Peripheral Vascular Disease

A High Ankle-Brachial Index Is Associated With Increased Cardiovascular Disease Morbidity and Lower Quality of Life

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Objectives	The purpose of this study is to determine if an ankle-brachial index (ABI) ≥1.40 is associated with reduced quality of life (QoL).
Background	Ankle-brachial index values ≥1.40 have been associated with some cardiovascular disease (CVD) risk factors and increased mortality, but the relationship to other disease morbidity such as reduced QoL has not been previously evaluated.
Methods	The PARTNERS (PAD Awareness, Risk and Treatment: New Resources for Survival) program was a national cross-sectional study of 7,155 patients age >50 years recruited from 350 primary care sites. All sites performed the ABI using a Doppler device and a standardized technique.
Results	A total of 296 subjects had an ABI ≥1.40 in at least 1 leg, and 4,420 had an ABI between 0.90 and 1.40. Diabetes, male gender, and waist circumference were positively associated with a high ABI, and smoking and dyslipidemia were inversely associated with a high ABI. After adjustment for age, gender, and the traditional CVD risk factors, and accounting for multiple comparisons, the high ABI group had significantly higher odds for foot ulcers (p < 0.005) and borderline associations with heart failure, stroke, and neuropathy. After the same adjustments and adjusting for patients with other CVD, the high ABI group scored 2.0 points lower on the physical component scale on the Medical Outcomes Study Standard Form–36 and 5.5 points lower on the Walking Impairment Questionnaire walking distance domain (p < 0.05 for both).
Conclusion	Individuals with a high ABI have higher odds for foot ulcers and neuropathy, as well as lower scores on some physical functioning QoL domains. (J Am Coll Cardiol 2008;51:1292–8) © 2008 by the American College of Cardiology Foundation

The ankle-brachial index (ABI) provides information on the presence of systemic atherosclerosis and associated cardiovascular risk. For example, individuals with an ABI <0.90 have an elevated risk for incident cardiovascular disease (CVD) morbidity (1,2) and mortality events (3–5). Recent studies indicate, however, that dichotomizing the ABI using the 0.90 cut point may lead to underdiagnosis, because cohorts with an ABI >1.30 have been associated with higher levels of many CVD risk factors (6) as well as coronary artery calcium (7). This suggests that this upper cut point may also be associated with higher CVD morbidity. Recent studies have also documented more leg pain (8) and higher levels of CVD morbidity and mortality among those with an ABI above 1.40 (9,10). Accordingly, using data collected from a community-based clinic population in the PARTNERS (PAD Awareness, Risk and Treatment: New Resources for Survival) program, the aim of this study was to determine the risk factors, comorbid CVD conditions, and quality of life (QoL) associated with an ABI ≥1.40.

Methods

A detailed description of the methods used in the PARTNERS program has been published previously (11). In brief, PARTNERS was a cross-sectional survey of

peripheral arterial disease (PAD) and other CVD prevalence and treatment that was performed at 27 regional coordinating centers selected for their expertise in PAD care. These regional centers identified 350 local primary care sites for patient evaluation. The local study physician and coordinator identified patients who met the eligibility criteria for the study. Sequential patients seen in these primary care practices underwent administration of standardized questionnaires, a review of their medical history, height, weight, blood pressure, and waist circumference, and each subject underwent an ABI measurement. The protocol was reviewed and approved by the institutional review boards at all study sites, and all patients provided written informed consent prior to participation.

Study population. Enrollment was based on predefined criteria based on the known epidemiology of PAD (12–17). Specifically, patients were enrolled if they were 70 years or older or if they were age 50 to 69 years and had a history of at least 10 pack-years of cigarette smoking or diabetes or both. Data were collected between June and October 1999.

At the study visit, subjects were classified for the presence of existing CVD or PAD, as well as new versus prior PAD based on the results of their ABI and medical history. Subjects were considered to have prior PAD if they had undergone prior lower extremity arterial revascularization regardless of their ABI value at the evaluation office visit, if the chart review revealed earlier abnormal vascular laboratory studies, or if their ABI was <1.00 at the evaluation visit. Patients with no previous history of PAD were considered to have new PAD if their ABI was ≤0.90 during the study office visit. A diagnosis of existing CVD required a documented history of coronary artery disease, cerebrovascular disease, or abdominal aortic aneurysm repair. A diagnosis of coronary artery disease was based on a history of angina (stable or unstable), myocardial infarction, percutaneous transluminal coronary angioplasty, or coronary artery bypass graft surgery. Patients were considered to have cerebrovascular disease if they had a history of transient ischemic attack, stroke (ischemic or hemorrhagic), or carotid endarterectomy.

ABI technique. Prior to study initiation, all local sites received instruction and training on the accurate use of the Doppler technique and calculation of the ABI. A 5-mHz Doppler device (Elite-100R, Nicolet Vascular Inc., Golden, Colorado) was used at each site to measure the ABI. With the subject in the supine position, systolic blood pressures were measured in the brachial arteries and in both the dorsalis pedis and posterior tibial arteries of the lower extremities. The ABI was calculated separately for each leg by dividing the higher of the 2 ankle systolic pressures by the higher of the 2 brachial systolic pressures. The sensitivity and specificity of an ABI <0.90 are both >90% for an angiographically defined stenosis of 50% or more in a major leg artery (18). The reproducibility of the ABI is good (19,20).

Clinical subgroups. The normal ABI group was defined as patients having an ABI >0.90 and ABI <1.40 in both legs. The definition of the high ABI group required that patients have an ABI ≥1.40 in both legs or an ABI >1.40 in 1 leg and a normal ABI in the contralateral leg. Individuals with an ABI <0.90 in either leg or a history of lower extremity revascularization were classified as having PAD and were excluded from this analysis.

Atherosclerosis risk factors. *Smoking* was defined as 1 pack-year or more of tobacco use based on patient interview or chart review. *Diabetes* was determined from the medical record, regardless of whether it was type 1 or type 2. The diagnosis of diabetes included treatment for this condition defined as current use of dietary interventions or use of diabetes medications. Laboratory screening for prevalent diabetes was not performed. *Dyslipidemia* was defined from the medical record as past or present use of lipid-lowering agents or: 1) a total cholesterol concentration ≥240 mg/dl; 2) low-density lipoprotein cholesterol concentration ≥160 mg/dl; 3) high-density lipoprotein (HDL) cholesterol concentration of ≤35 mg/dl; 4) triglyceride concentration ≥200 mg/dl; or 5) a total cholesterol/HDL ratio of ≥5.0 (21). Lipid-lowering therapy was defined as the prescription of agents used to treat lipid abnormalities (e.g., statins, niacin, fibrates, and bile acid binding resin agents). A fasting lipid profile was not obtained as part of this program. *Hypertension* was defined as the self-reported use of calcium channel blockers, angiotensin-converting enzyme inhibitors, beta-blockers, or diuretics for the indication of treatment of hypertension as well as either a systolic blood pressure ≥140 mm Hg or a diastolic blood pressure ≥90 mm Hg.

Questionnaire data. Subjects were surveyed on their QoL by completing the Medical Outcomes Study Standard Form-36 (SF-36) and the Walking Impairment Questionnaire (WIQ). The SF-36 is composed of 2 summary measures (physical health and mental health) (22–24). Each of these is composed of 5 scales that attempt to capture relevant QoL information by asking questions from 1 of 36 different items. For instance, the role physical scale consists of 4 items that obtain information on problems with work as a result of physical health. The individual SF-36 scales have been shown to have good validity among patients with intermittent claudication (25). The WIQ is a valid measure of community walking ability in patients with and without PAD (26). The WIQ yields 3 summary scores: walking distance, walking speed, and stair climb.

Abbreviations and Acronyms

ABI = ankle-brachial index

BMI = body mass index

CHF = congestive heart failure

CVD = cardiovascular disease

HDL = high-density lipoprotein

OR = odds ratio

PAD = peripheral arterial disease

QoL = quality of life

SF-36 = Medical Outcomes Study Standard Form-36

WIQ = Walking Impairment Questionnaire