

Developed by the BC Provincial Nursing Skin and Wound Care Committee in collaboration with the Wound Clinicians from:



<u>TITLE</u>	Procedure: Ankle Brachial Index (ABI) in Adults Using an Automatic ABI System (Dopplex Ability)
<u>Practice level</u>	<ul style="list-style-type: none"> Registered nurses must successfully complete additional education and related clinical practice before carrying out automatic Ankle Brachial Index testing. Agency / health authority policy and standards should be in place to support this practice. The care of clients with peripheral arterial disease requires an interprofessional approach to provide comprehensive, evidence-based assessment and treatment. This clinical practice guideline focuses solely on the role of the nurse, as one member of the interprofessional team providing care to these clients.
<u>Background</u>	<ul style="list-style-type: none"> Approximately half of those with lower extremity arterial disease are undiagnosed because they are asymptomatic, have atypical symptoms or are assessed using unreliable methods such as pulse palpation or a history of claudication. Ankle Brachial Index (ABI) is a valid and reliable non invasive test to measure arterial blood flow in the lower legs. It is used, as part of a comprehensive lower leg assessment, to screen clients for the presence and severity of arterial compromise and to identify those clients who require further vascular assessment, as well as being used to predict the healability of lower leg wounds. ABI compares the systolic ankle pressure to the systolic brachial pressure and it is calculated by dividing the higher systolic blood pressure in the ankle by the higher of the two systolic blood pressures in the arms and is expressed as a ratio. When planning care, ABI results must always be considered in the context of a comprehensive lower leg assessment and in conjunction with a review of client history. The automatic ABI system is comprised of a two chamber cuff for each extremity. One chamber is used to occlude the vessel while the second distal chamber senses the returning signals. This allows the four limbs to be measured simultaneously. The automatic ABI system calculates and interprets the ABI in 3 minutes without the need for the client to rest. The results are automatically calculated and displayed with Pulse Volume waveforms on the LCD panel on the machine. The test results are printed on either thermal paper or adhesive backed label paper via the integral printer. ABI may be difficult to perform in the presence of severe edema, lymphedema, and painful or extensive ulcers. However, it can be used on clients with a unilateral lower leg amputation. Early evidence indicates that the Automatic ABI results are consistent with Doppler results.¹⁰ An ABI between 0.91 and 1.30 is normal and indicates the absence of significant arterial disease; an ABI less than 0.91 indicates PAD and an ABI less than or equal to 0.40 indicates critical ischemia. ABI results greater than 1.30 may be falsely high readings due to calcified, non-compressible blood vessels; calcified blood vessels are more common in clients with diabetes, renal failure and in some older adults. Clients with an ABI greater than 1.30 should be referred to a physician / NP for a vascular assessment. Due to the high prevalence (> 50%) of arterial calcification in the diabetic population, toe pressures or toe brachial index testing is a more accurate measure of arterial circulation as the arteries of the toes are not as likely to become as calcified as those of the foot.
<u>Indications / Precautions / Contraindications</u>	<p>Indications:</p> <ul style="list-style-type: none"> For clients with risk factors for PAD including advanced age, tobacco use, diabetes mellitus, dyslipidemia, elevated lipoproteins, hypertension, chronic renal insufficiency and a family history of PAD. For clients with signs and symptoms of PAD.

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	<ul style="list-style-type: none"> • For clients with lower leg wounds in order to determine the presence or absence of arterial compromise, and therefore wound healability. • Required as part of a comprehensive lower leg assessment for clients with lower leg edema to determine vascular status prior to initiating any compression wraps or stockings. • Prior to referring clients for a vascular assessment (based on availability of services and agency policy). • To monitor clients following lower leg revascularization procedures or those with compression bandages or stockings. • Can be used on clients with a unilateral lower limb amputation. <p>Precautions:</p> <ul style="list-style-type: none"> • In the diabetic population there is high prevalence (50%) of medial arterial calcification which can cause a false high ABI result; Toe Pressures / Toe Brachial Index (TBI) tend to be more reliable in clients with arterial calcification. • ABI results may be falsely high if the client cannot remain still or lie flat during the test. In this situation refer the client to a wound clinician or physician / NP prior to conducting the test. • Should be done in collaboration with a physician / NP for clients with untreated cellulitis and suspected or untreated DVT. • ABI may be difficult to perform in the presence of severe edema, lymphedema, and painful or extensive ulcers. <p>Contraindications</p> <ul style="list-style-type: none"> • Do not use immediately post-op following a superficial bypass graft without first consulting with a physician / NP. • Do not carry out if the client has severe lower leg pain or severe lower leg wound pain; refer to a wound clinician or physician / NP. • Do not use for clients with dermatitis, pulmonary hypertension, a missing arm, severe hypertension, Parkinson's or very edematous limbs. • Do not use on a client post mastectomy or on an arm with a dialysis fistula. • Do not use with clients who have severe heart failure, gangrene or a recent skin graft on the upper or lower extremity.
<p><u>Definitions</u></p>	<p>Ankle Brachial Index (ABI) – A calculated number that indicates the amount of arterial blood flow to the extremity; compares the ankle systolic pressure & the higher of the two brachial systolic pressures with the ABI being a ratio of the two.</p> <p>Antecubital Fossa – The triangular area over the inner elbow crease; the brachial artery bifurcates at the base of the fossa.</p>
<p><u>Related Documents</u></p>	<p>Guideline: Assessment and Treatment of Lower Leg Ulcers in Adults Guideline: Assessment and Treatment of Diabetic and Neuropathic Ulcers in Adults Procedure: Ankle Brachial Index (ABI) in Adults using an Automatic ABI System Education Module: Ankle Brachial Index (ABI) Procedure in Adults using Handheld Doppler & Automatic ABI System</p>

Equipment and Supplies


- Dopplex Ability machine
- Four dual chamber cuffs with colour coded tubes.
- Clean gloves, if indicated
- Non-adherent low profile cover dressing for wound (if present)
- Plastic wrap to cover extremity if wound present.
- Agency approved disinfectant wipe.

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Procedure

Steps	Key Points
<p>1. Explain procedure to client and have them lying flat completely relaxed with arms at their sides in a quiet warm room. A 5 cm (2 inch) pillow may be used if required for respiratory issues.</p> <p>Remove the client's shoes, socks, compression stockings if present, and roll up pants and sleeves. Cover the trunk and lower extremities with a blanket to prevent cooling.</p> <p>Cell phones, computers and other electronic equipment must be at least a meter away from the ABI unit and the ABI unit and bed / plinth should not be pushed against the wall.</p>	<p>Having the client lying flat reduces any hydrostatic pressure inaccuracies. If the head is elevated more than 5 cm (2 inches) the feet must be elevated to the same height.</p> <p>Measurements can be taken over stockings, thin socks and thin shirts but not over sweaters or trousers.</p> <p>It is not necessary to have the client rest prior to the procedure.</p>
<p>2. Collect equipment & wash hands prior to starting the procedure. Wear clean gloves, if indicated.</p>	<p>Clean gloves should be worn if there is an open area, discharge or a rash on the lower limbs.</p>
<p>3. If the client has an upper or lower extremity wound in the area of cuff placement, ensure the wound is covered with a non adherent, low profile dressing and cover the surrounding area with plastic wrap to avoid contaminating the cuff.</p>	<p>Never apply the cuffs directly in non intact skin.</p>
<p>4. Ensure that the machine is connected to the main electrical supply or use battery power if an outlet is not available.</p>	<p>The machine should be plugged in to charge when it is not in use (see Appendix A: Trouble Shooting).</p>
<p>5. Connect the four colour coded wires to the machine and press the on/off button.</p>	<p>See Appendix C for a photo of the machine.</p>
<p>6. Select the "client type"</p> <ul style="list-style-type: none"> • Press the human figure icon on the screen • Press the forward / backward icons to select the 2-legged or left / right amputee modes • Press the ✓ icon to confirm 	
<p>7. Press the forward icon to proceed to the cuff placement screen. Position the cuffs starting with the arms first.</p>	
<p>8. Cuff placement on the upper arms:</p> <ul style="list-style-type: none"> • The cuff with the red tubing is placed on the right arm and the cuff with the yellow tubing is placed on the left arm • Have the arm resting away from the body with the palm facing up • Place the largest upper cuff 1-2 cm above the Anticubital Fossa • Place the lower cuff just below the elbow on the part of the forearm with the largest diameter. • The white line of the tube connecting the two cuffs should be in the middle of the Anticubital Fossa over the brachial artery • To tighten the cuff, hold the buckle in the left hand and pull the end of the cuff with the right hand 	<p>The connecting tube between the two cuffs does not need to lay flat but it should be straight.</p>

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Steps	Key Points
9. Cuff placement on the lower legs: <ul style="list-style-type: none"> ▪ The cuff with the black tubing is placed on the right foot and the cuff with the green tubing is placed on the left foot ▪ Place the largest upper cuff just above the ankle ▪ Place the lower cuff at the arch of the foot ▪ The white line of the tube connecting the two cuffs should be centered over the top of the foot ▪ To tighten the cuff, hold the buckle in the left hand and pull the end of the cuff with the right hand. ▪ Ensure the client's heel is resting on the bed surface so that the leg is not resting on the cuff 	<p>The connecting tube between the two cuffs does not need to lay flat but it should be straight.</p> <p>An inaccurate measurement may occur if the cuff rests on the bed.</p>
10. Instruct the client not move, laugh, talk, etc. during the procedure. The machine will beep with the test is completed. Press the forward icon to start the ABI measurement.	<p>The test takes three minutes. Any movement will lead to an incorrect reading; the machine will display a Cannot Measure message when this happens (see Appendix B: Error Messages)</p>
11. The test results are automatically displayed. Press the Printer icon at the bottom right of the screen to print the results.	
12. Press the ✓ icon to view the Automatic ABI System's interpretation of the test results.	
13. Press the waveform icon in the bottom left of the screen to show PVR waveforms.	
14. Press the on/off button for 3 seconds to turn the machine off.	
Inserting Printout Paper	
15. One printer roll will provide approximately 55 printouts. When the paper nears the end of the roll a red marker line will be visible on the report.	<p>When the red line is visible, approximately 5 reports can be printed before the paper runs out.</p>
16. Grasp the printer door on the top of the machine and gently pull backwards. Insert the paper roll with the end of the roll facing toward the front of the machine.	
17. Close the door over the roll leaving the paper end exposed.	<p>A "click" will be heard when the door is fully closed.</p>

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Interpretation and Follow-up

1. An ABI between 0.91 and 1.30 indicates the absence of significant arterial disease.
2. An ABI between 0.41 and 0.90 indicates mild to severe arterial compromise and requires referral to a physician / NP for further assessment.
3. An ABI of less than/equal to 0.40 indicates critical leg ischemia and requires immediate physician / NP notification.
4. An ABI greater than / equal to 1.31 indicates calcified arteries which are prevalent in diabetes mellitus; this requires referral to a physician / NP for further assessment.
5. Toe Pressures / Toe Brachial Index (TBI) should be considered for clients with diabetes as this test is more reliable in clients with medial arterial calcification.

Frequency of ABI Reassessment

As part of a comprehensive Lower Leg assessment, an ABI is reassessed:

- a) every 6 months for clients with a lower leg / foot wound which has a Goal of Treatment of To Heal
- b) every 6 months for clients receiving compression therapy
- c) when either of the following occur:
 - i. Increasing lower leg and/or foot pain unrelated to infection.
 - ii. Increasing signs of arterial insufficiency, e.g. delayed capillary refill, cold skin temperature, absent or diminishing peripheral pulses

Documentation

1. Document initial and ongoing ABI results including Doppler waveforms (where available) as per agency guidelines.
2. Also document any pulses that could not be evaluated and any deviations from the procedure, e.g. unable to lay flat.
3. Document the ABI as a component of a comprehensive Lower Leg Assessment (Link to Lower Leg DST).

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Appendix A: Trouble Shooting

Symptom	Possible Cause / Remedy
Display backlight switched off	This is a power save function that occurs when the machine is operated by the internal battery and happens when the keypad is not used for 3 minutes. Press any button below the display once to switch the display backlight on.
Unit switches off automatically	This is a power save function that occurs when the machine is operated by the internal battery and happens when the machine keypad is not used for 10 minutes. To turn on press power on/off switch and hold for 3 seconds.
Green power indicator not illuminated	<ul style="list-style-type: none"> • Power cable not connected to a live power source. • Power cable is defective. • Main outlet fuse blown.
Unit will not turn on	Not connected to live power source.
“Battery Low” symbol showing	Connect to the power source.
Battery does not hold a charge	Select “Battery Conditioner” menu or replace battery.
No results produced	Check all tubes and cuffs and repeat test.
Only one ankle cuff inflates	Check that the “patient type” is correctly set. (See section 12.4 in instruction manual).
Cuff takes a long time to inflate	Check air filter or check cuffs for leaks.
Display not clear	Contrast setting is incorrect. (See section 12.3.2 in instruction manual).
Printout paper blank.	Printout paper inserted incorrectly.

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Appendix B: Error Messages

Error Message	How to Correct the Error
Cuff Not Connected	<p>If the user fails to connect one or more of the cuffs to the unit, one of the following messages is displayed:</p> <ul style="list-style-type: none"> ▪ Left arm cuff – not connected. Refer to User Manual ▪ Right arm cuff – not connected. Refer to User Manual ▪ Left ankle cuff – not connected. Refer to User Manual ▪ Right ankle cuff – not connected. Refer to User Manual
Cuff Air Leak	<p>If an air leak is detected in the cuffs or tubing, one of the following messages is displayed;</p> <ul style="list-style-type: none"> ▪ Left arm cuff - Leak detected. Refer to User Manual ▪ Right arm cuff - Leak detected. Refer to User Manual ▪ Left ankle cuff - Leak detected. Refer to User Manual ▪ Right ankle cuff - Leak detected. Refer to User Manual
Inflation Problem	<p>If any cuff fails to inflate, one of the following messages is displayed;</p> <ul style="list-style-type: none"> ▪ Left arm cuff – Inflation problem. Refer to User Manual ▪ Right arm cuff – Inflation problem. Refer to User Manual ▪ Left ankle cuff – Inflation problem. Refer to User Manual ▪ Right ankle cuff – Inflation problem. Refer to User Manual
Excess Pressure	<p>If excess pressure is detected in any cuff, one of the following messages is displayed;</p> <ul style="list-style-type: none"> ▪ Left arm cuff – Excess pressure. Refer to User Manual ▪ Right arm cuff – Excess pressure. Refer to User Manual ▪ Left ankle cuff – Excess pressure. Refer to User Manual ▪ Right ankle cuff – Excess pressure. Refer to User Manual
Internal Fault	<p>If an internal fault is detected, a message will indicate this on the screen and the unit must be sent for servicing and/or repair.</p>
Service Required	<p>If service is required, a message will indicate this on the screen and the unit must be sent for servicing.</p>
Possible Incompressible Artery	<p>If the pressure in an occlusion chamber is insufficient to completely occlude blood flow, a human diagram will appear on the screen with pressures noted in all the extremities except the extremity with the incompressible artery and the ABI will not be noted for that side. If this occurs refer to a physician / NP or wound clinician.</p>
Cannot Measure	<p>If the software algorithms are unable to calculate results, the message “Cannot measure. Repeat test” will be displayed on the screen. Patient movement may cause this to happen so repeat the test and ask the client to remain as still as possible.</p>

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Appendix C: Dopplex Ability Machine



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