date: \_\_\_\_\_ Side \_\_\_\_\_

Prior Carotid US? Y N Date: \_\_\_\_\_



CCA		Rt	Lt
PSV (cm/s)			
EDV (cm/s)			
ICA		Rt	Lt
PSV (cm/s)			
EDV (cm/s)			
PSV ratio			
PST* (Y/N)			
ECA		Rt	Lt
PSV (cm/s)			
Vertebral		Rt	Lt
Flow Direction		Antegrade Retrograde	Antegrade Retrograde

\* PST ( post stenotic turbulence )

Degree of Stenosis	ICA, PSV, cm/s (Primary Parameters)	ICA/CCA PSV Ratio	ICA EDV cm/s	Plaque Estimate % (Primary Parameters)
Normal	< 125	< 2	< 40	None
< 50	< 125	< 2.0	< 40	< 50
50-69	125-230	2.0-4.0	40-100	≥ 50
≥ 70 but less than Near occlusion	> 230	> 4.0	> 100	≥ 50
Near Occlusion	High, low or undetectable	Variable	Variable	Variable
Total Occlusion	Undetectable	Not applicable	Not applicable	Visible, no detectable lumen

Right	ICA % Diameter Stenosis	Plaque Morphology	Rt	Lt
	Impression	Homogeneous		
		Heterogeneous		
Left		Irregular		
		Smooth		
		Calcified		

Comments:

---



---



---



---

Sonographer: \_\_\_\_\_

Updated August 2019