MARY WASHINGTON HEALTHCARE IMAGING SERVICES

RADIAL ARTERY ASSESSMENT FOR CABG PROTOCOL

I. Patient preparation: No preparation necessary.

II. Equipment:

A. The PVR unit with a Photoplethysmography (PPG) sensor will be used to assess the palmer arch and digital perfusion of the hand.

B. A real-time duplex scanner with imaging frequencies of at least 9 mHz linear transducer will be used when imaging is ordered by the ordering physician. Equipment capabilities include pulsed Doppler with directional flow, visual and audio output signals and Color Doppler Imaging.

III. General comments:

A. Indication: Assess patency and suitability of the radial artery for use as a conduit for coronary artery bypass. The evaluation includes the assessment of digital perfusion.

B. Definition: The exam will include evaluation with PVR and PPG . A unilateral examination may be done, studying the non-dominant arm when ordered. A bilateral study may be done if the non-dominant arm does not have an adequate conduit or digital perfusion, or if the referring physician orders a bilateral exam. Radial artery dependency of the hand should be assessed with PPG waveforms to avoid post operative ischemia if the radial artery is harvested.
Duplex imaging is typically not performed unless ordered by the ordering physician.

C. Patient position: Patient is placed on a stretcher in supine position. The arm should be positioned with the hand facing up.

IV. Anatomy of upper arm arterial circulation – see diagram below.

V. Flow Assessment of Palmer arch with Photoplethysmography.

A. Mark radial and ulnar pulses with indelible marker.

B. Annotation – Waveforms are automatically labeled in the PVR unit as follows:
   1. Location of PPG sensor as right or left, & which digit as thumb or 5th digit
   2. Which artery is compressed, i.e. radial artery labeled as RA, ulnar artery as UA

C. Exam protocol
   1. Enter patient data into the PVR unit including accession #, MRN#, patient first & last name, date of birth, ordering physician and technologist.
   2. Choose appropriate protocol in PVR unit.
   3. Obtain patient history and enter into the history page.
   4. Attach PPG sensors on the tips of the right and left thumb and fifth digits. Be sure to not apply the sensors too tightly. If waveform appears dampened at rest, attempt to reapply sensor looser.
   5. The PVR unit will prompt you to obtain a waveform of the right thumb and 5th digit at rest.
   6. Obtain a good quality resting waveform, then compress the radial artery and observe for changes in the waveform. Release compression and continue to run the waveform.
   7. Press space bar which will freeze the waveform.
   8. Scroll to adjust waveform to show resting, compression and post compression waveform in one frame.

9. Press enter which will prompt you to the next waveform.
10. Repeat steps 5-8 compressing the ulnar artery.
11. Repeat steps 5-8 compressing both the radial and ulnar arteries.
12. Repeat steps 5-11 for the left hand.
13. If the digital waveform is attenuated >50% with compression of the radial artery compared to the resting waveform, there is a considerable chance the hand could become symptomatic with radial artery harvesting.

VI. Duplex examination protocol - Duplex imaging is done at the discretion of ordering physician.

A. Annotation - Images are labeled according to the following:
   1. right or left when applicable
   2. scan plane orientation – long or trans
   3. vessel identification

B. Image optimization:
   1. Optimize gray scale images using TGC controls, I-scan, AGC, harmonics, depth, and transmit/focal zones controls to allow for vessel wall and plaque identification.

C. Measurement protocol
   1. A Doppler angle of 60 degrees or less is maintained throughout the exam, aligning the Doppler angle with the direction of flow.
   2. The sample volume size is kept small, depending on the size of the vessel.
   3. The sample volume is generally placed in the center of the vessel lumen to obtain the highest peak systolic and end diastolic velocities.
   4. Optimize spectral Doppler display, paying close attention to obtaining "clean" spectral window, if appropriate, to appropriate, to avoid measuring artifact.
   5. The scale and baseline controls are used to prevent aliasing of the spectral display when possible. Use lowest possible filter setting and minimum PRF before aliasing occurs.
   6. The invert control is used to ensure all arterial velocity waveforms are displayed above the baseline.

VII. Image sequence

A. Gray scale imaging
   1. Obtain transverse grayscale images of the proximal, mid and distal brachial artery obtaining maximal diameter measurements.
   2. Obtain longitudinal grayscale & color images of the proximal, mid and distal brachial artery obtaining AP diameter measurements. Note the presence of atherosclerotic disease or thrombus or anatomic variants of the arteries.
   3. Measure peak systolic velocity in the brachial artery.
   4. Return to transverse approach to evaluate the radial artery and repeat above steps 1 -3.
   5. Return to transverse approach to evaluate the ulnar artery and repeat above steps 1 -3.
   6. Repeat above steps for the contralateral arm if appropriate.

ANATOMY OF THE FOREARM ARTERIES

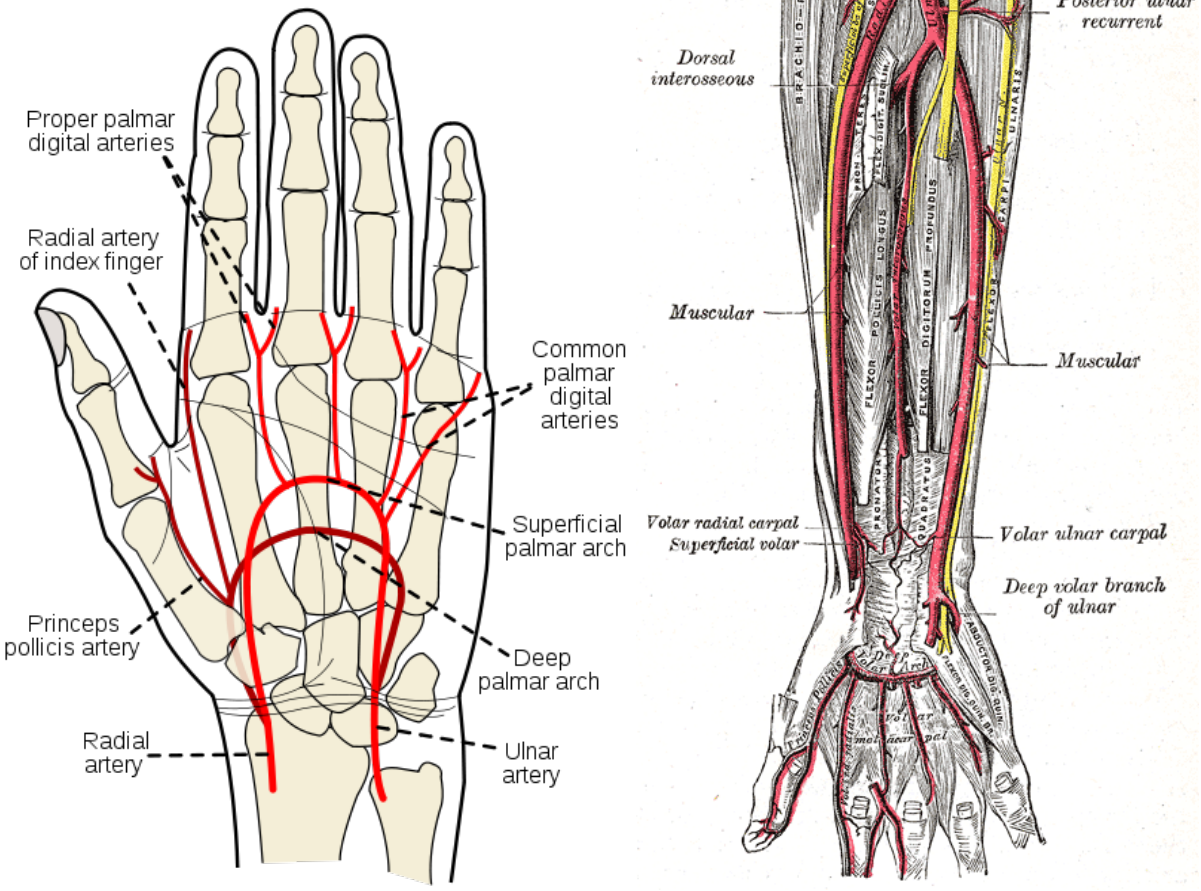

Image Summary

Image:	Measurement
1. Patient information screen	
2. Transverse proximal brachial artery grayscale	maximal diameter
3. Transverse mid brachial artery grayscale	maximal diameter
4. Transverse distal brachial grayscale	maximal diameter
5. Long proximal brachial artery grayscale	AP
6. Long proximal brachial artery color/spectral Doppler	PSV
7. Long mid brachial artery grayscale	AP
8. Long mid brachial artery color/spectral Doppler	PSV
9. Long distal brachial artery grayscale	AP
10. Long distal brachial artery color/spectral Doppler	PSV
11. Transverse proximal radial artery grayscale	AP
12. Transverse mid radial artery grayscale	AP
13. Transverse distal radial grayscale	AP
14. Long proximal radial artery grayscale	maximal diameter
15. Long proximal radial artery color/spectral Doppler	PSV
16. Long mid radial artery grayscale	maximal diameter
17. Long mid radial artery color/spectral Doppler	PSV
18. Long distal radial artery grayscale	maximal diameter
19. Long distal radial artery color/spectral Doppler	PSV
20. Long proximal ulnar artery grayscale	maximal diameter
21. Long proximal ulnar artery color/spectral Doppler	PSV
22. Long mid ulnar artery grayscale	maximal diameter
23. Long mid ulnar artery color/spectral Doppler	PSV
24. Long distal ulnar artery grayscale	maximal diameter
25. Long distal ulnar artery color/spectral Doppler	PSV
26. Repeat above steps for the contralateral arm if appropriate	

Documentation of areas of suspected stenosis must include representative waveforms recorded **before, at and distal** to the stenosis.

Reference:

1. Radial Artery Assessment for Coronary Artery Bypass; SVU Vascular Technology Professional Performance Guidelines

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