Developed in collaboration with the Wound Care Champions, Wound Care Specialists, Enterostomal Nurses, and South West Regional Wound Care Program (SWRWCP) members from Long Term Care Homes, Hospitals, and South West Community Care Access Centre contracted Community Nursing Agencies in the South West Local Health Integration Network.	
Title	**Procedure: Ankle Brachial Index (ABI) Testing Using a Handheld Doppler**

Background[1]	• Peripheral arterial disease (PAD) is a condition characterized by decreased blood flow to the limbs secondary to a narrowing or blockage of the tributary arteries[1]
	• The presence of PAD is frequently associated with age greater than 70 years, diabetes, high cholesterol and blood pressure, smoking, obesity, physical inactivity, and kidney disease[1-3]
	• PAD is a predictor for cardiovascular mortality[2]
	• Depending on the degree of arterial blockage or narrowing, clinical signs of PAD may vary from tingling/numbness in the affected limb, to intermittent claudication, rest pain, ulceration, gangrene, and/or amputation, however; most people with PAD are asymptomatic (two-thirds)[4-6]
	• For the purpose of assisting with the diagnosis of PAD, ABI testing is superior because it's:
	  ○ Simple to perform
	  ○ Non-invasive
	  ○ Very easy to routinely determine in most people
	  ○ 95% sensitive and 95% specific for PAD when done in a consistent manner
	  ○ Cost-effective
	• "Besides the diagnostic role, ABI testing has a prognostic role, identifying patients with very high cardiovascular risk, independent of the presence or absence of symptoms"[7], i.e.:
	  ○ An abnormal ABI below 0.9 is a "powerful independent marker of cardiovascular risk"
	  ○ There is an "inverse correlation between ABI value, non-fatal cardiac events (myocardial infarction, stroke and heart failure exacerbation) and mortality (cardiovascular and global), the relation being nonlinear, with patients with a very low ABI (<0.3) having an additional risk significantly higher"[7-10]
	  ○ ABI values over 1.3-1.4 correlate with major adverse cardiovascular events as well, i.e. sudden death, death from acute coronary syndromes, or stroke[11]
	• ABI values can be affected by:
	  ○ Age (due to the increased prevalence of PAD in the elderly)
	  ○ Height (in those without cardiovascular impairment, ABI values should increase proportionally with height because of the higher systolic blood pressure in the legs due to increased hydrostatic pressure[12])

	○ Race (due to genetic factors) ○ Order of the ABI measurements ○ Sex (females generally have a lower ABI, independent of their height[13]) ○ Body posture and knee position ○ Blood pressure cuff placement and size and rate of cuff inflation/deflation • ABI testing results can help: ○ Identify those who require further vascular assessment ○ Predict the healability of lower leg/foot wounds ○ Determine appropriate wound care interventions
Indications	This procedure is intended to be used by front line registered health care providers to assist with their assessment and management of individuals presenting with a leg or foot ulcer and/or lower limb edema and/or signs of PAD. This procedure should NOT be conducted: • Immediately post-superficial bypass graft without first consulting with the surgeon • If the person has significant lower leg/wound pain, making them intolerant of the procedure • On the arm of a person with a dialysis fistula or who has had a mastectomy • By a health care provider who has not received training in ABI testing
Procedure	**NOTE: The use of the "Procedure: Ankle Brachial Index (ABI) Testing Using a Handheld Doppler" is but one part of the holistic assessment of an individual presenting with a leg or foot ulcer and/or lower limb edema and/or signs of PAD.** **Assessment** 1. Determine whether the performance of this procedure is appropriate for the person presenting to you, i.e. any person with a wound on their leg or foot and/or with lower limb edema and/or signs of PAD, who has not had ABI or equivalent testing conducted in the past six month, or if they have, has not had a significant change in the presentation of their limb or wound since the last testing 2. This procedure should be used in conjunction with the "Guideline: The Assessment of People with Diabetic/Neuropathic Foot Ulcers" or "Guideline: The Assessment of People with Leg Ulcers". Check the person's chart to determine if either of these assessments have been completed, and review their contents. If the applicable assessment has not been completed, consider conducting the assessment 3. Look through the person's chart for any prior ABI results, for comparison purposes **Planning** 1. Expected outcomes: a. Information from your ABI assessment will contribute to the

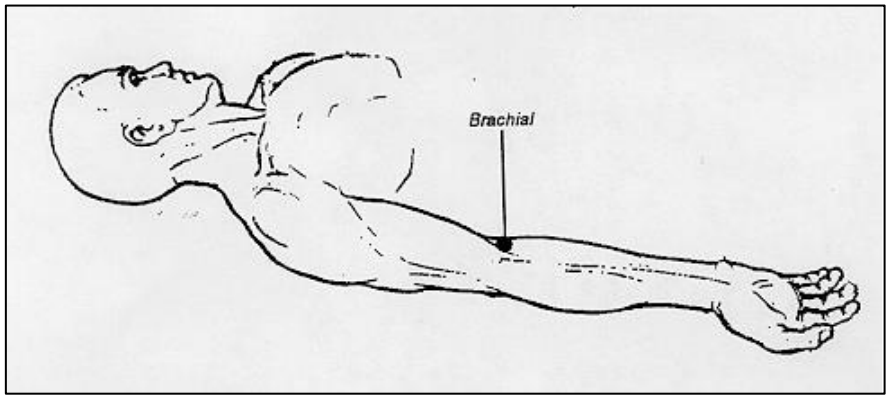
completion of the "Interdisciplinary Diabetic/Neuropathic Foot Assessment Form" or "Interdisciplinary Lower Leg Assessment Form", and will help identify if PAD is an underlying cause of the foot/leg wound(s) and/or leg edema/signs of PAD

b. Registered nursing staff, in collaboration with other involved health care disciplines and the person with the wound/edema/signs of PAD and/or their SDM/POA C (if applicable), will be able to use the ABI assessment information (along with the holistic foot/lower leg assessment information) to initiate/modify and implement an appropriate, interdisciplinary, person-centered plan of care which contains clear directions to staff and others who are providing the person with direct care

2. Explain the procedure and purpose of the ABI assessment to the person and/or their SDM/POA C, and obtain verbal or implied consent

Implementation

1. Provide for privacy
2. Have or help the person remove any clothing that may restrict accurate assessment of their arm/leg pressures, i.e. shoes, socks, tight pants/shirts, sweaters, etc.
3. Have or assist the person to lie supine in a relaxed, comfortable position to facilitate the assessment – have them lie as flat as possible. Have/help the person position themselves so that their arms are at their side, palms up (see the diagram below). **NOTE: the person must remain in a supine position for at least 15 minutes prior to and during ABI testing to minimize any hydrostatic pressure inaccuracies**

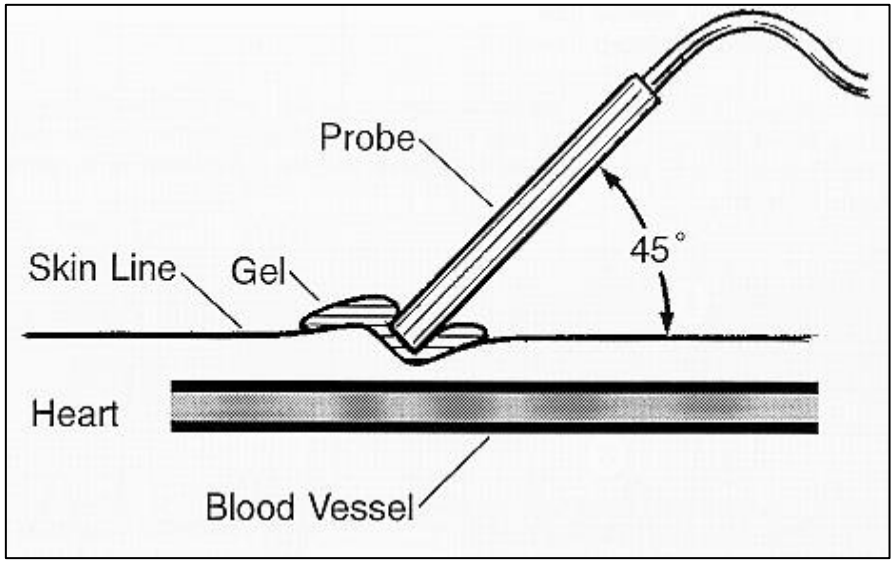


4. Ensure adequate lighting
5. Wash your hands
6. Don clean disposable gloves and expose the persons antecubital spaces
7. Apply an appropriately sized blood pressure cuff on the person's

RIGHT upper arm, approximately 1-2cm above the antecubital fossa. **NOTE: Cuff width must equal 20% more than the upper arm diameter or 40% of circumference around upper arm and two thirds of upper arm length (see chart below). If the cuff is too narrow, the reading may be falsely high and vice versa**

Cuff Size	Upper Arm Circumference at Midpoint (cm)
Small	22-26.9
Adult	27-34.9
Large Adult	35-44.9
Extra Large (Adult Thigh)	45-52

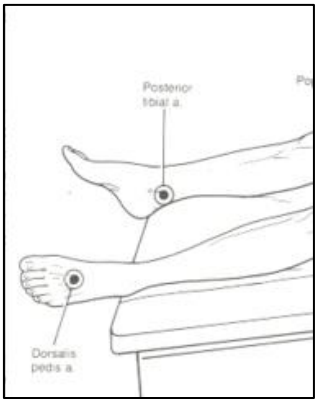
8. Palpate for the brachial pulse and place ultrasound gel (1/4" thick) over that area. **NOTE: ensure there are no large air bubbles in the applied ultrasound gel, as the Doppler requires a continuous conducting medium**
9. Turn the Doppler on and hold the 8MHz Doppler probe at a 45-60 degree angle to the artery (the probe itself should be pointing in the direction of the person's head – see the diagram below)



10. Gently move the probe through the gel in a circular motion until you find the best quality pulse sound
11. Stabilize your hand/arm before inflating the blood pressure cuff to ensure that you are able to hold the probe in position as the cuff inflates/deflates
12. Inflate the blood pressure cuff quickly to approximately 70-90mmHg, and then further inflate in 20-30mmHg increments until the pulse sound is completely lost. Do NOT inflate the cuff past 200 mmHg as

this may dislodge any plaques that may be present in the blood vessels

13. Gradually deflate the cuff (2mm/sec) until the pulse sound returns, and record the pressure at which the pulse sound returns. **NOTE: if it is necessary to re-inflate the cuff due to loss of sound, be sure to completely deflate the cuff before re-inflating. If the cuff is repeatedly inflated or left inflated for long periods, the systolic pressure reading may be falsely low. If the cuff is deflated too rapidly, the true systolic pressure may be missed**
14. Repeat steps 7-13 on the LEFT arm
15. Next, move to the lower legs. If an ulcer is present on one of the lower legs, test the unwounded leg first
16. If a wound is present in the location where you will be placing the blood pressure cuff, ensure the wound is covered with a low profile dressing
17. Apply an appropriately sized blood pressure cuff on the person's lower leg, approximately 1-2cm above the lateral malleolus. **NOTE: If the cuff is too narrow, the reading may be falsely high and vice versa**
18. Palpate for the posterior tibial artery (see the diagram below re location of the pulse), and place ultrasound gel (1/4" thick) over that area. **NOTE: ensure there are no large air bubbles in the applied ultrasound gel, as the Doppler requires a continuous conducting medium**



19. Turn the Doppler on and hold the 8MHz Doppler probe at a 45-60 degree angle to the artery (the probe itself should be pointing in the direction of the person's head). **NOTE: a 5 MHz probe may be required if you find it difficult to locate a pulse in a person with severe edema, lymphedema, or painful or extensive ulcers**
20. Gently move the probe through the gel in a circular motion until you find the best quality pulse sound
21. Stabilize your hand/arm before inflating the blood pressure cuff to ensure that you are able to hold the probe in position as the cuff inflates/deflates
22. Inflate the blood pressure cuff quickly to approximately 70-90mmHg, and then further inflate in 20-30mmHg increments until the pulse

sound is completely lost. Do NOT inflate the cuff past 200 mmHg as this may dislodge any plaques that may be present in the blood vessels

23. Gradually deflate the cuff (2mm/sec) until the pulse sound returns, and record the pressure at which the pulse sound returns
24. On the same leg, now palpate for the dorsalis pedis artery (see the diagram above re location of the pulse), and place ultrasound gel (1/4" thick) over that area, and repeat steps 19-23
25. Repeat steps 19-24 on the opposite leg
26. Remove remnants of the ultrasound gel from the person's skin
27. Assist the person to a comfortable position as needed and assist them with the reapplication of any clothing items removed for testing purposes, as needed. **NOTE: the person may feel dizzy/lightheaded when they first sit up, so encourage them to remain seated for a few minutes before attempting to ambulate**
28. If the person is to remain in bed, ensure the bed is returned to a safe height (if applicable), and ensure the person's safety, i.e. apply side rails, personal alarms, restraints, etc. as per the person's care plan/medical orders
29. Clean reusable equipment/surfaces touched during the procedure with warm soapy water or detergent wipes and dry thoroughly to prevent cross infection, returning reusable equipment to the appropriate places
30. Remove and dispose of your gloves in the appropriate receptacle and wash your hands
31. Calculate the person's left and right leg ABIs, and compare with any available previous results:

$$\text{ABI} = \frac{\text{The higher of the two ankle pressures for that leg}}{\text{The higher brachial pressure of the two arms}}$$

32. Discuss the findings of the assessment with the person and/or their SDM/POA C and implement referrals and interventions indicated (see ABI interpretation below):

Interpretation of ABI and Recommended Compression Therapy	
ABI & Description	**Recommended Therapy**
ABI >1.2 or unable to compress (Abnormal)	Referral for further vascular assessment required, i.e. segmental compression studies, toe brachial pressure index. No compression.
ABI 0.8 – 1.2 in the presence of signs of PAD, rheumatoid arthritis, diabetes, or systemic vasculitis	No compression. Further testing required before initiating high compression.

ABI 1.0 – 1.2 (normal); ABI 0.8 – 0.9 (acceptable) with an ankle circumference > 18cm.	High compression (30-50mmHg), i.e. Profore, Proguide, Coban 2, Surepress, Comprilan (Peter Staudinger method).
ABI 0.5 – 0.8 (abnormal – mixed venous/arterial disease)	Implement modified compression bandaging with physician agreement, i.e. Profore Lite (0.6-0.8), Coban 2 Lite (0.5-0.79), Viscopate (fan folded) and Kling (figure of 8 wrap) (0.5-0.79), Comprilan (Parkwood method) (0.6-0.8 with no ischemic S+S), Tubigrip/Tubifast. Consider further medical assessments, i.e. segmental compression studies, toe brachial pressure index.
ABI <0.5 (arterial ulcer)	No compression. Urgent vascular surgery consult.

33. Share the results of the Doppler testing with the interdisciplinary members of the person's wound care team
34. Complete/update and initiate the person's interdisciplinary person-centered plan of care, based on your Doppler testing and overall holistic foot/lower leg assessment, as per your organization's policy

Evaluation

1. Unexpected outcomes:
    a. Doppler testing is not done according to this Procedure, and appropriate interventions are not initiated based on your holistic foot/lower leg assessment
    b. You are unable to compress the persons arteries or they present with an abnormally high test result, necessitating further vascular studies
    c. You are unable to complete the testing as the person is unable to lie flat for a period of 15 minutes pre-procedure and during the procedure, you are unable to detect pulses with the Doppler, or the application of an inflated blood pressure cuff is too painful for the person to tolerate
2. Reassess ABIs:
    a. Every six months for people with 'healable' lower leg/foot ulcers
    b. Every six months for people undergoing compression therapy
    c. If the person develop signs of PAD
    d. If the person develops lower leg/foot pain unrelated to infection/injury

References

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Related Tools (NOTE: these tools and their instructions can be found on the SWRWCP's website: swrwoundcareprogram.ca)	• Guideline: The Assessment of People with Leg Ulcers • Guideline: The Assessment of People with Diabetic/Neuropathic Foot Ulcers • Interdisciplinary Diabetic/Neuropathic Foot Assessment Form • Interdisciplinary Lower Leg Assessment Form