

MESA Exam 5

Carotid Artery Intima-Media Thickness (IMT) and Distensibility Sonographer Manual (v2.0, 7-15-2010)

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1.0 Overview of Carotid Ultrasound imaging protocol

1.1 Protocol

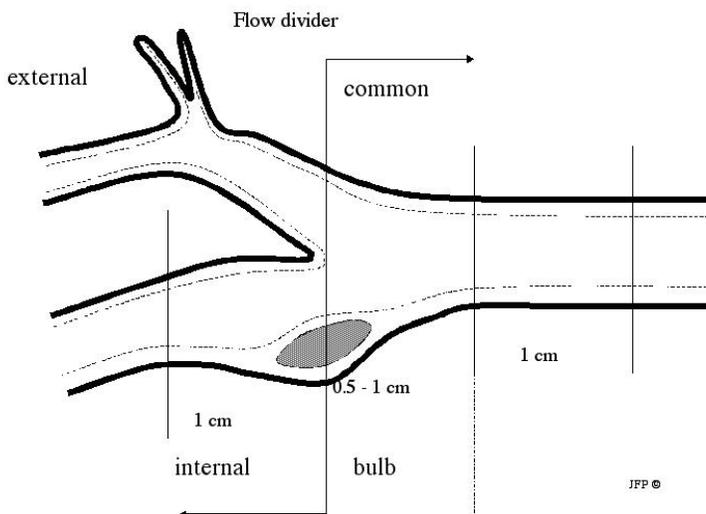
1.1.1 Carotid Anatomy and Definition of Terms

1.1.1.1 Carotid Arterial Segments – Overview

Proximal arterial segments are considered closer to the heart and distal segments are further away from the heart. For example, the distal common carotid artery (CCA) segment is the most distal portion of the carotid artery immediately proximal to the bulb dilatation. The carotid bulb is defined as the region between the distal CCA and the divider between the internal and external carotid arteries. It starts proximally when the distal CCA changes from a perfectly cylindrical segment to a more dilated and bulbous vessel. The opposing walls lose their parallel appearance. It is defined distally by the flow divider (bifurcation point) where the bulb bifurcates onto the internal (ICA) and external (ECA) carotid branches. In most cases the bulb segment is approximately 1 cm long. The proximal ICA is the first 1 cm of the internal carotid artery branch, immediately after the bifurcation point. The ICA generally is larger than the ECA, traverses more posteriorly, and does not have branches in the neck. The ICA flow is characterized by a low resistance pattern compared to the high resistance pattern in the ECA.

1.1.1.2 Carotid Arterial Segments – Anatomy

The right CCA originates from the innominate artery on the right and the left CCA originates directly from the aortic arch. Each CCA ascends in the neck, lateral to and posterior to the trachea. At the approximate level of thyroid cartilage, slightly below the angle of the mandible, the CCA bifurcates into the ICA and ECA. Proximal to the bifurcation, the CCA dilates to form the carotid bulb. The origin of the bulb can be recognized in most, though not all, subjects. The bulb is elliptically shaped and geometrically complex in the longitudinal view. The tip of the flow divider defines the bulb's upper limit. The tip of the flow divider also marks the origin of the ICA and ECA. The external carotid artery lies anterior and slightly medially to the internal carotid artery in 90% of individuals. In the remaining 10%, the orientation is reversed. The ECA is usually smaller than the ICA and it has branches that supply the neck and face. The ICA has no branches in the neck and ascends into the skull to supply blood to the brain. The extracranial carotid arteries are divided into four anatomically defined segments:



1. Distal CCA. The CCA segment immediately proximal to the origin of the carotid bulb, where the near and far walls of the artery are parallel to one another. We will evaluate the CCA in the distal 1 cm segment, immediately proximal to the carotid bulb. This segment is straight. The end of the distal CCA is marked widening of the vessel walls, which is the carotid bulb.

2. Carotid bulb. Originates at the beginning of carotid dilatation, about 1 cm inferior to the tip of the flow divider (bifurcation). The superior extent of the bulb is defined by tip of the flow divider.

3. ICA. Originates at the tip of the flow divider. It ascends in the neck and enters the base of the skull. For the purposes of this protocol, the ultrasound study will be limited to the initial 10 mm of the ICA.

4. ECA. Originates at the tip of the flow divider. Smaller than the ICA, it supplies blood to the neck and face. It will not be examined in this protocol.

The lateral extent of each segment is defined relative to the tip of the flow divider. The three segments of interest are the distal common carotid artery, the carotid bulb, and the internal carotid artery. No external carotid images will be recorded.

1.1.1.3 Naming Conventions for Imaging Scans and Angles

1. Transverse scans. The purpose of these scans is to characterize the orientation the carotid arteries and to identify areas of wall thickening or plaque. For both right and left-sided carotid scans, the probe is oriented with the notch towards the right of the subject and the carotid artery is imaged transversely, in a cross section.

Recordings of transverse images are obtained at 4 cm depth without magnification in 3 separate, 5 second loop acquisitions:

- (i) a CCA acquisition, scanning from clavicle to beginning of bulb,
- (ii) a bulb acquisition from the distal CCA through the bifurcation into the ICA and ECA, and
- (iii) a distal acquisition, scanning from the middle of bulb to approximately 2 cm past the bifurcation into the ICA and ECA branches.

During the transverse scans, advance the probe very slowly. The transverse scans are labeled “RT” or “LT. “

2. ICA Doppler scans.

3. Plaque scans. The purpose of these scans is to identify carotid plaques, defined as a discrete, focal wall thickening > 1.5 cm or focal thickening at least 50% greater than the surrounding IMT. These scans are a series of longitudinal cine loop acquisitions that are acquired at 4 cm depth without magnification. There are separate acquisitions from the anterior, lateral, and posterior angles.

4. CCA distensibility scans (right-side only). The purpose of these scans is to evaluate the elastic properties of the right CCA by accessing the relationship between diameter changes and pressure changes during the cardiac cycle. Because of the dynamic nature of this analysis, translation artifacts alter the calculations, so optimal images are acquired at end-expiration. Images must be stable in the vertical plane over a 5 second period, showing clear near and far walls of the distal CCA.

5. Carotid IMT scans. The purpose of these scans is to present images that the reader can use to measure carotid IMT. Optimal images display the vessel horizontally with clear double lines on the near and far walls. Images will be obtained from the CCA and the bulb or ICA segments. All images will be obtained at 4 cm depth. Four images will be obtained of each segment:

- (i) An unzoomed best “match” image compared to reference image provided
- (ii) A zoomed best “match” image compared to reference image provided
- (iii) An unzoomed best “protocol-defined” image

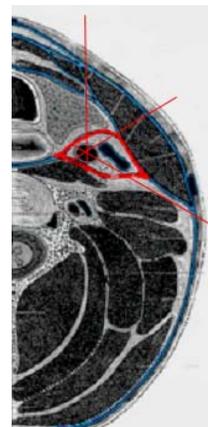
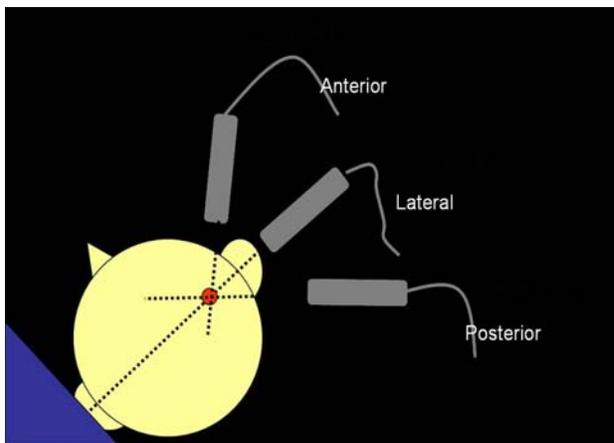
(ii) A zoomed best “protocol-defined” image compared to reference image provided

Images will be defined by angles of insonation as described below:

1. Anterior angle. The arch on the surface of the neck from the midline (trachea) to 55°, relative to a line drawn from the mid-trachea to the center of the back of the neck.

2. Lateral angle. The arch along the lateral surface of the neck, from 55° to 100° relative to a line drawn from the mid-trachea to the center of the back of the neck. The sternocleidomastoid muscle can be palpated beneath this portion of the skin’s surface. This angle also can be defined by an imaginary line that connects the ears, an “ear-to-ear” imaging plane.

3. Posterior-oblique. The arch from 100° to the perpendicular to 145°. The probe almost always lies just behind the posterior margin of the sternocleidomastoid muscle.



The posterior angle is behind the sternocleidomastoid muscle

1.1.2 Access to Reference Images

For each subject, the protocol requires that sonographer review of the CCA and bulb/ICA images taken during Exam 1 and scan to match these images. Exam 1 images are distributed to the sonographers at each site via sftp transfer. A unique username and password will be provided to each site sonographers and coordinator. Images will be uploaded a few weeks prior to the subject’s scheduled Exam 5 date. The images are organized on individual folders named by the subject’s identification number (“idno”). You should download the reference images folders to your dedicated image review laptop provided by the DCC. Each folder contains right and left CCA images from exam 1 to match for IMT imaging. Images of the right and left bulb/ICA segments also may be present, with annotations describing the angle they were taken from (*i.e.* “ant,” “lat,” or “post”). In some subjects you also may see a separate RCCA image showing landmarks for the distensibility acquisition. This will be labeled “RCCA-distensibility.” For example, the reference images folder for subject 3899223 will look like this:

Name	Type	Date Modified
3899223 RICA-Lat.bmp	Windows BMP Image	2/7/2010 9:37 PM
3899223 RCCA-distensibility.bmp	Windows BMP Image	2/7/2010 9:37 PM
3899223 RCCA.bmp	Windows BMP Image	2/7/2010 9:37 PM
3899223 LCCA.bmp	Windows BMP Image	2/7/2010 9:37 PM
3899223 LBulb-Post.bmp	Windows BMP Image	2/7/2010 9:37 PM

These reference images provide arterial and extra-arterial landmarks to assist the sonographer in

matching the same segment, as well as instrumentation information to match the same frequency, depth of zoom box, focal zone placement, and angle of approach used during Exam 1. They will be viewed in the scan room while scanning each participant in Exam 5, as close to the Logiq700 monitor as possible. The images can be displayed by double clicking on the file name to open it. Sonographers should verify that the MESA Subject ID imprinted on the displayed Exam 1 image is that of the participant being scanned. If the image file cannot be found or the imprinted Subject ID does not match, please notify the Ultrasound Reading Center immediately.

1.1.3 Participant Positioning

The participant should rest supine without a pillow during the carotid exam with their head slightly rotated to the opposite side of the scan, approximately 30-45 degrees from midline. All scans start with the right carotid artery and end on the left side. The sonographer scans from the head of the bed, with sufficient room to rest their elbows on the bed to gain stability. Discourage the participant from looking at the monitor, which in most cases will result in an overextended neck position. The sonographer may gently place his/her hands on the subject's head to rotate the head into the correct position. The sonographer should emphasize the importance of not moving. To improve the subject's comfort and reduce low back tension, have the subject bend their knees and place a pillow under their legs, if they desire.

1.1.4 Blood Pressure Measurement for Distensibility

The average of the 2 systolic and diastolic pressures in the right arm will be used for further calculations of stiffness values, unless the left arm systolic blood pressure is more than 10 mmHg higher than the right arm blood pressure. In that circumstance, left arm measurements will be used.

A blood pressure (BP) cuff is connected to an automated sphygmomanometer (Dinamap) and placed over the right and then left upper arms. It is very important to use the appropriate cuff size for each subject. Each field center should have the follow cuff sizes available: small adult (17-25 cm), adult (25.1-33 cm), large adult (33.1-40 cm), and thigh (40.1-50 cm). The subject is placed supine and should rest for 5 minutes prior to measurement, preferably 10 minutes if possible. Other study set-up procedures should be performed while the subject is resting. The arms are positioned slightly abducted from the body, but resting comfortably on the table.

BP measurements will be made in both arms to verify that there are no significant differences. If the difference in systolic BP between the arms is ≤ 10 mmHg, it will be repeated until 2 consecutive systolic BP measurements are within 8 mmHg on the right side. If the left arm systolic BP is ≥ 10 mmHg higher than the right arm BP, left arm measurements will be used. The 2 most recent stable values should be averaged and the average systolic and diastolic blood pressures and heart rates should be recorded on the case report form (CRF).

BP and heart rate alerts should follow the same criteria as for the seated procedures. Immediate alerts should be initiated if the systolic BP is >210 mmHg, the diastolic BP is >120 mmHg or the heart rate exceeds 130 beats/minute. Urgent alerts should be initiated when the systolic BP is between 180-210 mmHg or the diastolic BP is between 110-120 mmHg.

Summary of Blood Pressure Measurement Protocol

1. Initial Blood Pressure Measurements, performed after a 5-10 minute rest in the supine position.
 - A. Right Arm
 - B. Left Arm
2. If the right and left arm systolic BPs are <10 mmHg different, re-measure right arm pressure every 3 minutes until 2 consecutive systolic blood pressures are <8 mmHg different.
3. If the left arm systolic BP is ≥10 mmHg higher than the right arm systolic BP, re-measure left arm pressure every 3 minutes until 2 consecutive systolic blood pressures are <8 mmHg different.
4. Enter the average of the last 2 systolic and diastolic blood pressures and heart rates in section 3 of the CFR.

While you are recording blood pressures and setting up for carotid imaging, ask the subject if they had any carotid artery intervention (i.e. carotid endarterectomy or carotid stent placement). If a single side was worked on, then perform your ultrasound scan *only on the contralateral side*. If both sides were intervened or operated on, you will not collect US images from either side. Complete the US form specially document under question 4.

1.1.5 Imaging Presets

1.1.5.1 Transducer Frequency

MESA ultrasound scans will all be performed with GE Logiq 700 ultrasound machines using the M12L probe. The probe operates at two different frequencies: 9 and 13 MHz. In Exam 1, images of the CCA were captured at 13 MHz, and the bulb/internal carotid images were captured at 9 MHz. The sonographer must double check the reference images to match the exact frequency used on Exam 1. When you review the reference images pay attention to the frequency used at the time of Exam 1 and match that setting. Pulse wave Doppler measures are not affected by the probe frequency setting. When making pulse wave Doppler measurements, the probe frequency can remain set at the frequency that makes the execution of the protocol most efficient.

1.1.5.2 GE Logiq 700 System Set-up

All images should be obtained using the “Common Carotid” preset entered in the GE Logiq 700 device. Review your preset and confirm these are your current settings.

“Common Carotid” preset

Frequency: 13 MHz
66 Dyn Range
Res
Edge 3
Map G
Ave 2
Number focal zones: 2 (*position of focal zones: mid artery*)

1.1.6 Subject Naming Conventions on the GE Logiq 700 System

Participant information is entered on the ultrasound machine’s demographics information screen to identify the scan as a MESA Exam 5 study for a particular subject. The following information should be included on the demographics screen and on the image throughout the scan:

Entering Subject Information into the Subject Information Screen

- Press "New patient"
- Archive Patient Data Screen
- Answer Y (Yes) to erase patient info and measurements?
- Hit "return" until you reach the new patient question (Y/N): type **Y** and then return
- Keep hitting return until the Last Name field, enter: **MESA5** (no spaces)
- Keep hitting return until the First Name field, enter: **Idno**
- Keep hitting return until the Patient ID field, enter: **Idno-5** (no spaces)
- Hit return for gender: **M or F**
- Hit return and enter your **Sonographer ID**
- Hit the "Exit" key to exit to begin scanning
- Start a new subject on the MDR by pressing "New Patient" (see Section 4.2 below for details)

NEW PATIENT

Erase patient info and measurements? (Y=Yes N=No & Return) Y

Exam Category (SET to select):

GENERAL IMAGING	* VASCULAR
OB/GYN	PEDIATRIC
SMALL PARTS	

PATIENT NAME
↓

LAST:
FIRST:
MIDDLE:

PT ID: SEX (M/F): OPERATOR ID:

Accession #:
Description:
DOB (MM/DD/YYYY): / /

HT: ft in WT: lbs

HISTORY:

ADDITIONAL EXAM DATA (Y/N) N

REF MD:

TKBL/RET to position SET to select ROI Size to page
EXIT to quit

1.1.7 Annotation Keys for Labels

Enter the following labels in the Logiq 700 annotation library. Remember that the system doesn't accept spaces.

1. To access the library page, select **[Code L]**.
2. Use the trackball to activate the field you want to edit, and press **Word Del** to clear
3. Type the new code. Press **Return** to move to the next field and **Exit** to leave the menu

4. To retype the annotation text, type over the existing text. Press the **Spacebar**, **Backspace** or **Word Del** to delete extra characters

<u>Code</u>	<u>Label</u>
1	RT
2	LT
3	PLAQUE-ANT
4	PLAQUE-LAT
5	PLAQUE-POST
6	ICA-DOPPLER
7	RCCA-DIST1
8	RCCA-DIST2
9	CCA1
0	CCA2
-	BULB1
=	BULB2 (not used, except in rare circumstance when ICA2 can't be visualized, <i>i.e.</i> subjects with "high bifurcation")
Q	ICA1
W	ICA2
A	ANT
L	LAT
P	POST

		ANNOTATION LIBRARY
	CODE	ANNOTATION
1.	1	RT
2.	2	LT
3.	3	PLAQUE-ANT
4.	4	PLAQUE-LAT
5.	5	PLAQUE-POST
6.	6	ICA-DOPPLER
7.	7	RCCA-DIST1
8.	8	RCCA-DIST2
9.	9	CCA1
10.	0	CCA2
11.	-	BULB1
12.	=	BULB2
13.	Q	ICA1
14.	W	ICA2
15.	A	ANT
16.	L	LAT
17.	P	POST
18.		
19.		
20.		
21.		
22.		
23.		

TKBL/RET to position EXIT to save

The UW AIRP will provide you with a laminated list of labels to tape above the Logiq 700 keyboard next to the corresponding code keys



1.1.8 Image Sequence

Always start with the right carotid artery; image the left side when the right-sided scan is complete. Distensibility loops are obtained only on the right side.

1.1.8.1 Transverse scans

For both right and left-sided carotid scans, the probe is oriented with the notch towards the right of the subject and the carotid artery is imaged transversely, in a cross section.

The purpose of transverse scan is to:

1. Characterize the orientation the carotid arteries
 - a. To identify the relative location of the jugular vein to the common carotid artery
 - b. To locate the bifurcation
 - c. To locate the common carotid artery bulb.
2. To identify areas of wall thickening or plaque.

Before recording transverse scan, perform a brief, initial overview to become familiar with the subject's anatomy and the orientation of the carotid artery and branches. The sonographer should locate the bifurcation and distinguish which vessel is the ICA and which is the ECA. The site of maximal wall thickening in the near or far wall, in the bulb or internal carotid artery should also be identified during the initial scan. Color and pulse-wave Doppler can be used as identification aids. This initial overview scan is not recorded.

After the initial overview, adjust the transducer position to improve full probe contact and delineation of near and far walls. The ideal transverse images are obtained when the transducer orientation and applied pressure allow for stacking the jugular vein over the carotid artery. This angle of approach allows the venous blood interface to serve as an ideal acoustic window. Apply light pressure and adjust the transducer incidence in order to maintain the vein distended. Try to position the artery in the center of the screen at an ideal 2-3 cm depth where the image resolution is the best.

The transverse scan is obtained at 4 cm depth without magnification in 3 separate acquisitions:

1. CCA acquisition scan

Record a 5 second loop showing the proximal CCA, starting just above the clavicle, proceeding superiorly until its transition into the bulb (denoted by the change in shape from a circular to a more oval cross sectional image). This sweep should be performed slowly, adjusting the focus and gains to show the artery in the center of the screen and with clear double lines on the near and far wall.

2. Bulb acquisition scan

The next 5 second loop starts at the level of the distal CCA and advances slowly through the bulb until the bifurcation is seen. Pay extra attention to the gain settings so soft plaques are not.

3. Distal acquisition scan

The next 5 second loop starts from the middle of the bulb and advances distally to show the first 2 cm of the ICA and ECA branches.

1.1.8.2 Plaque Scans

Carotid plaques are defined as a discrete, focal wall thickening >1.5 cm or focal thickening at least 50% greater than the surrounding IMT. These scans are a series of longitudinal cine loop acquisitions that are acquired at 4 cm depth without magnification. There are separate acquisitions from the anterior, lateral, and posterior angles. This circumferential approach is used to find the plane that is perpendicular to the plaque at its largest encroachment into the arterial lumen. Extra images may be obtained to demonstrate findings, if the sonographer desires.

1. Anterior plaque screen

From an anterior angle of approach, record a 5 second loop showing the near and far walls of the bulb and ICA segments looking for areas of plaque or discrete thickening. If plaque areas were noted in the CCA, include that segment on the screen. "Heel-toe" the probe to achieve a perpendicular approach for each wall screened. Make all movements very slowly to allow the reader to notice any transitions. Label as "RT PLAQUE-ANT."

2. Lateral plaque screen

From a lateral angle of approach, record a 5 second loop showing the near and far walls of the bulb and ICA segments looking for areas of plaque or discrete thickening. If plaque areas were noted in the CCA, include that segment on the screen. "Heel-toe" the probe to achieve a perpendicular approach for each wall screened. Make all movements very slowly to allow the reader to notice any transitions. Label as "RT PLAQUE-LAT"

3. Posterior plaque screen

From a posterior angle of approach, record a 5 second loop showing the near and far walls of the bulb and ICA segments looking for areas of plaque or discrete thickening. If plaque areas were noted in the CCA, include that segment on the screen. "Heel-toe" the probe to achieve a perpendicular approach for each wall screened. Make all movements very slowly to allow the reader to notice any transitions. Label as "RT PLAQUE-POST".

1.1.8.3 ICA Doppler Scans

A 4 cm field-of-view is used as the default image size. The critical information is the peak systolic ICA velocity. Using a small sample gate (2mm) the Doppler measurement should be taken from the first cm of the ICA. The audible signal can be used to facilitate placement of the Doppler sample gate. Color Doppler may be used to facilitate the best angle for sampling the strongest signal and detecting any areas of turbulence. Angle correction must not exceed 60° . Select a representative beat and measure

peak systolic velocity. The frozen image of the measurement is stored.

Procedure for obtaining and recording ICA peak velocity:

1. Hit the **cursor** key.
2. Move the cursor to the middle of the artery with the trackball
3. Press the toggle switches ("angle steer" and "angle correct") until there is an angle of 60 degrees between artery axis and the ultrasound beam.
4. Press the **PW** button. Adjust the velocity scale so that the Doppler waveform fits the display (Y-axis).
5. When a satisfactory Doppler tracing is obtained, freeze the image, measure the peak velocity using the electronic caliper, press **set** and store the still frame with the measurement.

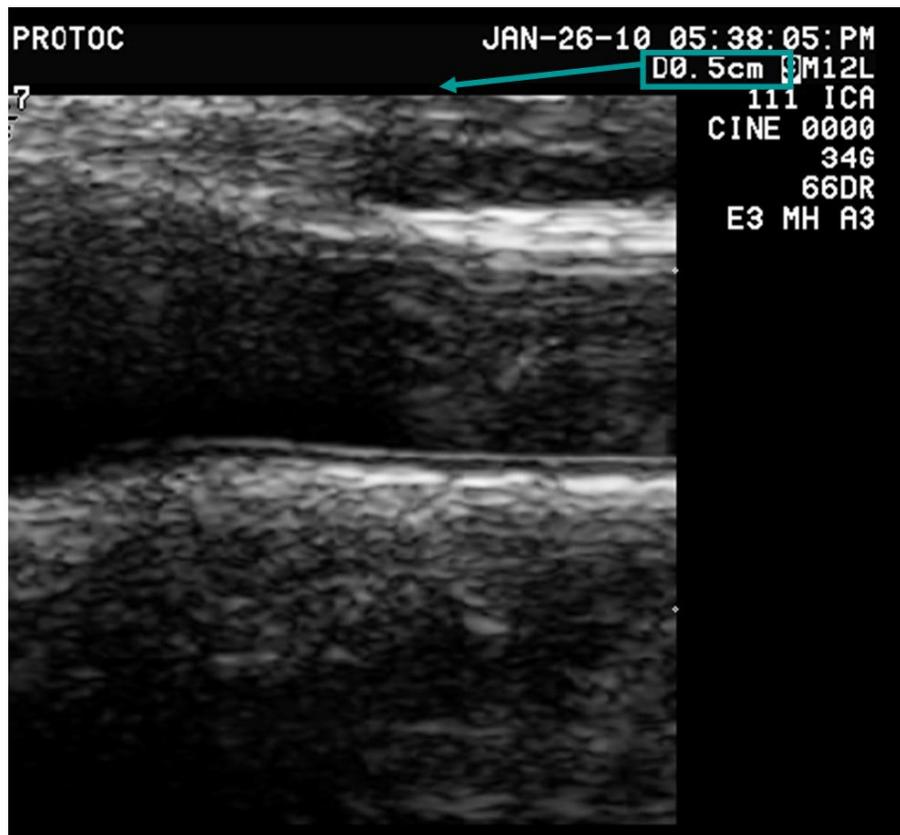
If needed, you may use color Doppler by pressing the **CF** button.

1.1.8.4 Right CCA Loops for Distensibility

Distensibility studies are only performed on the right side. The distensibility analysis assumes that pressure and diameter information are obtained simultaneously, which is why following the blood pressure acquisition protocol is essential (section 1.1.4). This scan is performed over the distal 1 cm of the right CCA, in zoom mode.

Before beginning, review the reference image from exam 1 ("RCCA-distensibility"), if provided, and try to match any vascular and/or vascular landmarks that were present, with the goal of imaging the same segment. Specifically observe the depth of the zoom box, artery wall appearance, muscle striations, jugular vein distension and if visible, the start of the bulb. Document the visibility of the landmarks and assess the quality of the exam 1 image on the procedure form. Make sure the reference image is displayed on a computer monitor near the ultrasound monitor, so they are as close to being "side by side" as possible.

Record a still frame with the ROI (region of interest) box over the full size (unzoomed) image at 4 cm depth. Compare the location of the zoom box with your reference image and place it to match the previous location, if at all possible. All zoom boxes are a 2 x 2 cm in area. On the top right of the images the near field depth of the zoom box location is displayed as a "D" followed by the depth information. For example on the image below, you know that the zoom box was located with the near field margin at a 0.5 cm depth. Adjust the depth, focus, and corroborate the frequency used to make sure they match the reference image provided. If there is not a reference image, obtain two sets of best quality "protocol-defined" images.



1. Distal right CCA distensibility scan #1 (“match”). From a full-sized image with a 4 cm field of view, place the zoom box at the same depth as the one used on the reference image. Move it horizontally until you see a similar segment to your reference within the box. Store a still frame of this image. Turn Zoom on. A 5 second recording is made of the optimal "zoomed" image of the CCA that matches the reference image. Both near and far wall interfaces defining the media-adventitia and intima-media thickness should be clearly imaged over at least a 1 cm length. This recording is made at end-expiration. In order to avoid translation artifact, wait a few seconds after the subject stops breathing and the jugular vein reaches a stable distension. On the previous exams, the distensibility loops included the distal segment of the RCCA unless obvious thickening was present. The sonographer was instructed to move proximally to a more normal arterial segment. You may need to move more proximally to match the image. Annotation should read “RT and in the next line RCCA-DIST1.”

2. Distal right CCA distensibility #2 (“protocol-defined”). Try to improve the image from the previous recording. Turn to full size view at a 4 cm depth with the zoom box overlaying the ROI. The sonographer might change the pressure applied, zoom box location, focus and make slight changes in angle of incidence (still from a lateral approach) to clearly demonstrate the near and far wall double lines. Store a still frame. Turn on zoom, adjust for any respiratory variations, and record an end-expiration 5 second loop. Annotation should read “RT and in the next line RCCA-DIST2.”

1.1.8.5 Carotid IMT Scans

These are the most important scans in the protocol. Their purpose is to present images that the reader can use to measure carotid IMT. Optimal images display the vessel horizontally with clear double lines on the near and far walls. Images will be obtained from the CCA and the bulb or ICA segments. All images will be obtained at 4 cm depth first followed by a magnified image (zoomed on a 2x2cm box). If there is not a reference image, obtain two sets of best quality “protocol-defined” images. Four images

will be obtained of each segment:

1. Right CCA #1 (“match”) and #2 (“protocol-defined”)

Review the appearance of the exam 1 CCA reference image (“RCCA”) on a computer screen. Note the location and orientation of the bulb, the depth of the zoom box, artery wall appearance, muscle striations, jugular vein distension and if visible the tip of the flow divider. Document the visibility of the landmarks and assess the quality of the Exam 1 image on the procedure form. Make sure the reference image is displayed on a computer monitor near the ultrasound monitor, so they are as close to being “side by side” as possible.

The goal of the right CCA #1 image acquisition pair is to match the same distal 10 mm of the CCA to exam 1. Initially store an unzoomed still frame at 4 cm depth with the zoom box overlay at the same location it was placed for exam 1. After matching the segment and saving the still frame, zoom magnification is turned on and a 5 second loop is acquired. Use label “RT-CCA1.”

The goal of the right CCA #2 image acquisition is to obtain the best “protocol-defined” image of the distal right CCA. For this pair of images, the emphasis is on obtaining the “optimal image” without trying to match the exam 1 reference. The carotid bulb is displayed on the left side of the monitor (when facing the screen). The probe should be angled to obtain the best view of the CCA IMT that shows clear double lines on the near and far walls. In general the best angle to achieve the optimal CCA image is 45 degrees and stacked over the jugular vein. Acquire an unzoomed still frame at 4 cm depth with the zoom box overlaying the distal 1 cm of the CCA. Include the beginning of the bulb in the zoomed area. After acquired the best “protocol-defined” CCA image of the distal right CCA, turn on the zoom magnification and record another 5 second loop. Use label “RT-CCA2.”

2. Right Bulb/ICA #1 (“match”) and #2 (ICA only, “protocol-defined”)

The MESA exam #1 carotid ultrasound protocol included images from 3 planes demonstrating the thickest segment of the bulb or ICA, depending on the sonographer’s assessment of the subject’s disease burden. If the artery was normal, the study was centered on the initial 10 mm of the ICA. The tip of the flow divider was used to identify the inferior aspect of beginning of the ICA. The priority was to display the wall interfaces of the proximal ICA, not the tip of the flow divider.

Based on the review of the images obtained, the protocol has been changed. Now, we will obtain ICA or bulb images from a single angle. As with the other segments, the UW AIRP will create a reference image from exam #1 based on the angle that shows the wall interfaces the best, overall image quality, and disease presence. The sonographer must review the appearance of the exam 1 bulb/ICA reference image (“RICA-xxx” or “RBulb-xxx”) on a computer screen. Note the location and orientation of the bulb and ICA, the depth of the zoom box, artery wall appearance, muscle striations, jugular vein distension and if visible the tip of the flow divider. Document the visibility of the landmarks and assess the quality of the Exam 1 image on the procedure form. Make sure the reference image is displayed on a computer monitor near the ultrasound monitor, so they are as close to being “side by side” as possible.

The goal of the right bulb/ICA #1 image acquisition pair is to match the same images as in exam 1. Initially store an unzoomed still frame at 4 cm depth with the zoom box overlay at the same location it was placed for exam 1. After matching the segment and saving the still frame, zoom magnification is turned on and a 5 second loop is acquired. If there is not a reference image, obtain two sets of best quality “protocol-defined” images. Use label “RT-BULB1-xxx” or “RT-ICA1-xxx” where the “xxx” refers to the angle of the scan (*i.e.* ant, lat, or post).

The goal of the right ICA #2 image acquisition is to obtain the best “protocol-defined” image of the ICA. For this pair of images, the emphasis is on obtaining the “optimal image” without trying to match the exam 1 reference. This exam focuses on the ICA, not the bulb, except in rare circumstance when ICA2

can't be visualized – aka “high bifurcation.” The carotid bulb is displayed on the left side of the monitor (when facing the screen). The probe should be angled to obtain the best view of the ICA IMT that shows clear double lines on the near and far walls. In general the best optimal ICA image shows the vessel horizontally on the screen and shows the thickest far wall IMT, but shows clear double lines on the near and especially the far walls. Acquire an unzoomed still frame at 4 cm depth with the zoom box overlaying the proximal 1 cm of the ICA. Include the distal bulb and flow divider in the zoomed area. After acquired the best “protocol-defined” ICA image of the proximal right ICA, turn on the zoom magnification and record another 5 second loop. Use label “RT-ICA2-xxx” where the “xxx” refers to the angle of the scan (*i.e.* ant, lat, or post).

3. Repeat the same acquisition sequence of transverse, plaque scan, ICA Doppler, distensibility scan (right side only) and IMT scan on the left side. Do not perform the distensibility scan on the left side. Then close the study.

1.2 Protocol Summary

Image Description	To Be Stored
Right Side (4 cm depth)	
1. Transverse scan	3 consecutive 5 sec loops focusing on CCA, bulb and ICA
2. Plaque screen	3 consecutive 5 sec loops from anterior, lateral and posterior angles searching for plaques; special emphasis on bulb and ICA segments; extra images may be required
3. PW Doppler ICA	Still frame with measured peak velocity
4. CCA distensibility 1 (“match”)	(a) Still frame w/zoom box overlay, then (b) Zoom and store 5 sec loop at end-expiration, matching RCCA distensibility image, if available
5. CCA distensibility 2 (“protocol-defined”)	(a) Still frame w/zoom box overlay, then (b) Zoom and store 5 sec loop at end-expiration, w/double lines defined and no translation
6. CCA CIMT 1 (“match”)	(a) Still frame w/zoom box overlay; then (b) Zoom and store 5 sec cine loop at end-expiration trying to match original RCCA CIMT reference image
6. CCA CIMT 2 (“protocol-defined”)	(a) Still frame w/zoom box overlay; then (b) Zoom and store 5 sec cine loop at end-expiration trying to obtain the best image, w/double lines defined and no translation
7. Bulb/ICA 1 (“match”)	(a) Still frame w/zoom box overlay; then (b) Zoom and store 5 sec cine loop at end-expiration trying to match original Bulb/ICA CIMT reference image
8. ICA 2 (“protocol-defined”)	(a) Still frame w/zoom box overlay; then (b) Zoom and store 5 sec cine loop at end-expiration trying to obtain the best image, w/double lines defined and no translation
Left Side (4 cm depth)	Repeat right side images, <i>without CCA distensibility (steps 2 & 3)</i>

***If no matching image is provided for any view, obtain two sets of “protocol-defined” images**

1.3 Description of Good Carotid Ultrasound Images and Acquisition Priorities

A good carotid ultrasound image:

1. For ALL images, appropriate transducer, presets, and overall gain; image in center of screen

2. For matching images, the frequency, depth, focal zone location, zoom location, and internal and external landmarks (jugular vein distension, amount of bulb visualized, presence of plaque, muscle striations, etc.) precisely match the reference image.
3. For distensibility images, held at end-expiration, clear double lines on near and far wall for at least 1 cm of right CCA
4. For IMT images, vessel is displayed horizontally in center of screen, showing clear double lines on near and far walls

Acquisition priorities are:

1. Obtaining perfectly matched images of the far wall of each CCA for measurement of IMT
2. Obtaining perfectly matched images of the far wall of each bulb/ICA for measurement of IMT
3. Obtaining perfectly matched images of the right CCA for measurement of distensibility. Accurate blood pressures are as critical as obtaining good quality images.
4. Performing comprehensive plaque scanning

1.4 Alert Values

Identification of a carotid artery dissection or any peak systolic carotid velocity of ≥ 250 cm/s should be considered an alert value and MESA Alert procedures should be followed. These values should be brought to a physician's attention and appropriate follow-up, determined by local policies, should be assured.

2.0 Forms and Image Management

There are two forms that the MESA sonographers will complete: (i) the **Carotid IMT DVD Log** and (ii) a **Carotid IMT Ultrasound Case Report Form**, titled **Carotid Ultrasound-Exam 5**.

The Carotid IMT DVD log sheet is kept locally to help catalogue the copies of the studies kept locally on DVDs. A copy is faxed to the UW AIRP (608-263-1534) after uploading the digital images to the server.

The MESA Carotid IMT Ultrasound Case Report Forms are scanned into the MESA web database at the field center. You also will fax the 2 page Carotid Ultrasound – Exam 5 forms to the UW AIRP.

All images are digital. Videotape will not be used. The ultrasound images are converted to digital, DICOM images using a NAI MDR box (see section 4.0). They will be transmitted to the UW AIRP via the internet (see section 4.6). A DVD copy of all studies will be burned for local backup (see section 4.7).

2.1 Carotid IMT DVD Log Sheets and DVD Labels

The Carotid IMT DVD Log will help sonographers keep track of local copies of the carotid ultrasounds from exam 5. Local copies will be on DVDs with labels printed by the NAI MDR (see section 4.7). DVDs and log in sheets are kept at each site as a backup in case images need to be resent to the UW AIRP (e.g. image file corrupted, incomplete transmission, etc.)

Organize your log sheets by date in your study binder filing the most recent one on top. Double check the dates and Idno entries in this log before faxing and filing it, this will help minimize errors and follow up queries.

Sample Carotid IMT DVD Log Sheet

**MESA Exam 5
CD/DVD Log**

Site: _____

Page number: _____

	Scan Date	DVD#	Idno	Plaque (circle)	Sonographer ID	Comments
1	4/2/2010	35001	3551212	Rt CCA Bulb ICA Lt CCA Bulb ICA	317	<i>Nice clean and easy scan</i>
2	4/2/2010	35001	3899223	Rt CCA Bulb ICA Lt CCA Bulb ICA	316	<i>Plaque in right ICA</i>
3	4/4/2010	35002	3221555	Rt CCA Bulb ICA Lt CCA Bulb ICA	317	<i>Use extra LCCA image, thick neck difficult to scan</i>
4						
5						

Directions: Fax copy to UW AIRP **608-263-1534** as soon as a CD/DVD is created and images are transmitted via internet. File this form in the study binder.

2.2 Carotid IMT and Distensibility Ultrasound Case Report Form

All MESA CRFs require entry of the MESA participant ID, acrostic, and date at the top right, and the sonographer ID. The sonographer is responsible for the numbered items and to verify the Subject ID, acrostic and the date. The originals are to be returned to the clinic coordinator who will oversee their being scanned into the MESA database system.

Multi-Ethnic Study of Atherosclerosis
Exam 5



Ultrasound Completion

Participant Id#:

Acrostic:

Date: / /
Month Day Year

Sonographer ID#:

1 Arm used for blood pressure measurements:

- Right Left

2 Blood pressure measurements:

	Systolic:	Diastolic:	Heart rate:
First:	<input type="text"/>	<input type="text"/>	<input type="text"/>
Second:	<input type="text"/>	<input type="text"/>	<input type="text"/>
Third:	<input type="text"/>	<input type="text"/>	<input type="text"/>

3 Average blood pressure measurements:

NOTE: Always average last two measurements

Systolic:	Diastolic:	Heart rate:
<input type="text"/>	<input type="text"/>	<input type="text"/>

4 Has participant had a carotid endarterectomy or a carotid stent placed?

- No Yes → Right side
 Left side
 Both sides

NOTE: Be sure to scan the contralateral side even if one side has had an intervention.

5 Carotid IMT and distensibility ultrasound study performed:

- Done → *Skip to #7*
 Incomplete
 Not Done → *Complete Question 6 and skip to END*

6 Reason carotid IMT and distensibility ultrasound examination was incomplete or not done:

- Equipment malfunction
 Time/staff/room constraints
 Examinee refused/uncooperative
 Examinee physically unable
 Other:

7 Availability of reference images for matching:

- None available → *Skip to #10*
 Computer malfunction - not available → *Skip to #10*
 All 5 reference images provided
 Some reference images missing.



Check reference images that were not available

- Right CCA distensibility
 Right CCA IMT
 Left CCA IMT
 Right bulb/ICA IMT
 Left bulb/ICA IMT

8 Overall quality of reference images:

- Excellent
 Very good
 Satisfactory
 Poor

Images matched:

- All reference images were matched
 Images unable to be matched



Check reference images that could not be matched

- Right CCA distensibility
 Right CCA IMT
 Left CCA IMT
 Right bulb/ICA IMT
 Left bulb/ICA IMT

Reminder -- be sure Question #5 has been completed

10 Overall quality of current exam:

- Excellent
- Very good
- Satisfactory
- Poor

11 Results of right CCA distensibility scan:

- Done
- Incomplete
- Not Done

12 Results of right ICA Doppler scan:

- Done → Maximum velocity = cm/s
- Incomplete
- Not Done

13 Results of right carotid IMT scan:

- Done → Skip to #15
- Incomplete
- Not Done

14 Reason right carotid IMT scan incomplete or not done:

- Equipment malfunction
- Time/staff/room constraints
- Examinee refused/uncooperative
- Examinee physically unable
- Other:

15 Results of left ICA Doppler scan:

- Done → Maximum velocity = cm/s
- Incomplete
- Not Done

16 Results of left carotid IMT scan:

- Done → Skip to #18
- Incomplete
- Not Done

17 Reason Left Carotid IMT scan incomplete or not done:

- Equipment malfunction
- Time/staff/room constraints
- Examinee refused/uncooperative
- Examinee physically unable
- Other:

18 Alerts: (right or left ICA Doppler velocity is >250 cm/s, elevated blood pressure, or other major finding)

- Yes No

19 Backup DVD#:

Site #
↓
 5

20 Faxed DVD log form to UW AIRP?

- Yes No

21 Uploaded images to UW AIRP?

- Yes No

↓
Date of Upload:
 / /
Month Day Year

2.3 Image Transmission to UW AIRP

Ultrasound scans are recorded to the NAI MDR and should be transmitted to the UW AIRP server via the internet for review and analysis on the same day they are recorded. The MDR is set up to send images to the UW AIRP as soon as a study is completed. Field Centers should assure that images are transmitted to the UW AIRP immediately after completion of the scan. See section 4.6 below for instructions on image transmission using the MDR.



2.4 Burning DVDs for Local Backup

A local copy of the studies completed that day should be stored on a DVD and labeled appropriately. DVDs must be burned at least weekly. Add the notation “QA” for scans performed for reproducibility. See section 4.7 below for instructions on image transmission using the MDR.

2.5 Image Overview Reports from the UW AIRP

All studies received by the UW AIRP will be reviewed within 5 working days. Any studies with alerts will be reviewed as quickly as possible, usually within 24 hours. The sonographer and study coordinator will receive an e-mail with comments about the scan. Sonographers will receive feedback on protocol adherence, image quality, and completion of paperwork, as well as praise and constructive tips for improving future images. During the overview and check-in process, a quality score is generated based on the over-read form. In some cases, the scan might not receive a passing score and some segments or the whole study may need to be repeated.

2.6 Sonographer Certification and Reproducibility Scans

Sonographers must complete in-person training at the UW AIRP. This will include didactic, interactive, and hands-on scanning sessions using the Logiq 700 system. After in-person training sonographers will be required to complete *at least 2* sets of paired mock exams, using their local GE Logiq 700 system and following all study procedures. Mock scans can be any volunteer willing to be scanned for practice, following local policies. Each pair will consist of part 1, a protocol-defined scan, which will be sent to the UW AIRP for overview and selection of images to match on part 2, which will be completed per the study protocol, as if the images to match came from a participant. A sonographer will not be certified to scan subjects for MESA exam 5 until they have successfully completed 2 pairs of mock scans.

Sonographers will retain their certification by performing at least one passing scan every 60 days after they have achieved initial certification. After 45 days, the sonographer will receive a reminder of this process. If they do not plan on scanning a study subject in the next 2 weeks, they should perform a single mock exam and send it for review. It must achieve a passing score of 90%. Sonographers also must have over 95% of scans have a passing score of over 85% and may not have more than two scans in a row without passing scores. Sonographers may be decertified if these criteria are not met, or at the discretion of the reading center, if their performance is determined to be substandard.

Designated subjects from each field center will have a repeat carotid ultrasound study to evaluate sonographer reproducibility. A reproducibility exam may be performed on the same day as the initial exam, however not in the same sitting. Subjects are expected to leave the room for a minimum of 30 minutes before returning for a reproducibility exam. They may perform other MESA Exam 5 activities during this time, such as completing questionnaires. If not performed on the same day as the initial exam, repeat exams must be performed within 28 days of the initial exam. Each sonographer at a field center must complete at least 15 reproducibility exams. Therefore, sites with more than 2 sonographers will complete more than 30 reproducibility exams. Sites are expected to perform approximately 3 reproducibility exams per calendar month.

Scans of subjects selected for a reproducibility (QA) study will be labeled differently in the US system. See example below.

NEW PATIENT

Erase patient info and measurements? (Y=Yes N=No & Return) Y

Exam Category (SET to select):

GENERAL IMAGING	* VASCULAR
OB/GYN	PEDIATRIC
SMALL PARTS	

PATIENT NAME

LAST: MESA5-QA
 FIRST: 1234567
 MIDDLE:

PT ID: 1234567-5B SEX (M/F): M OPERATOR ID: 123

Accession #: Description: DOB (MM/DD/YYYY): 0/0/0

HT: 0ft 0in WT: HISTORY: ADDITIONAL EXAM DATA (Y/N) N

REF MD: TKBL/RET to position SET to select ROI Size to page EXIT to quit

Do not leave any spaces, use a dash line and add QA after "MESA5"

Without leaving any spaces label -5A the first and -5B the second scan performed on the same subject

3.0 Ultrasound Phantom Scans

A small parts gray scale phantom (Gammex 404GS LE-0.7) will be used by each field center to detect changes in the ultrasound image calibration, transducer performance, and overall image quality throughout the course of the study. Phantom scans will be performed every 6 months starting in March 2010, before subjects are scheduled, to determine the Logiq 700 system baseline performance at each field center.

During the data collection period, sonographers will be instructed to repeat the phantom scan twice a year, reproducing the initial equipment settings. They will submit the images to the UW AIRP lab. Measurements of axial and lateral resolution will be performed with and without magnification. A subjective assessment of overall image uniformity and objective measurements of distance calibrations (vertical and horizontal) will be reported.

The ultrasound phantom form will assist the sonographer in setting up the equipment correctly for the phantom scan exam. The sonographer will record 5 still frame images following the protocol provided during the face-to-face training:

1. Axial/lateral Resolution (4 cm)
2. Axial/lateral Resolution (zoom)
3. Depth Calibration
4. Horizontal Calibration
5. Vessel Simulation

For these images, the sonographer should start with the MESA preset, place the TGCs vertically to the right (maximum scale) and adjust the overall gain to show the gray scale cysts demonstrating a full range of echogenicity, from totally echolucent, to very echogenic. The overall gain setting should be documented on the Phantom Scan Form and used for the remainder of the scan as well as for follow-up phantom scans. For image 2, the focal zone should be adjusted to the level of the pins. Returning to a full size view, images 3 and 4 should be centered on the horizontal and vertical calibration pins. The sonographer is expected to perform horizontal and vertical measurements. The 5th image is a longitudinal scan of a 3.6 mm simulated vessel.

Images should be transmitted to the UW AIRP for review. Upon review and approval of the scan, a shipping slip will be sent via e-mail to the sites that share the phantom equipment (Columbia-Minnesota, Wake Forest-UCLA). Northwestern and Johns Hopkins will use the same phantom provided by a different study coordinated by UW AIRP. A sample of the Phantom Scan Form is below.

MESA Air Exam 5 Phantom Scan Form

Machine company and model: _____
 Machine serial #: _____
 Transducer model: _____
 Transducer serial #: _____
 Ultrasound phantom serial #: _____
 Phantom scan date: _____
 Sonographer ID: _____

Use the following instrument settings and fill in the blanks below:

1. Use MESA "Carotid" preset
2. Move all TGC pods to the right and only adjust overall gain
3. For all scans other after the baseline phantom scan, use the same overall gain setting you used for the baseline scan.

Frequency: set at 9 MHz
 Power: MI _____, _____ %
 Dynamic range / Compression: _____ dB
 Overall Gain: _____ dB (set using far field gray scale cysts)
 Transmit focus at: set at 2.0 cm using 2 focal zones
 Depth: set at 4.0 cm
 Frame rate: _____ Hz

Obtain the following 6 still frame images and fill in the blanks below:

1. Axial resolution and lateral resolution pins at 4 cm with zoom box overlay
2. Axial resolution and lateral resolution pins with zoom on. Adjust the focus to the middle of the zoom box
3. Depth measurement accuracy (leading edge to leading edge):
 Measured distance on ultrasound system: _____ cm
 Actual distance: 0.5 cm
4. Horizontal Measurement Accuracy (middle of pin to middle of pin, distance over 2 pins):
 Measured distance on ultrasound system _____ cm
 Actual distance: 2.0 cm
5. Vessel Simulation (image the 3.5 mm cylinder in a transverse plane to simulate vessel):
 Measured vessel from leading edge to leading edge _____ cm
 Complete longitudinal axis seen (circle one) yes no

TO BE COMPLETED BY UW AIRP:

Image uniformity (circle one):

Significant Non-uniformity					Excellent Uniformity
1	2	3	4	5	

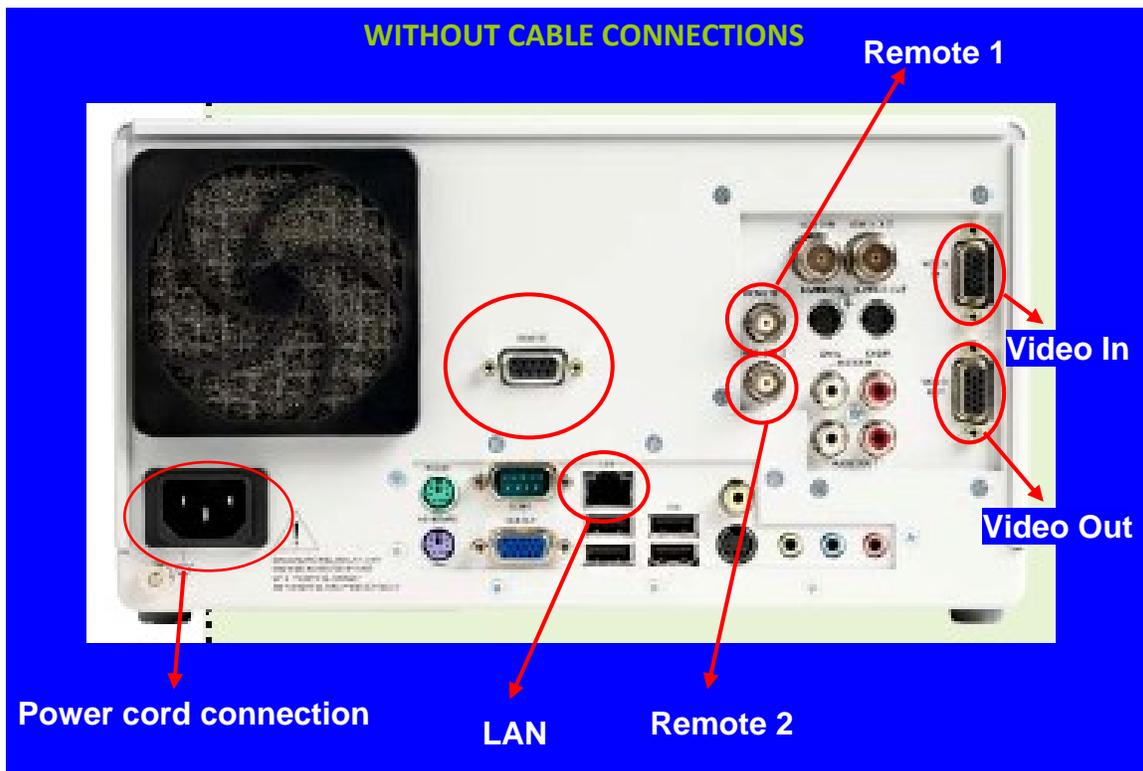
Same as Baseline (Circle one)? Yes No

4.0 Instructions for Using the MDR on the GE Logiq 700 Ultrasound System

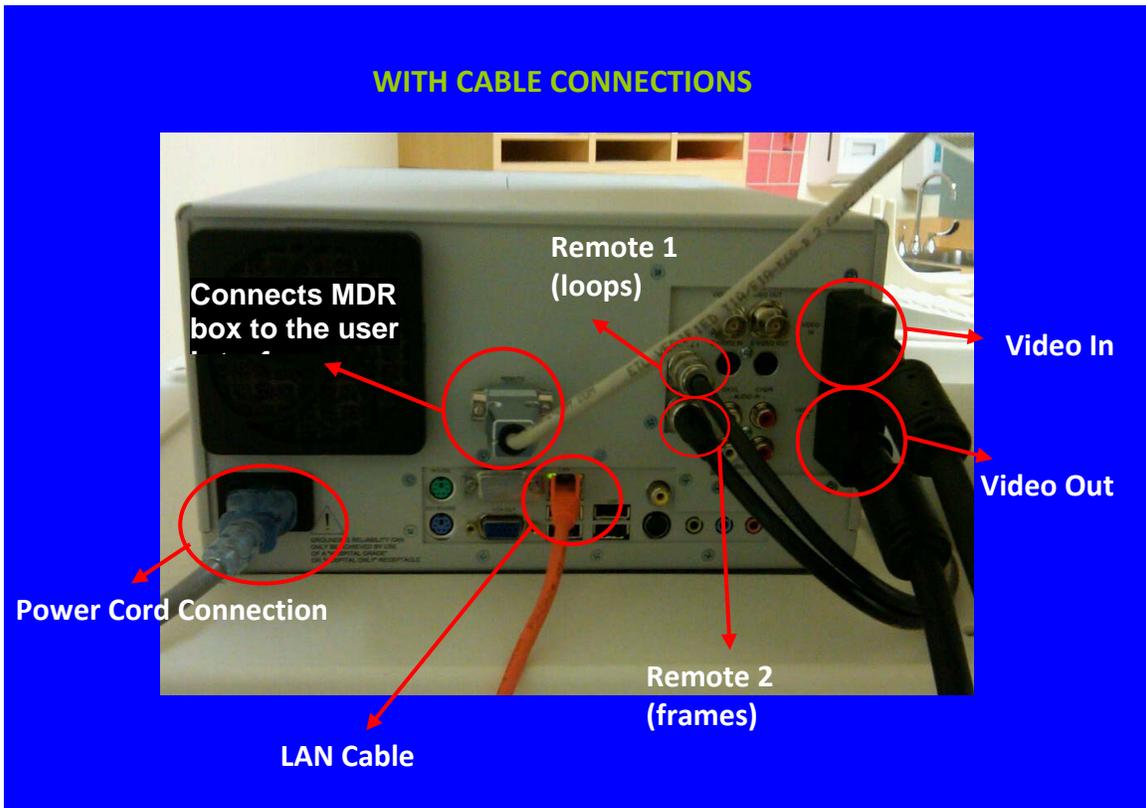
For the MESA Exam 5 carotid ultrasound studies, we will be using NAI Tech Products Medical Digital Recorder (MDR) to digitize the ultrasound image video stream, convert it to a DICOM file, and send it to the UW AIRP lab.

4.1 How to Connect the MDR to the Logiq 700

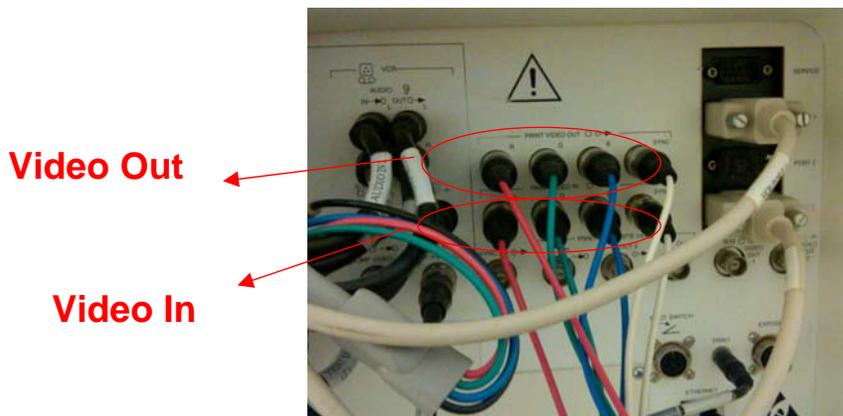
The video cable connections on the back of your MDR and Logiq 700 systems should look like the pictures below.



Back of the MDR *without* cable connections



Back of the MDR *with* cable connections



Back of the Logiq 700

The color coded dual foot pedal should be connected to the remote 1 and 2 ports (bnc) of the MDR box. The port labeled as Remote 1 is programmed to record cine loops. Remote 2 is used to record still frame images.

The “video out” from the Logiq 700 should be connected via a thick, rectangular, black input cable to the MDR “Video In” port. A similar thick, rectangular, black cord should connect from the MDR “Video Out” port to the “Video In” on the Logiq 700. These two connections respectively allow for digitization of video images from the Logiq into the MDR and from the MDR to play back on the Logiq system when you want

to review what was recorded. With this new setup, we completely bypass the Logiq system's hard drive archiving. A large gray cable connects from the back of the MDR box to the MDR user interface box. The gray power cord connects on the back of MDR to an outlet in the wall. Lastly, the orange LAN line connects at LAN on the back of the MDR to your network Ethernet socket in the wall.

4.2 Set Up a New Subject

Prior to scanning a new MESA subject and storing images in the MDR, you need to enter all the pertinent information into the Logiq 700 first.

A. Open a new patient file in the Logiq 700. The information needed to be entered into Logiq 700 should follow the following conventions.

1. The fields to be completed are last name, first name, patient ID # and operator.
 2. For the last name you need to enter **MESA5** in capital letters with no spaces.
 3. The first name is entered as their Idno number.
 4. Under Patient ID enter their 7 digit Idno number again.
 5. Under the operator field enter your sonographer ID number.
- Press "exit" or the "New Patient" key to return to the imaging screen.

```

NEW PATIENT
Erase patient info and measurements? (Y=Yes N=No & Return) Y
Exam Category (SET to select):
GENERAL IMAGING          * VASCULAR
OB/GYN                   PEDIATRIC
SMALL PARTS
PATIENT NAME
+
LAST: MESA5
FIRST: 1234567
MIDDLE:
PT ID: 1234567-5        SEX (M/F): M        OPERATOR ID: 123
Accession #:
Description:
DOB (MM/DD/YYYY): 0/0/0
HT: 0ft 0in           WT: 0 lbs
HISTORY:
                                ADDITIONAL EXAM DATA(Y/N) N
REF MD:
TKBL/RET to position    SET to select    ROI Size to page
EXIT to quit
  
```

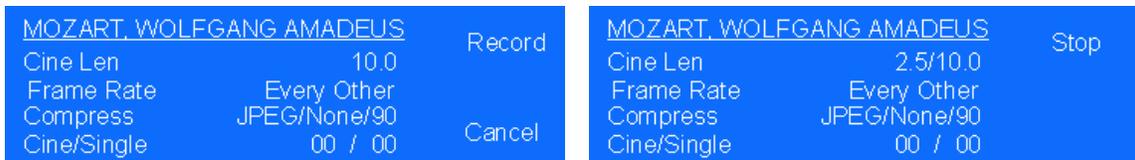
B. Now you are ready to set up the MDR box. Select “**New patient**” on the MDR box. The MDR is configured to take this information from the Logiq 700 by “Patient ID as ACR”. ACR stands for “Automated Character Recognition.” Before starting your scan, confirm that the MESA exam number and Idno entries were recognized correctly. If correct, press the “**Next**” soft key followed by the “**OK**” soft key on the MDR user interface. If the information is not correct, press the “**Cancel**” soft key and edit the information on the Logiq system and start a “New Patient”

For more information on starting a new exam, please refer to page 5, section 2.1.1 of the MDR user manual version 5.40, or call the UW AIRP directly.

4.3 Acquiring Images

There are two ways you can record images: (A) by using the dual-foot pedal and (B) by using the MDR user interface.

- A. To capture loops with the foot pedal:
 1. When the foot pedal for loop acquisition is pressed down you will hear one beep, which means that recording has started.
 2. To stop the recording, remove your foot from the pedal. When doing this you will hear another beep, which means recording has stopped. The MDR user interface will display the number of currently saved loops and frames.
- B. To capture loops using soft keys, if the pedal does not work or if you prefer this approach
 1. Press the “Record” soft key on the MDR user interface to begin recording a cine loop.
 2. To stop the recording you can either press the “**Stop**” soft key or it will automatically stop when the cine loop preset time has been reached (the length of the cine loops has been internally pre-set at 5.5 seconds for this study).



- C. There are two ways to capture single images:
 1. By using the foot pedal opposite to the pedal used for the cine loop capture
 2. By pressing the “Enter” soft key on the MDR user interface.
- D. When the study is completed, press the “**End Exam**” soft key on the MDR. A new screen with “New patient” or “Exam Mgr” will appear.

4.4 Deleting Images

You can delete the last cine loop or image acquired. To do this, hit the → (right arrow) key. The word “reject” will appear on the right side of the display and you can press the associated soft key to delete the last acquired cine/image.



4.5 Replaying Images

To replay images using the Logiq 700 and MDR:

1. On the Logiq 700, press and hold the “**Code**” key then press the “**k**” key, which also says “Video.”
2. Select “**External Video Input**”
3. Toggle to “**External RGB**”
4. On the MDR, if reviewing exams already ended* press the “**Exam Mgr**” soft key
5. Highlight the exam you want to review, and then press the **Enter key to access the exam details**.
6. Press the “**Play Back**” soft key
7. Use the ↑ (up arrow) and ↓ (down arrow) soft keys to toggle through the images

*For exams still open, press the right arrow key to start reviewing what was acquired and the ↑ (up arrow) and ↓ (down arrow) soft keys to toggle through the images replaying.

When finished replaying images:

1. On the Logiq 700, toggle to “**Internal RGB**”
2. Press the “**Exit**” key on the Logiq 700 key board
3. On the MDR, press the “**Exit**” soft key several times until the **New Patient/Exam Mgr** screen is displayed.

**For more information on replaying images refer to page 8, 2.4.1 of the MDR user manual version 5.40, or call the UW AIRP directly.*

4.6 How to Send Images to the UW AIRP Lab

Your studies will automatically be sent to the UW AIRP lab via the internet when you close each study, using a “Freeland” DICOM server program.

You must close the current study by hitting “End Exam” on the MDR. This step is critical. If you do not close the study, the images will not be sent to the UW AIRP.

The user interface will indicate that a study is being sent by a plus sign (+) symbol next to the subject’s

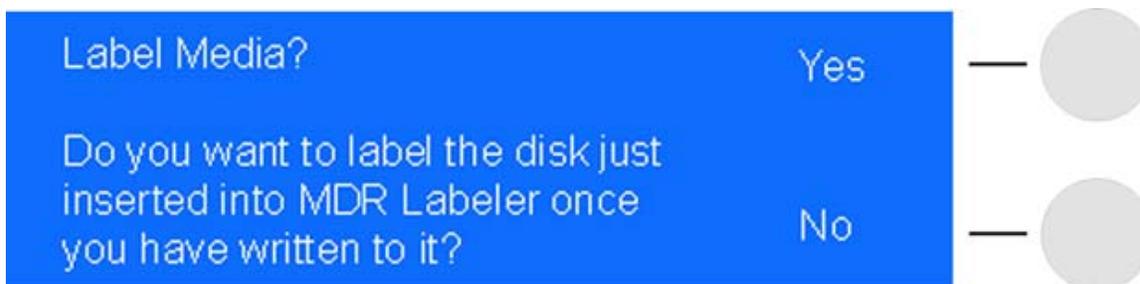
name (see image below). When the study has successfully transmitted, this symbol will disappear. You can start a new subject while the transmission occurs in the background.

If you are having problems with the network, contact your IT support group and inform the UW AIRP.

4.7 Copying Exams to a DVD

You must save all images to a DVD for local backup, at least once weekly. To create a DVD, please follow the following steps. The MDR will automatically label the DVD with the images after it is created.

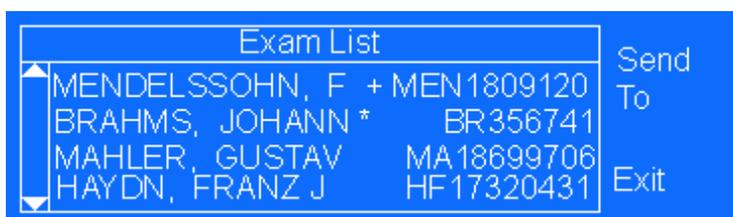
- A. To open and close the drive you must press the ↑ (up arrow) key.
- B. Insert a recordable DVD. We recommend you use DVD disks with printable labels; however the DVD writing software will work with non- printable surface DVDs in case you run out of labels.
- C. You will be prompted, as shown in the picture below, to answer “yes” or “no” if the DVD is able to have a label printed on it. Be sure though that you select the “No” soft key if you are placing a DVD in the drive that cannot be labeled. This question will appear on the screen for about 2 minutes; if you do not choose “yes” or “no,” the MDR will default to “No” and will not print a label on the disk. If you mistakenly press the “no” soft key, you can handwrite the exams copied to the disk with a permanent marker.



- D. To select the exams you want to copy to the DVD, select the “**Exam Mgr**” soft key.
- E. Highlight the subject name and then press the “**Send to**” soft key.
- F. You will have two options: “Disk Burn” and “Freeland” Highlight “**Disk Burn**” and then press the “**Enter**” key. You don’t want to select “Freeland” since the information is sent there automatically. The below prompt will appear on the screen:
 - Press “**More**” to add additional exams to the disk (if you press more, you are able to fill the disk with multiple exams, until no more exams will fit on the disk).
 - Press “**Finish**” to burn the exam and eject the disk (Once you press “Finish”, you are unable to add anymore exams to the finished CD).

You will know that the subject information is queued to send to UW AIRP when there is a plus sign (+) after the subject’s name. If you are burning the subject’s images to a CD/DVD, then an asterisk (*) will appear after the subject’s name. See below image.

Symbols when sending or burning disks:



4.8 Turning Off the MDR

Do not turn off the MDR unless the main screen says “Ready” or “No Disk.” The MDR should not say “staging,” “closing,” or “finalizing” if ready to power off the unit; you must wait until the unit finishes the current task.

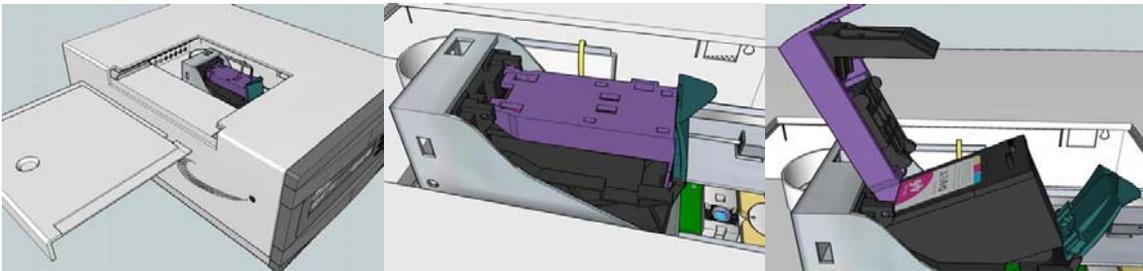


On/Off Button

4.9 Basic Ink Level Information

We do not have the capability to see the current ink level of the ink cartridge. When the printing of the CD becomes streaky or the color seems to be fading, it is time to change your ink cartridge.

Open the lid of the MDR by sliding out the ink cartridge access cover as shown by the first picture above. Press down on the blue latch and then flip up the purple cartridge holder. Now lift up on the ink cartridge and slide it out. Replace old cartridge with a new one.



Note: If a replacement ink cartridge is not available, do not remove the old cartridge. The label printer/DVD drive will not work properly without an ink cartridge in place.

**For more information on replacing your ink cartridge refer to page 37, 8.0 of the MDR user manual version 5.40*

4.10 Cleaning Fan Filter

It is very important to clean the fan filter **every 30 days**. To do this, unhook the outer black frame. Inside of the frame is the filter. To clean the filter you can either run it under water and then let it dry or vacuum the lint out of it. See below picture for location of fan filter on back of MDR.

