Ankle-Brachial Index: A Diagnostic Tool for Peripheral Arterial Disease

Step-by-step instructions on how to perform and interpret the ABI

What is the ABI?

The ankle-brachial index (ABI) is a simple, noninvasive tool used to screen for peripheral arterial disease (PAD), a vascular condition affecting more than 8 million adult Americans and associated with significant morbidity and mortality.[1] Despite its prevalence and cardiovascular risk implications, only 25% of PAD patients are undergoing treatment.[1] As only about 10% of patients with PAD present with classic claudication—40% of patients are asymptomatic—clinicians need to have a high level of suspicion for this disease in their adult patient population.[2] According to AHA/ACC guidelines, an ABI should be conducted on patients presenting with risk factors for PAD so that therapeutic interventions known to diminish their increased risk of myocardial infarction (MI), stroke, and death may be offered.[2] *(Level of Evidence: B)*

Risk Factors for PAD

- Age >70 yr
- Age >50 yr if atherosclerosis risk
  - Smoking
  - Diabetes
  - Hypertension
  - Dyslipidemia
  - Hyperhomocysteinemia

How to perform the ABI.

Measurement of the ABI can be easily performed in a clinician's office using a blood pressure (BP) cuff and handheld Doppler device with a vascular probe. Systolic BP is determined in both arms and both ankles. An ABI measurement can usually be performed in less than 10 minutes.

Tools Needed for Measuring ABI

- Sphygmomanometer with appropriately sized cuff(s) for both arm and ankle
- Handheld Doppler device with vascular probe
- Conductivity gel compatible with the Doppler device

<u>Step 1: Measure the brachial systolic pressure in both arms[3,4]:</u>

- Allow patient to rest for 5-10 minutes in the supine position.
- Place the BP cuff on patient's upper arm with the lower edge approximately 1 inch above the antecubital fossa.
- Palpate for the brachial pulse and apply conductivity gel over the brachial artery. Place the tip of the probe into the gel at a 45-60-degree angle until clear arterial pulse sounds are heard.
- Inflate the cuff to the point that pulse sounds disappear, then go 20 mm Hg above that point. Slowly deflate at a rate of 2 mm Hg per sec and record the point where arterial pulse sounds resume. This is the brachial systolic pressure.
- Repeat this procedure in the other arm.
- The higher of the two brachial systolic pressure readings will be used to calculate the ABI. There should be a difference of less than 10 mm Hg between each brachial BP.

Step 2: Measure the posterior tibial and dorsalis pedis systolic pressures in both legs:

- Place the BP cuff on the patient's leg approximately 2 inches above the ankle's medial malleolus.
- Locate the posterior tibial (PT) pulse, apply gel, and position the Doppler probe. Measure the systolic pressure following the same procedure described for the brachial artery.
- On the same leg, locate the dorsalis pedis (DP) pulse and measure systolic pressure.
- Repeat measurement of both the PT and DP systolic pressures on the other leg.
- Select the higher of the two ankle readings for each leg (PT or DP). These numbers will serve as the ankle systolic pressures in the ABI calculation.
- If either the PT or DP ankle pulse is absent, use the measurable reading to calculate the ABI.

Step 3: To calculate the ABI, divide each ankle systolic pressure by the brachial systolic pressure.

- Divide the higher of the two systolic pressures for each leg by the higher of the two arm pressures to get the right and left ABI.
- For example, consider the results at the right. The ABI for this patient is calculated by using 130 (the higher of the two brachial pressures) as the denominator and 95 and 130 as the numerators for the right and left legs, respectively. The ABI for the right leg is 0.73 and for the left leg is 1.0.

ABI Results

Systolic Pressure	Right	Left
Brachial	130	129
Posterior Tibial	95	120
Dorsalis Pedis	90	130
ABI = Ankle systolic/brachial systolic		
	95/130	130/130
ABI	0.73	1.0

How to interpret the ABI.

An abnormal ABI may be an independent predictor of mortality, as it reflects the burden of atherosclerosis.[5,6] Most will agree that a normal ABI is >0.9. An ABI <0.9 suggests significant narrowing of one or more blood vessels in the leg. The majority of patients with claudication have ABIs ranging from 0.3 to 0.9. Rest pain or severe occlusive disease typically occurs with an ABI <0.5. ABIs <0.2 are associated with ischemic or gangrenous extremities. Conditions such as diabetes mellitus or end stage-renal disease can give falsely elevated ABIs (1.3-1.5). The ABI test approaches 95% accuracy in detecting PAD.[7] However, a normal ABI value does not absolutely rule out the possibility of PAD. Some patients with normal or near-normal ABI results may have symptoms suggesting PAD. If the resting ABI is normal, an exercise ABI should be conducted.

ABI Key
Normal: 1.0 - 1.1
Borderline: 0.91 - 0.99
Abnormal: <0.9 or >1.3

Ask your patients about leg pain and measure ABI in all patients at risk for PAD.

References

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